DENSO
Crafting the Core

Efforts in Advanced R&D Fields

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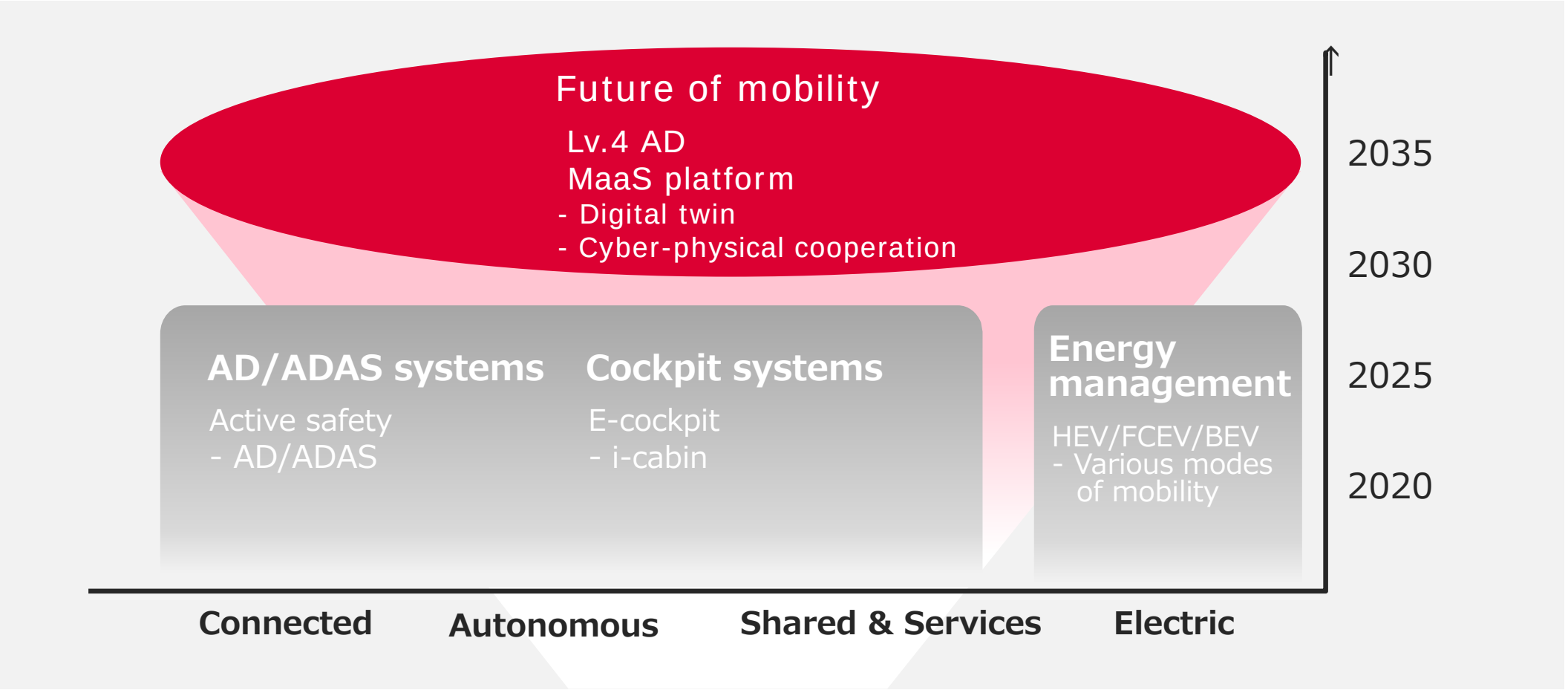
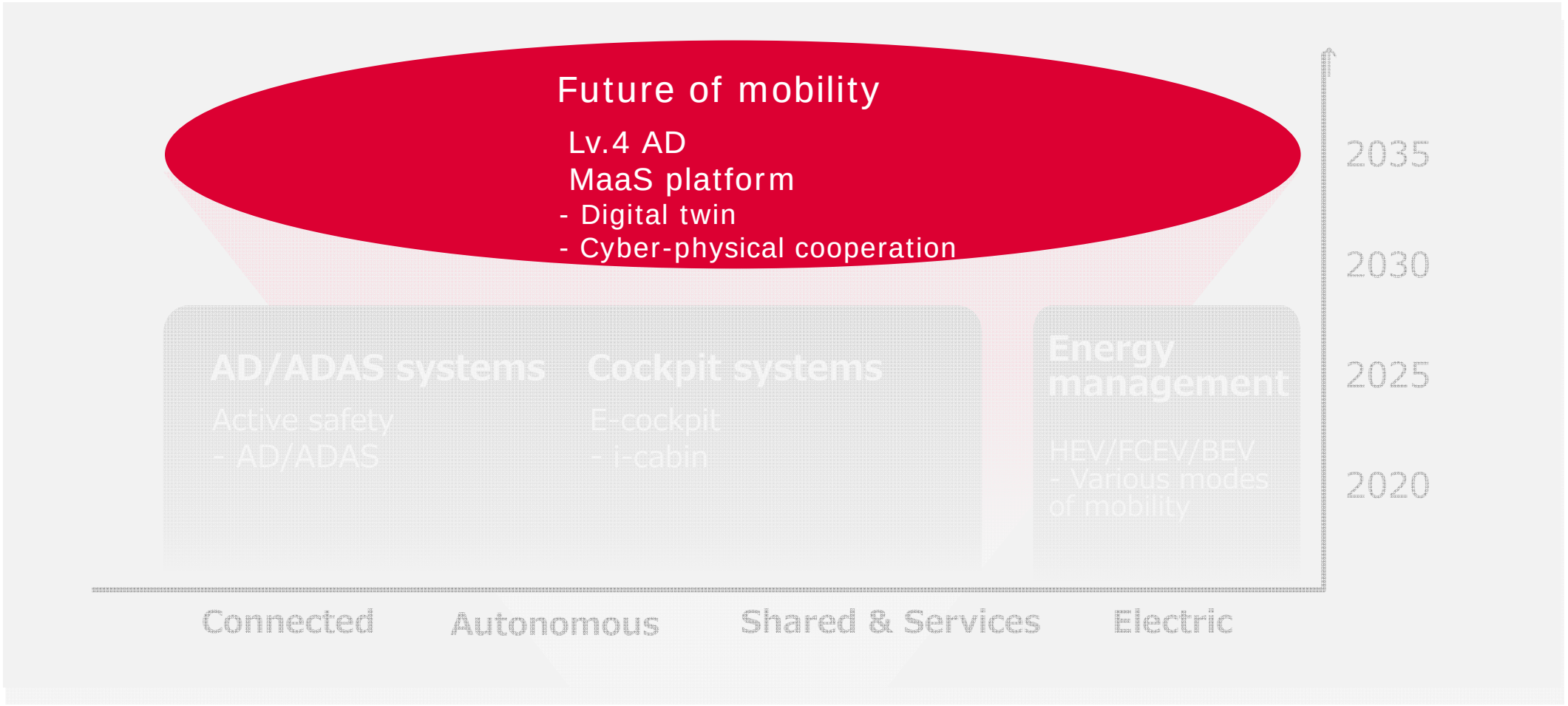
Changes in mobility by CASE

Overview of efforts in the CASE field



Overview of efforts in the CASE field



Efforts to achieve automated driving systems

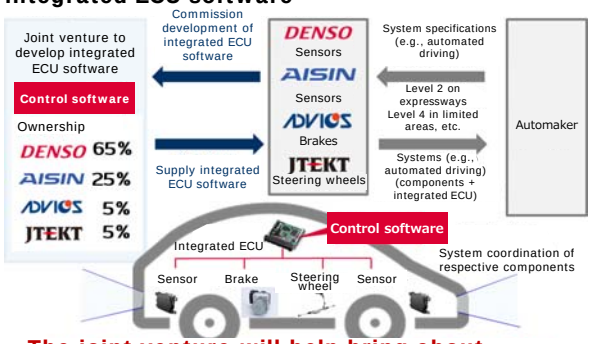
	Active safety	ADAS/AD Lv.2/3	AD in limited areas Lv.4	Automated parking
Passenger cars	**Diffusion period** **From 2017**  • Autonomous emergency braking • Adaptive cruise control • Automatic high-beam headlights • Lane departure prevention support • Traffic-sign recognition	 Lv. 2/3 on limited highways **Diffusion period** **From 2020**  Lv. 2/3 on general roads **Diffusion period** **From the first half of 2020s**	———	Fully automated valet parking **Diffusion period** **From 2020** 
Commercial vehicles (trucks)	**Diffusion period** **From 2020** 	Lv. 2/3 on limited highways 	———	———
Shared & services (taxis/small buses)	———	 Lv. 2 to 4 on limited general roads **Introduction period** **From 2018** **Diffusion period** **From 2020s**	 Lv. 4 in limited areas **Introduction period** **From 2020s** **Diffusion period** **From the mid-2020s**	———

Example of cooperation with partners

- Established J-QuAD DYNAMICS, a joint venture (April 2019)

  Development of integrated control software for automated driving

Establishment of a joint venture to develop integrated ECU software



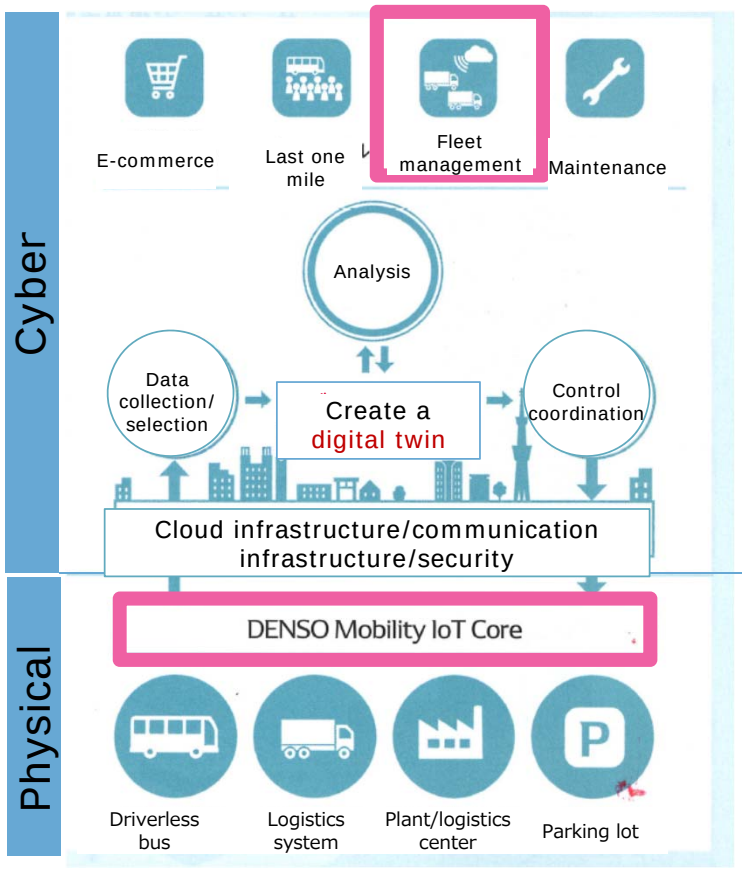
The joint venture will help bring about automated driving that ensures safe and secure travel for everyone.

- Invested in the Uber Advanced Technologies Group (April 2019)

  Collaboration to develop and deploy hardware for automated driving and ride-sharing services

Efforts to achieve the MaaS platform

Achieve mobility services by creating a digital replica of a physical entity in cyberspace (digital twin)



Example of cyber
mobi-Crews

Example of physical
Mobility IoT Core

Example of a physical solution – Mobility IoT Core –

In-vehicle edge computer to achieve the MaaS platform

Incorporating a communication function, processor, and server function

Collect various kinds of mobility data

- Process data as much as possible on the edge (vehicle) side instead of transmitting large amounts of unprocessed data
- Process data before transmission to facilitate handling on the cloud side

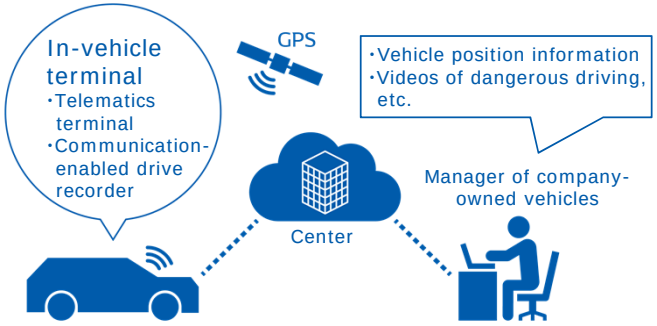
Transmit commands from the cloud to the vehicle

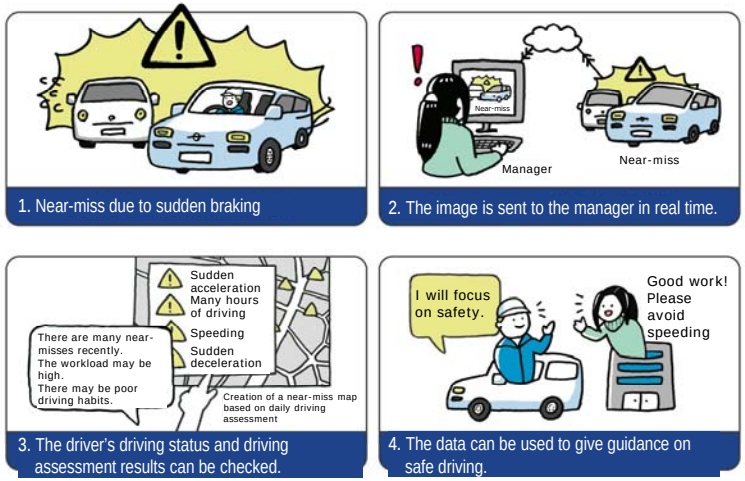
Give the processing capability to the edge side so that services can be maintained even if communication is interrupted temporarily

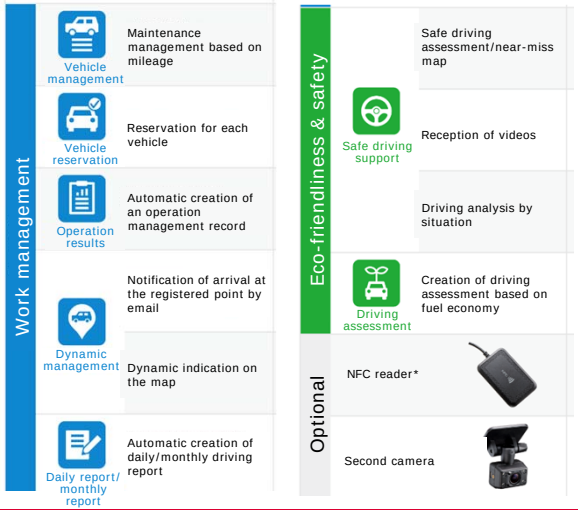
Example of a cyber solution – mobi-Crews –

Increase efficiency of fleet management by utilizing the MaaS platform to support safe driving

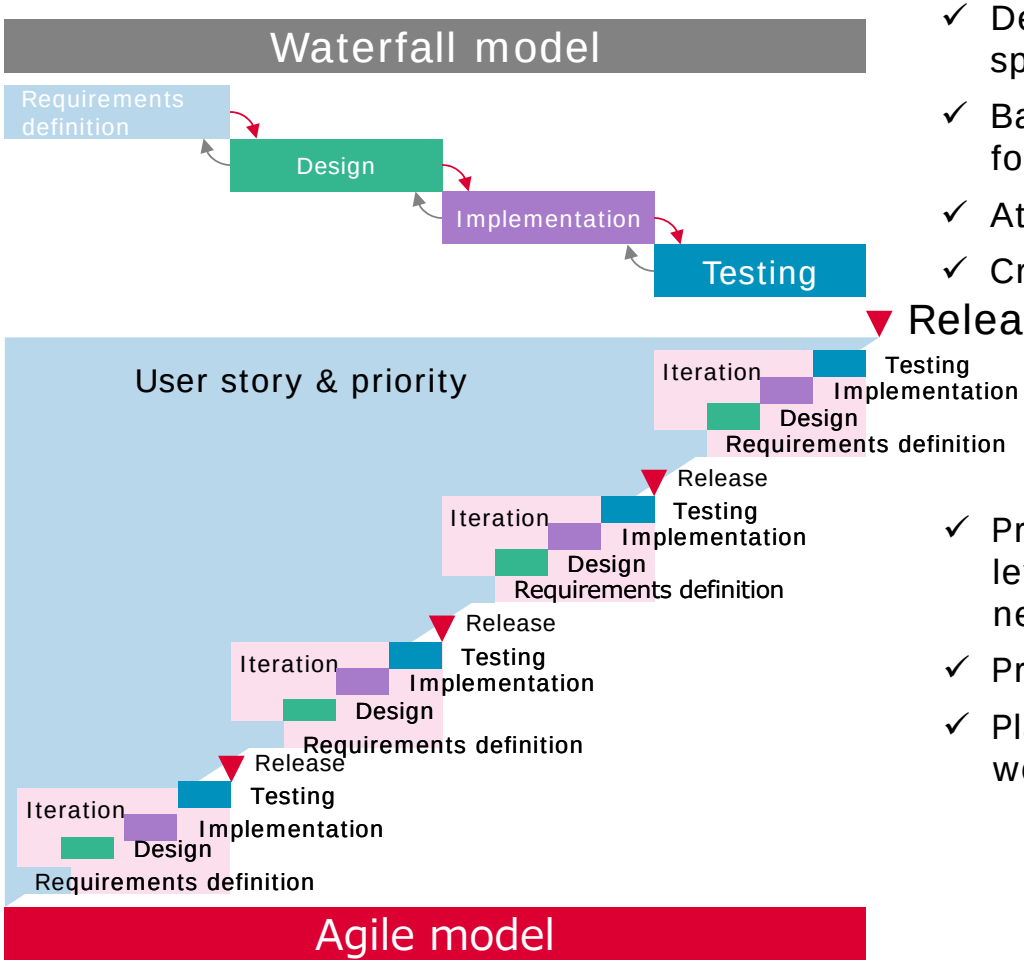
Communication-enabled drive recorder







Agile development – Strengthening profitability to support future growth –



- ✓ Define the requirements and fix the specifications at the beginning
- ✓ Based on the assumption that the plan is followed
- ✓ Attach importance to documents (deliverables)
- ✓ Create working software in the final stage

- ✓ Prioritize the requirements depending on the level of importance in business, and develop necessary functions in stages
- ✓ Promote communication and dialog
- ✓ Place importance on software (code) that works properly

Development of innovative technologies to achieve CASE

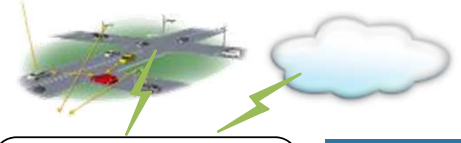
Driver

Human characteristics

Measurement of brain waves, cerebral circulation, and myoelectricity

HMI

Society/infrastructure



Information & communication

Industrial equipment

SOFC

Quantum computer

MaaS (C, S)

Automated driving (A)

Vehicle

Electrification (E)

AI

Interactive path planning

Position of one's own vehicle — Gyroscope

Surround sensors — Sensing (LiDAR, millimeter-wave, sonar)

Recognition and judgment — AI

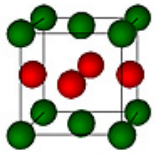
Motor — Magnetic material (FeNi)

Inverter — Power semiconductor (SiC, gallium oxide)

Power supply — Solid-state battery

Air conditioning — Magnetic heat pump

Magnetic material

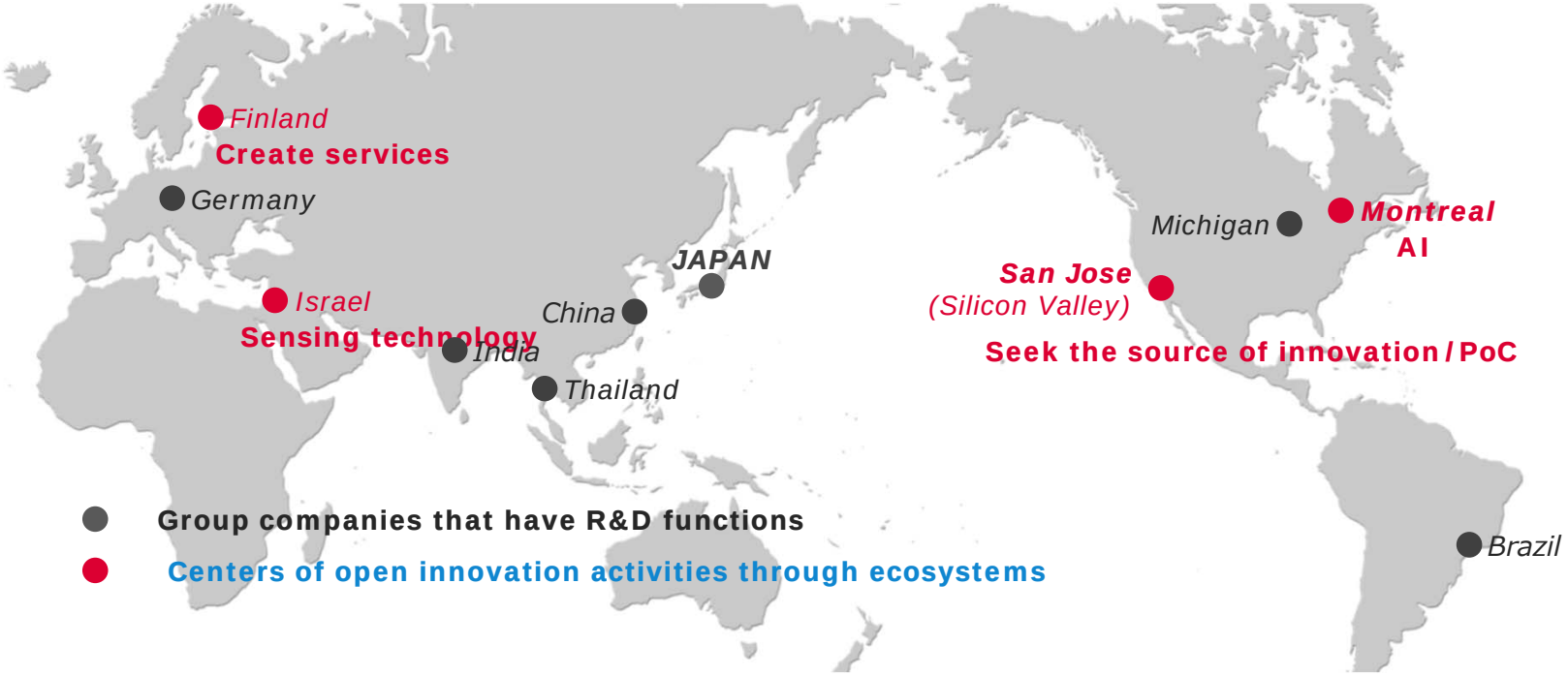


FeNi superlattice

Take on challenges to achieve fundamental innovation in materials, semiconductors, human characteristics, and AI

Satellite R&D activities – Taking on challenges to create new value –

Utilize the best brains in the world (industry-government-academia cooperation) +
Demonstrate in optimal locations by utilizing regional characteristics



Promote hypothesis demonstration-type agile development at the innovation epicenters around the world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