DENSO
Crafting the Core

Efficient cloud-based cabin preconditioning for EVs with a compact heat pump system

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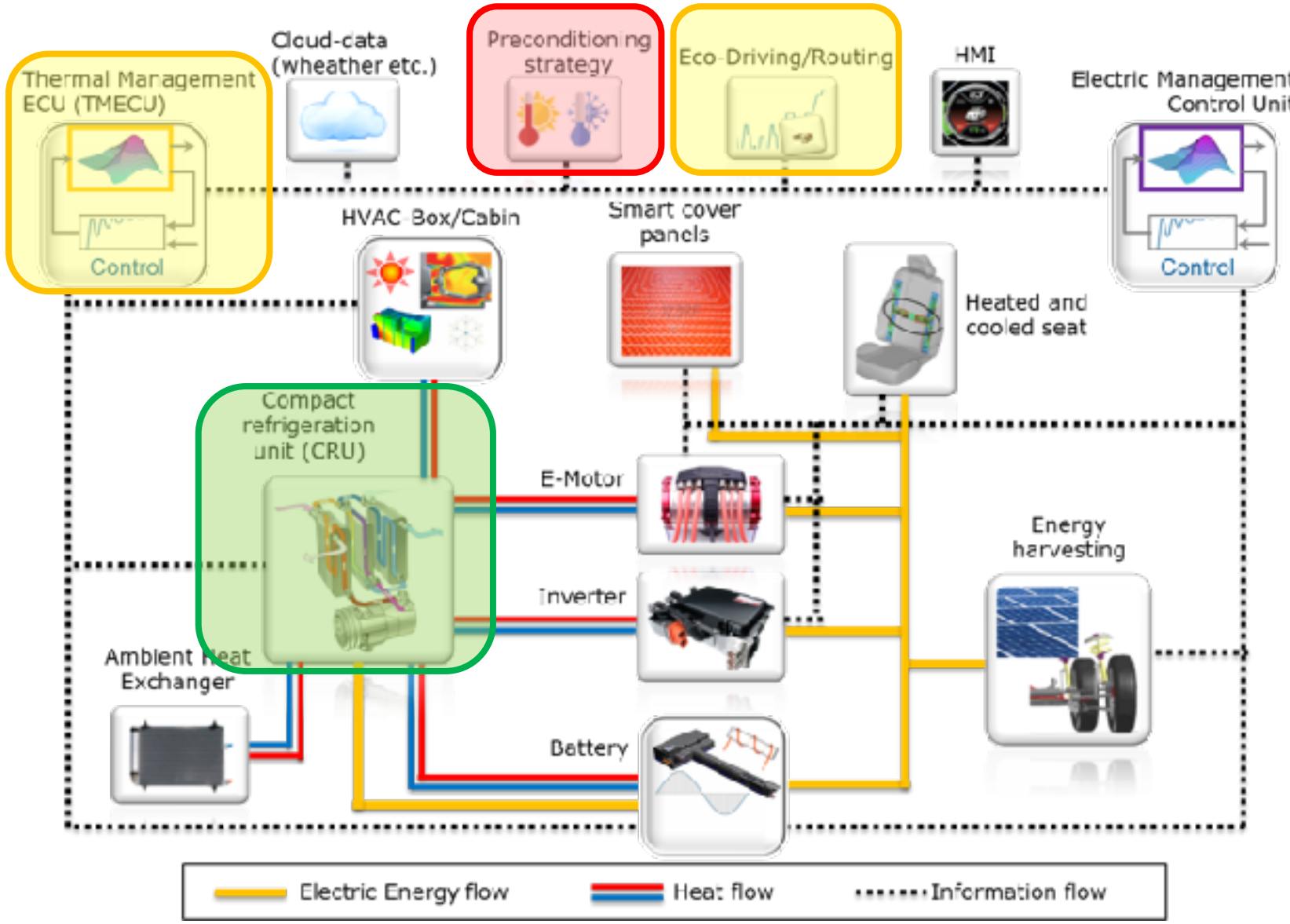
Agenda

1. OPTEMUS project technologies
2. Preconditioning strategy
3. Preconditioning HMI
4. Compact Refrigeration Unit (CRU)
5. Evaluation
6. Conclusion

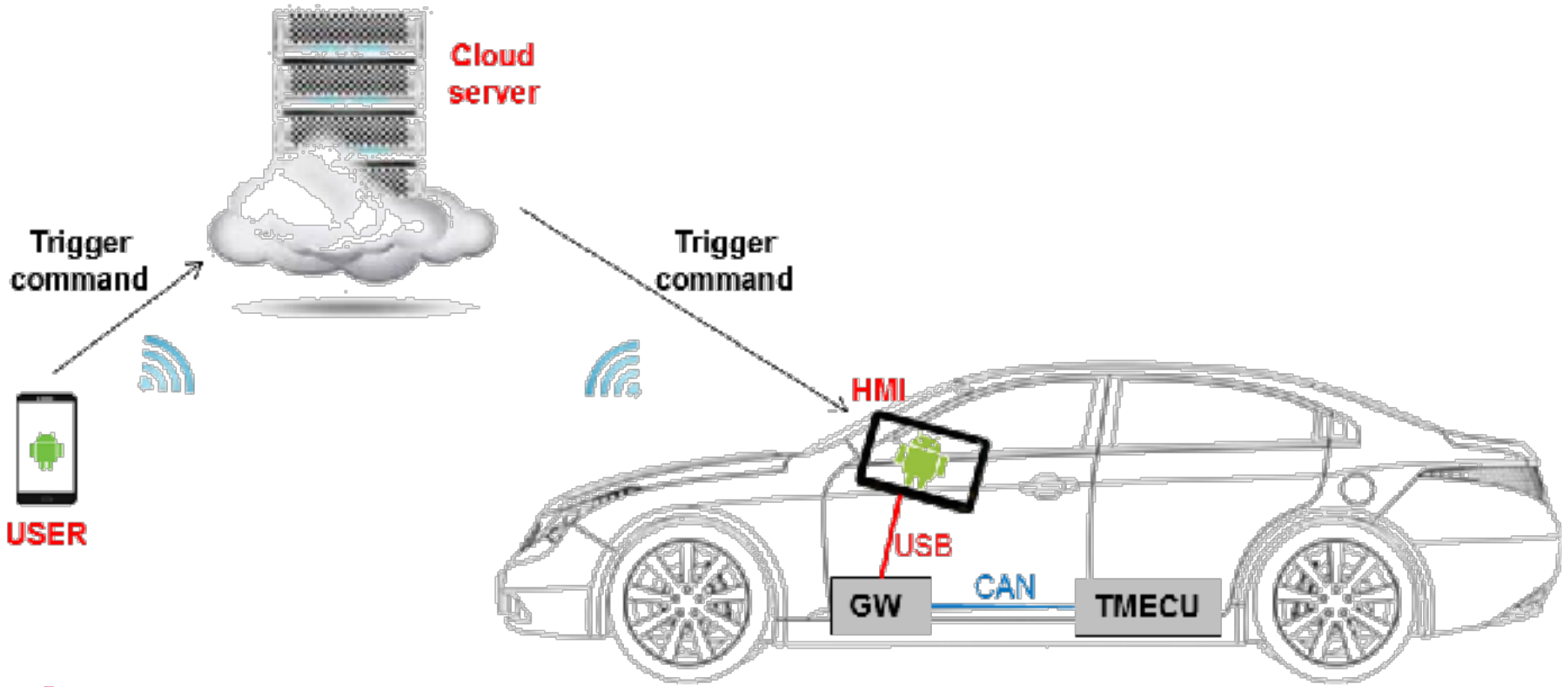
1) OPTEMUS project technologies



2) Preconditioning strategy

I) User-triggered

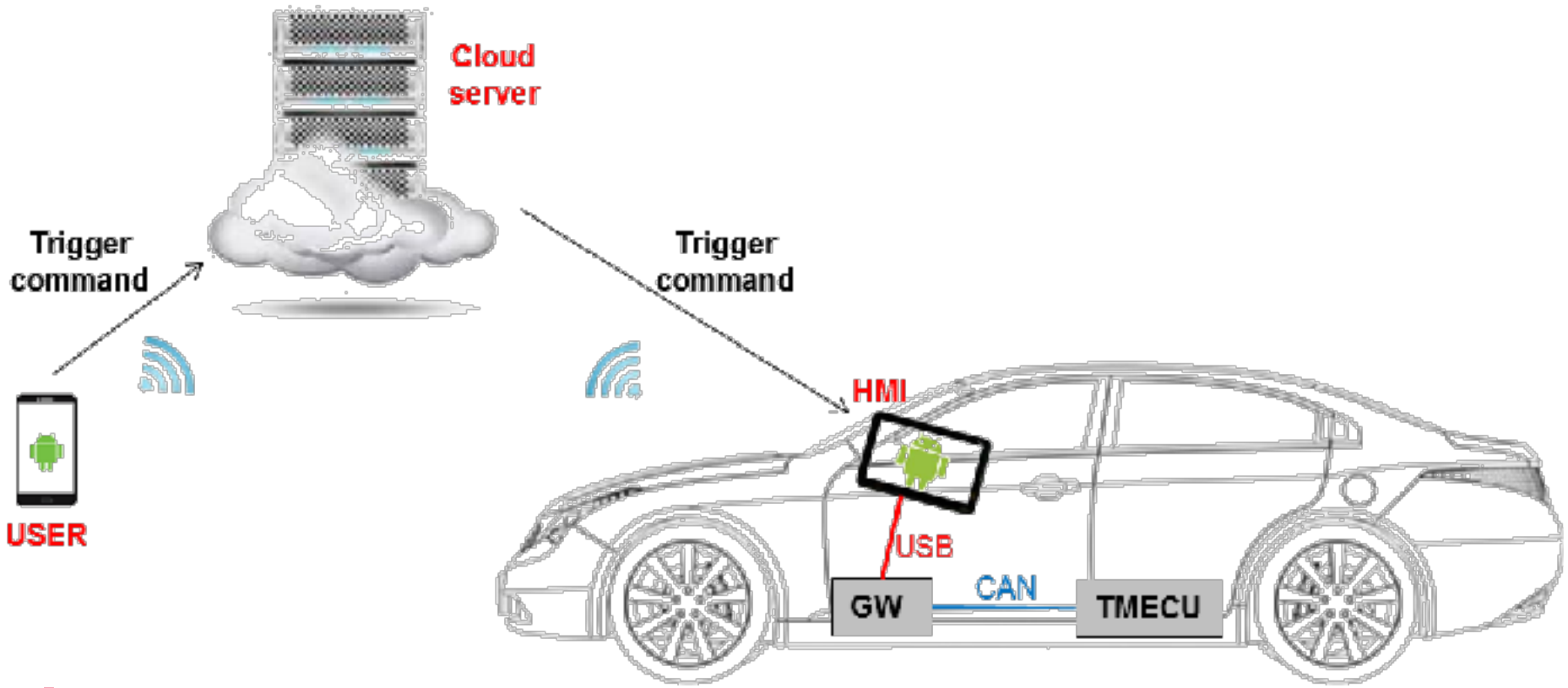
- User indicates desired “boarding”-time and temperature
- Triggered by the user over app



2) Preconditioning strategy

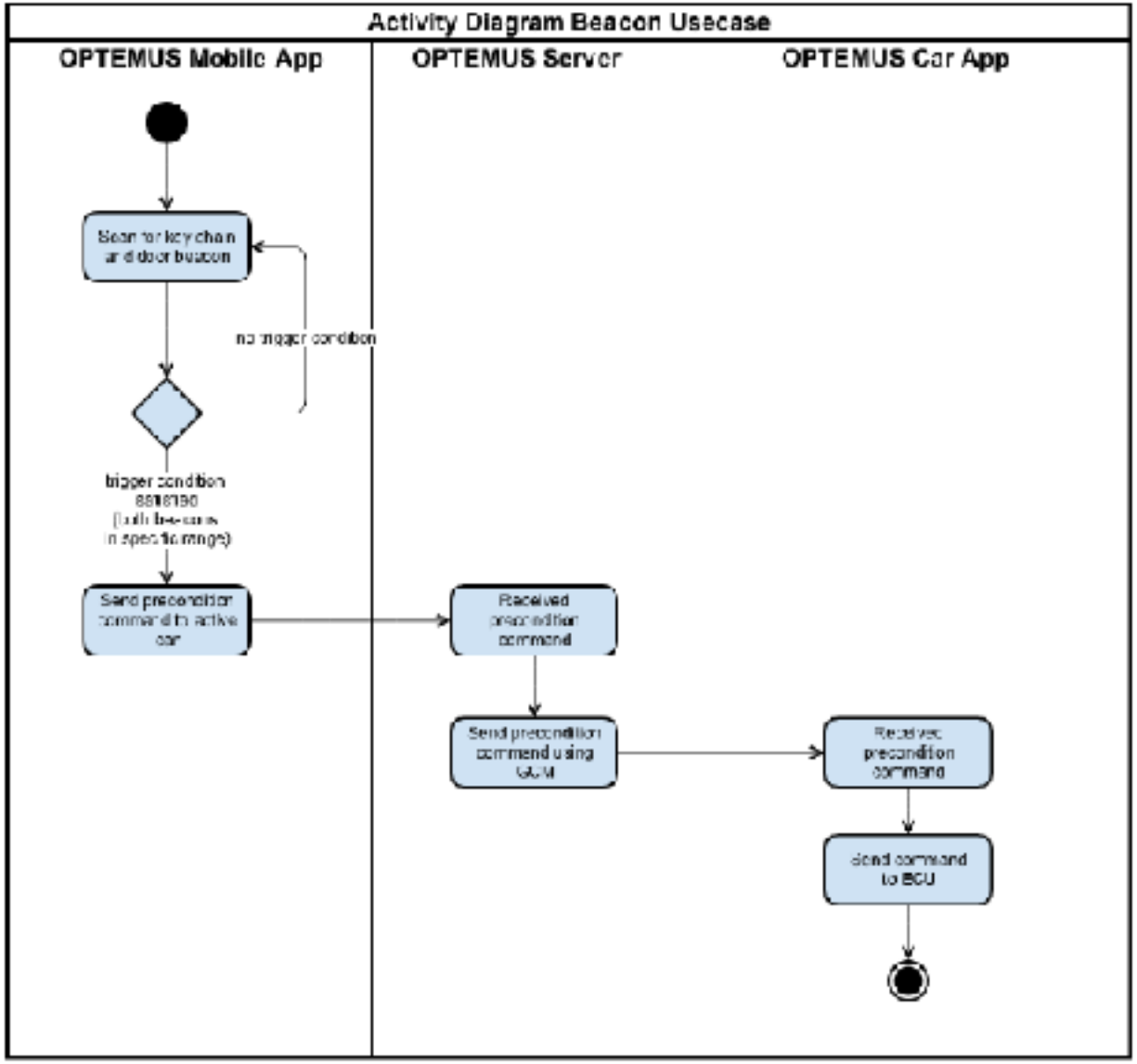
II) Predictive

- Vehicle foresees driver's approach and starts the preconditioning process correspondingly
- Event-triggered (events defined in user's profile)



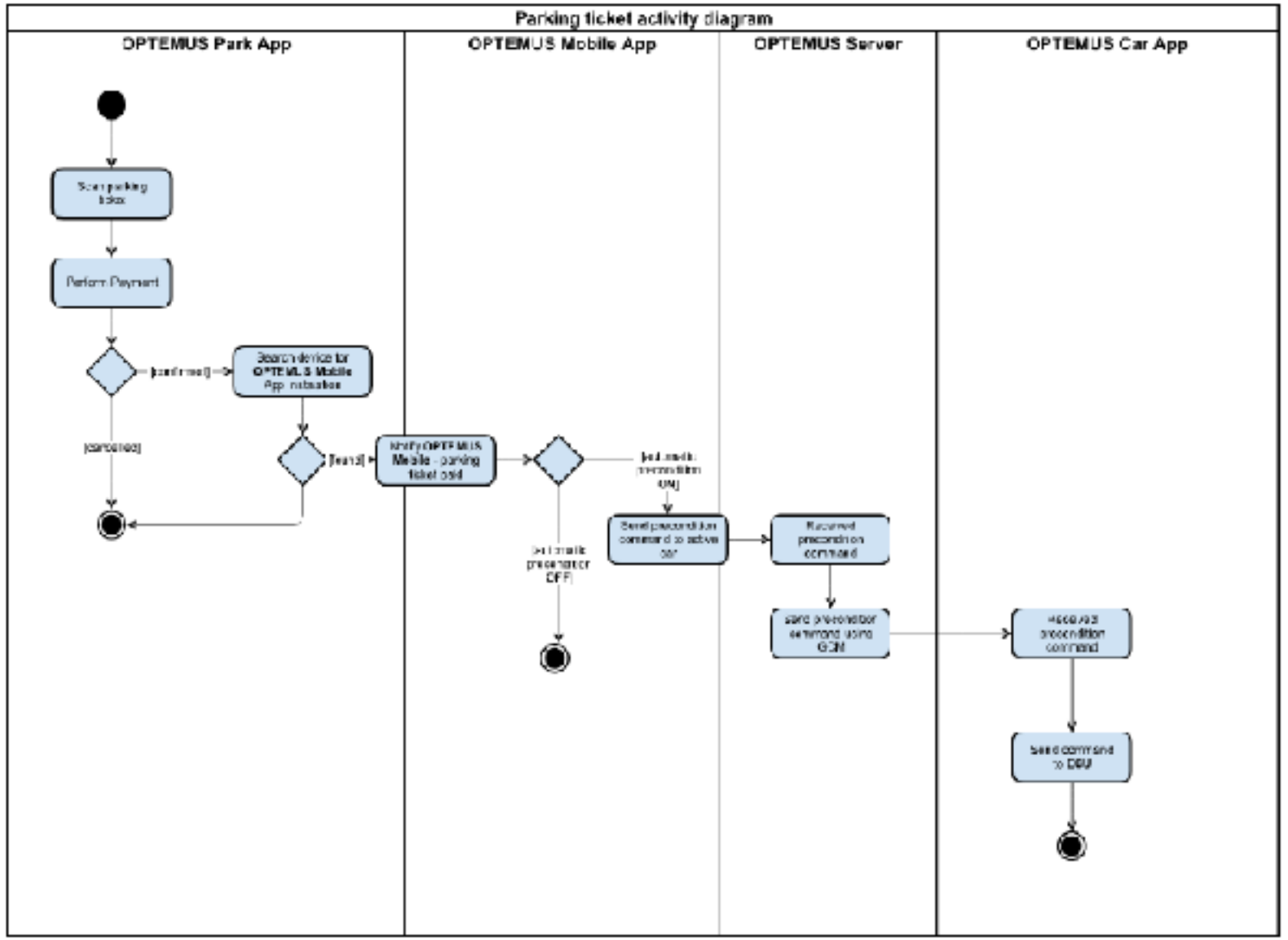
2) Preconditioning strategy

II.a) Predictive (at home)



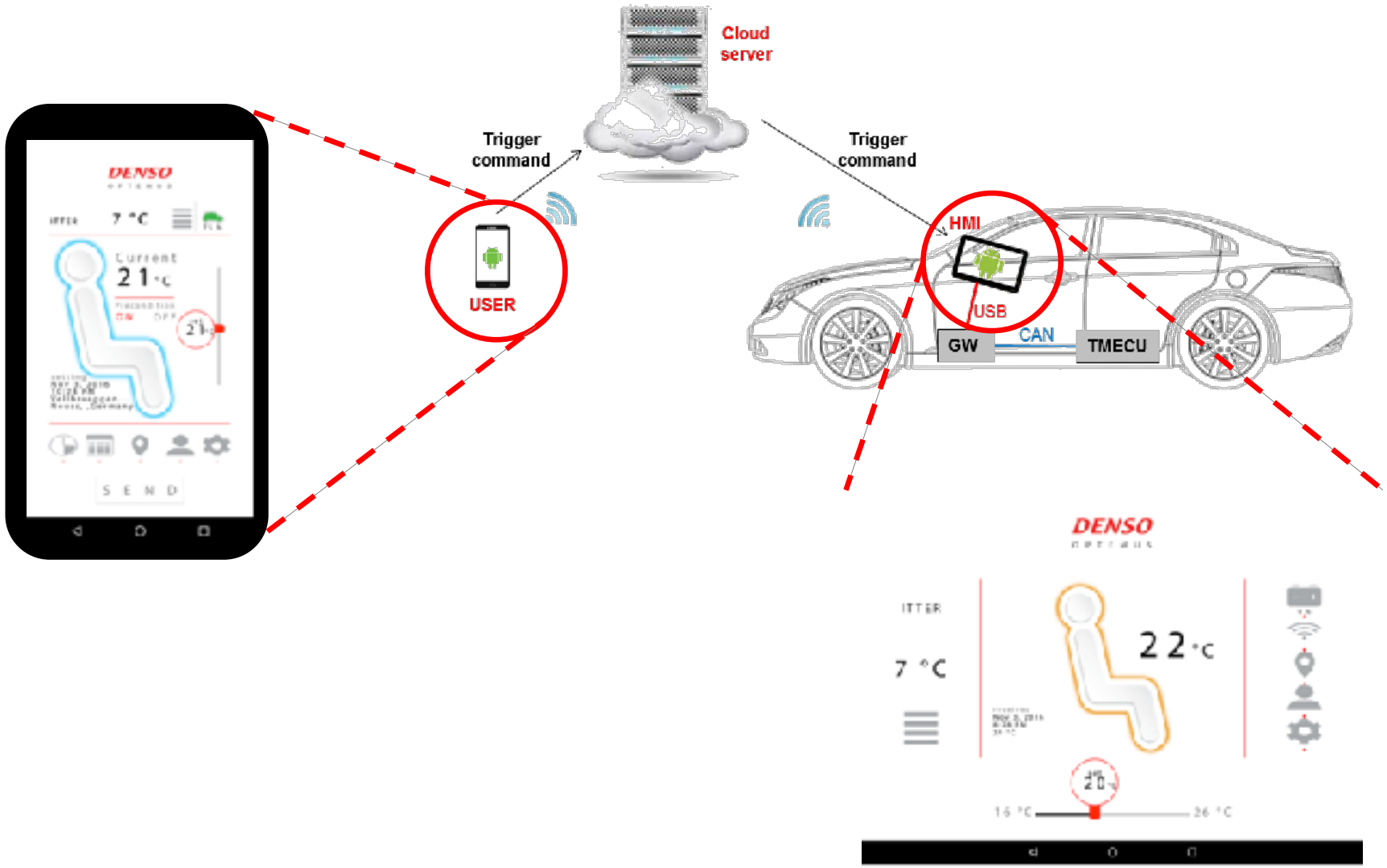
2) Preconditioning strategy

II.b) Pseudo-predictive



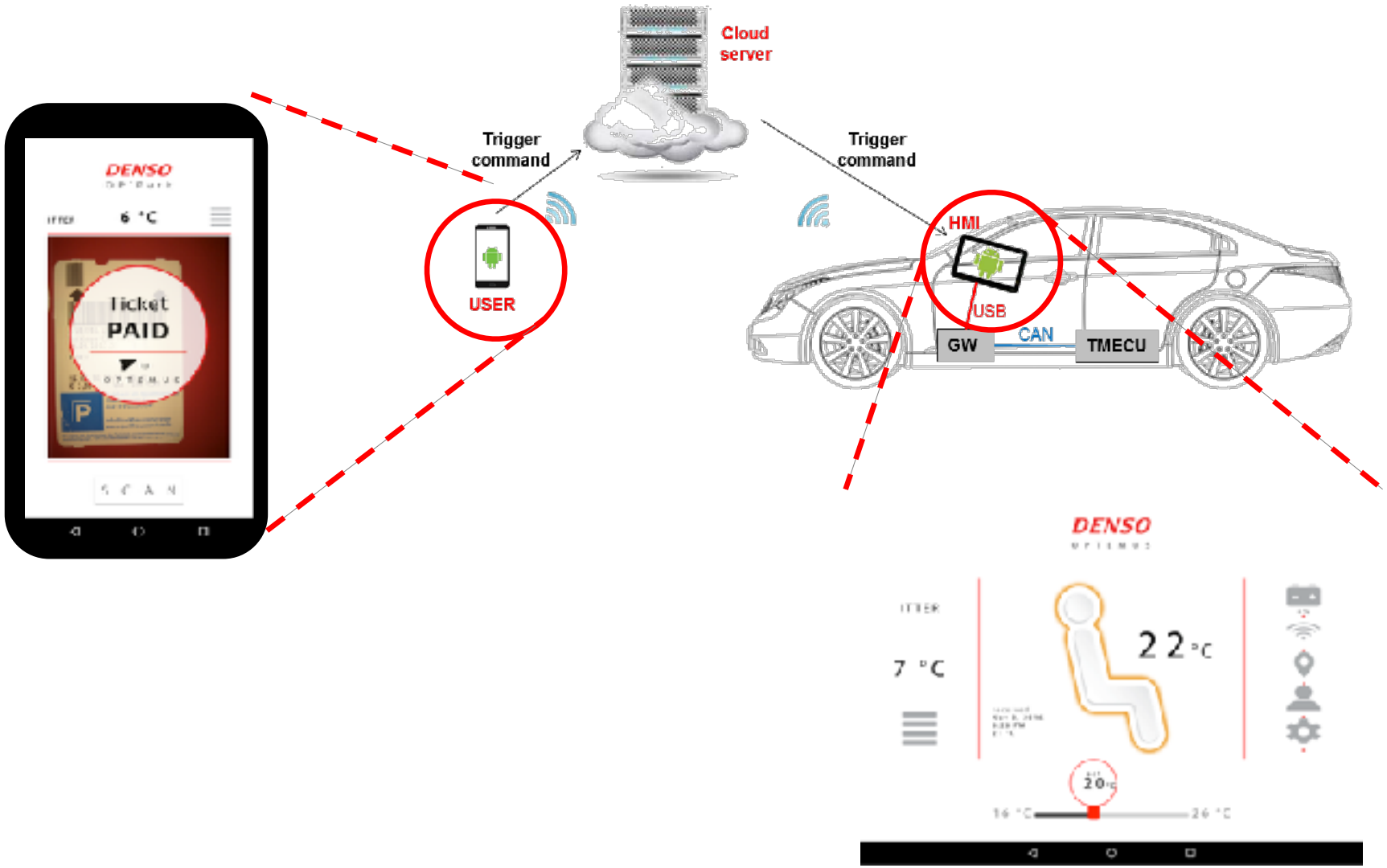
3) Preconditioning HMI

I) User-triggered



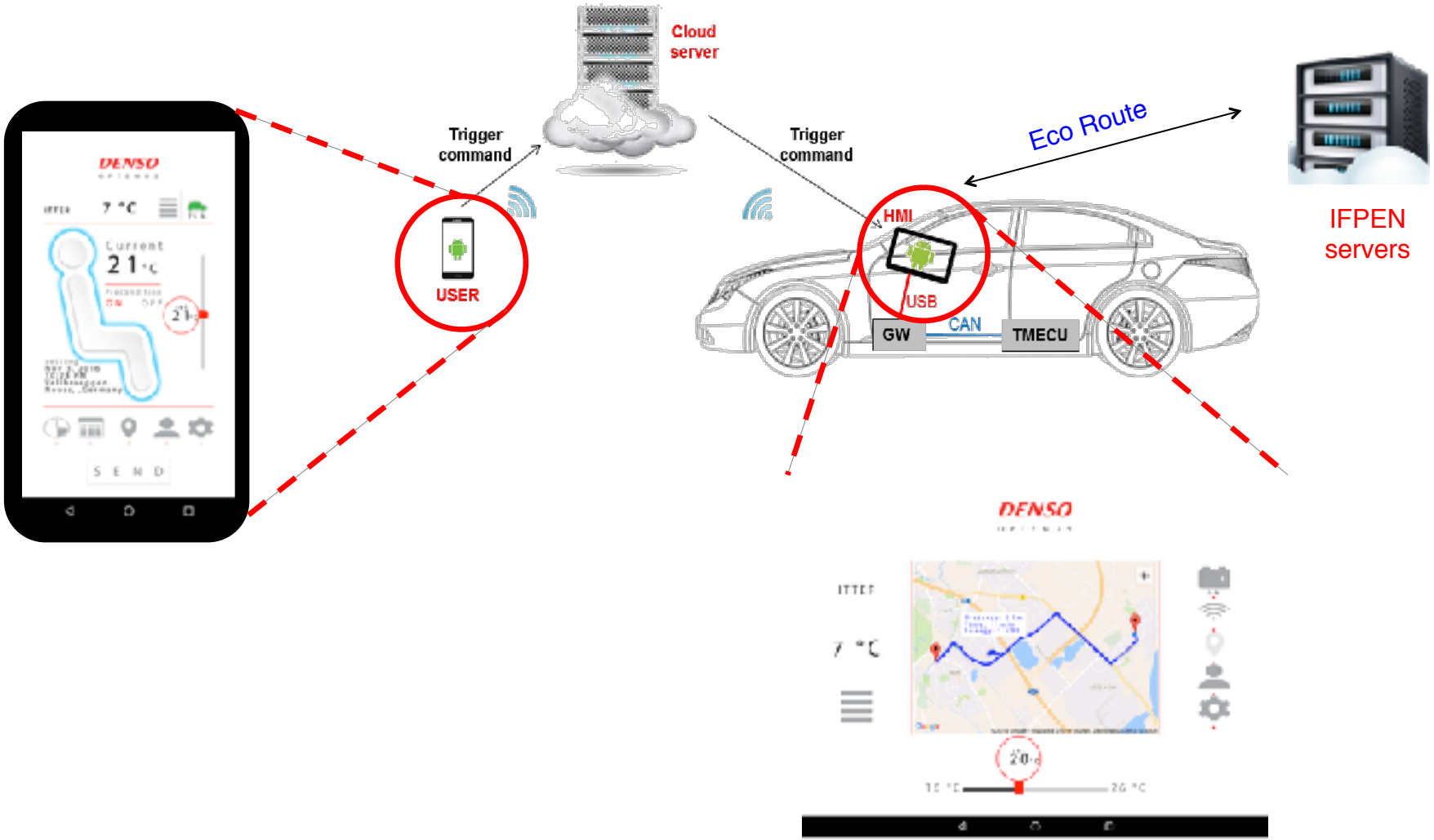
3) Preconditioning HMI

II.b) Pseudo-predictive



3) Preconditioning HMI

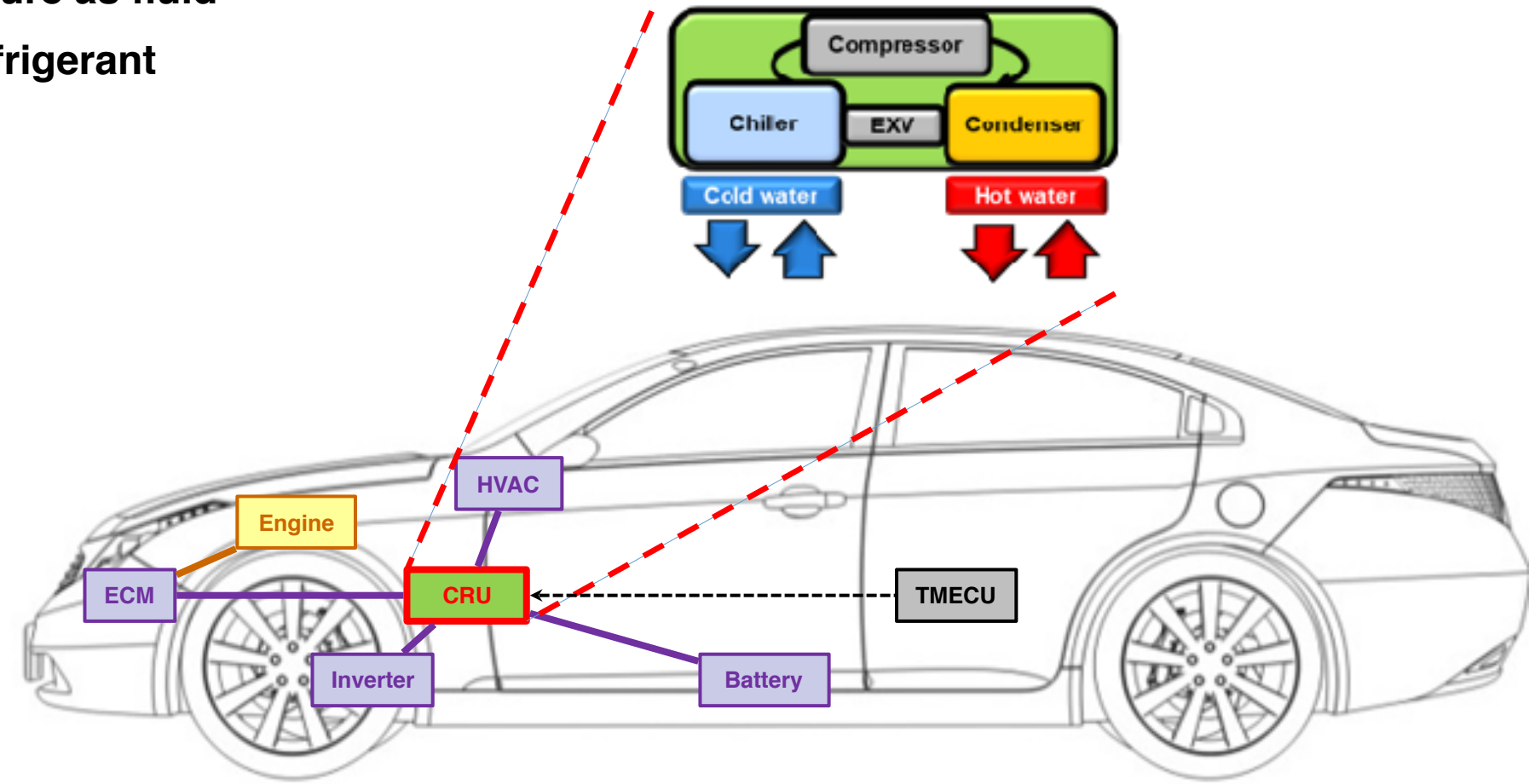
Eco-routing functionality



4) Compact Refrigeration Unit (CRU)

Water-to-Water heat-pump system

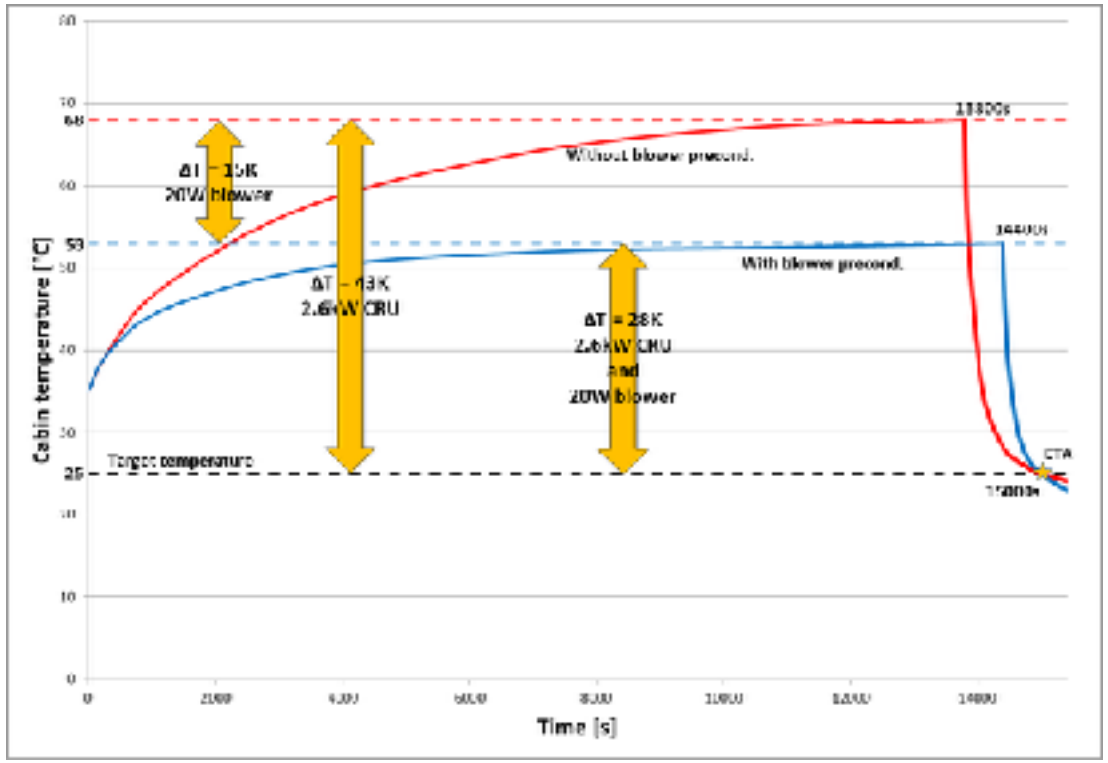
- two-plate type heat exchangers
- water-glycol mixture as fluid
- natural gas as refrigerant

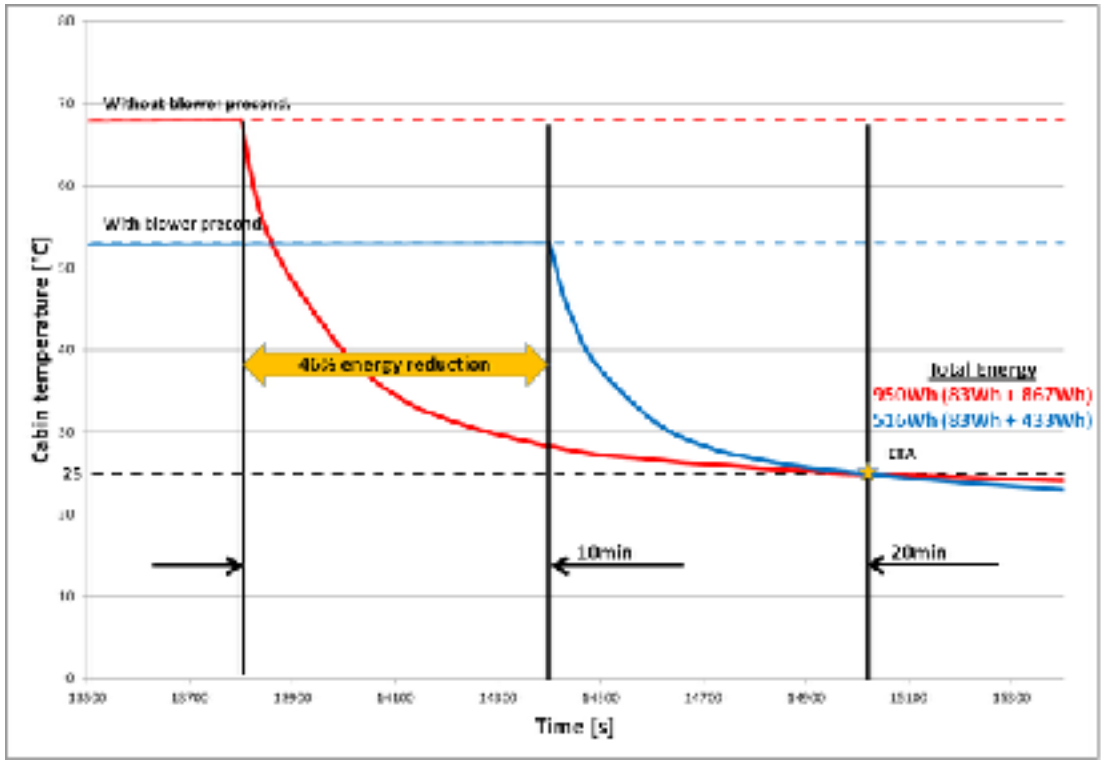


5) Evaluation → Strategy simulation

Energy reduction of 46% can be achieved by preconditioning succesively with the blower and the CRU

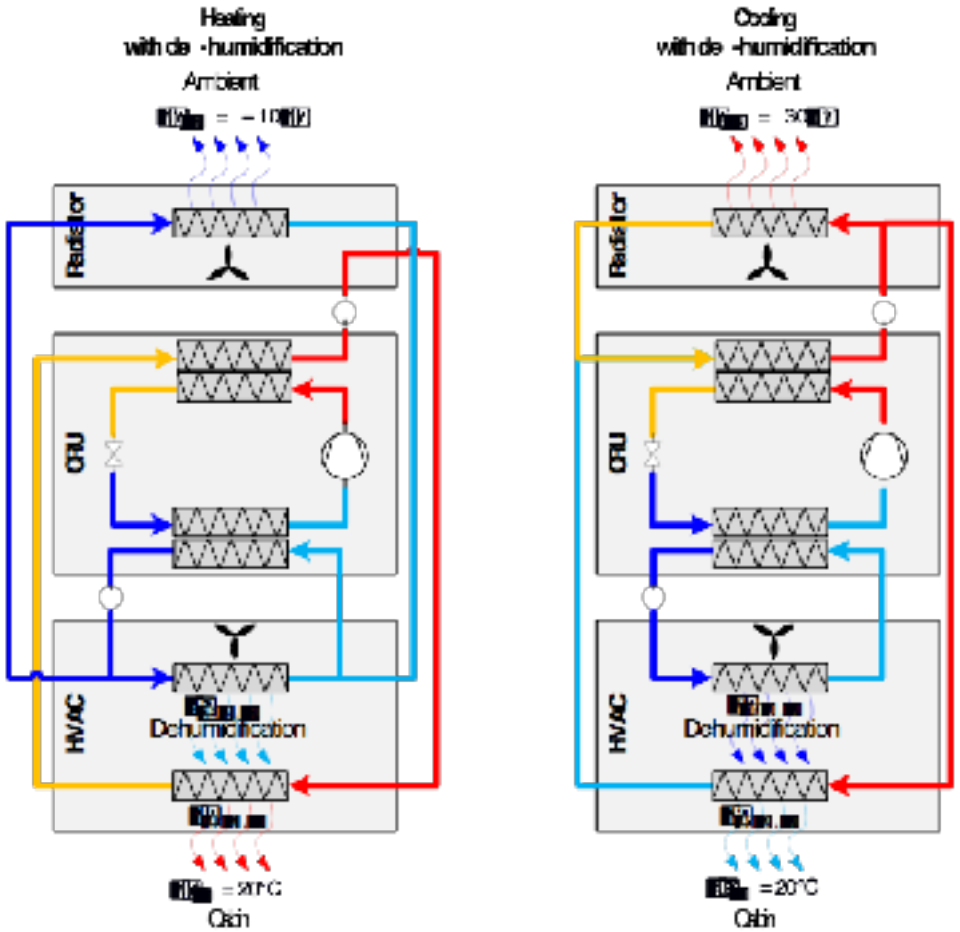
- Mid-sized vehicle, 35°C ambient temperature, 40% relative humidity, 800W/m² sun load

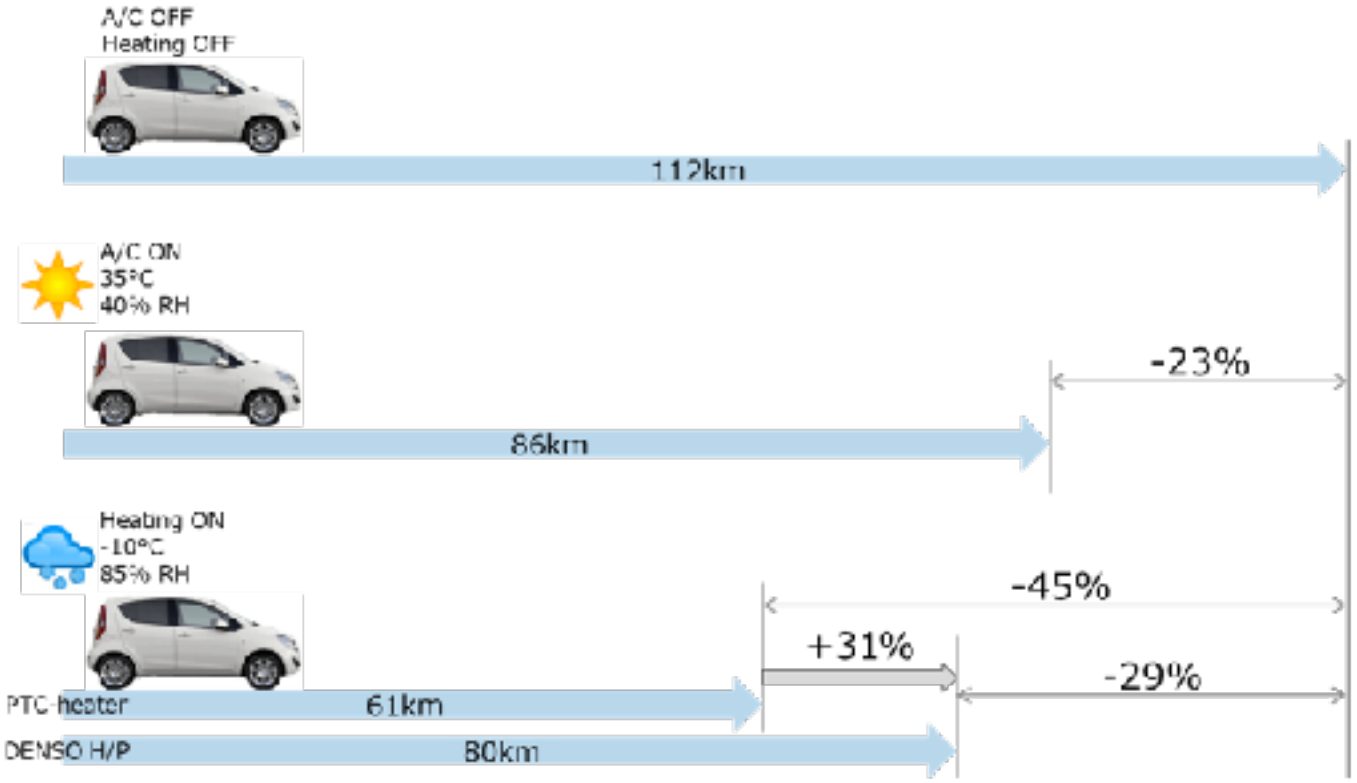




5) Evaluation → Prototype testing

The CRU increases the driving range by 31% compared to PTC-heater





6) Conclusion

DENSO has developed a compact and efficient Water-to-Water heat-pump system based on natural refrigerant

- Full cabin cooling and heating power possible in range from -20° to 40°C
- All modes possible to realize with water shut-valves and tacting control of valves
- Easy to install and well established control for water management

Next steps

- Design optimization
- Control
  - Multiple-in-Multiple-out control on water circuit and HVAC-unit
  - Proportional valves implementation
- Integration
  - Battery pack conditioning
  - Excess heat harvesting optimization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