Situational Awareness in routing in Vehicular Ad hoc Networks (VANETs)

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Outline

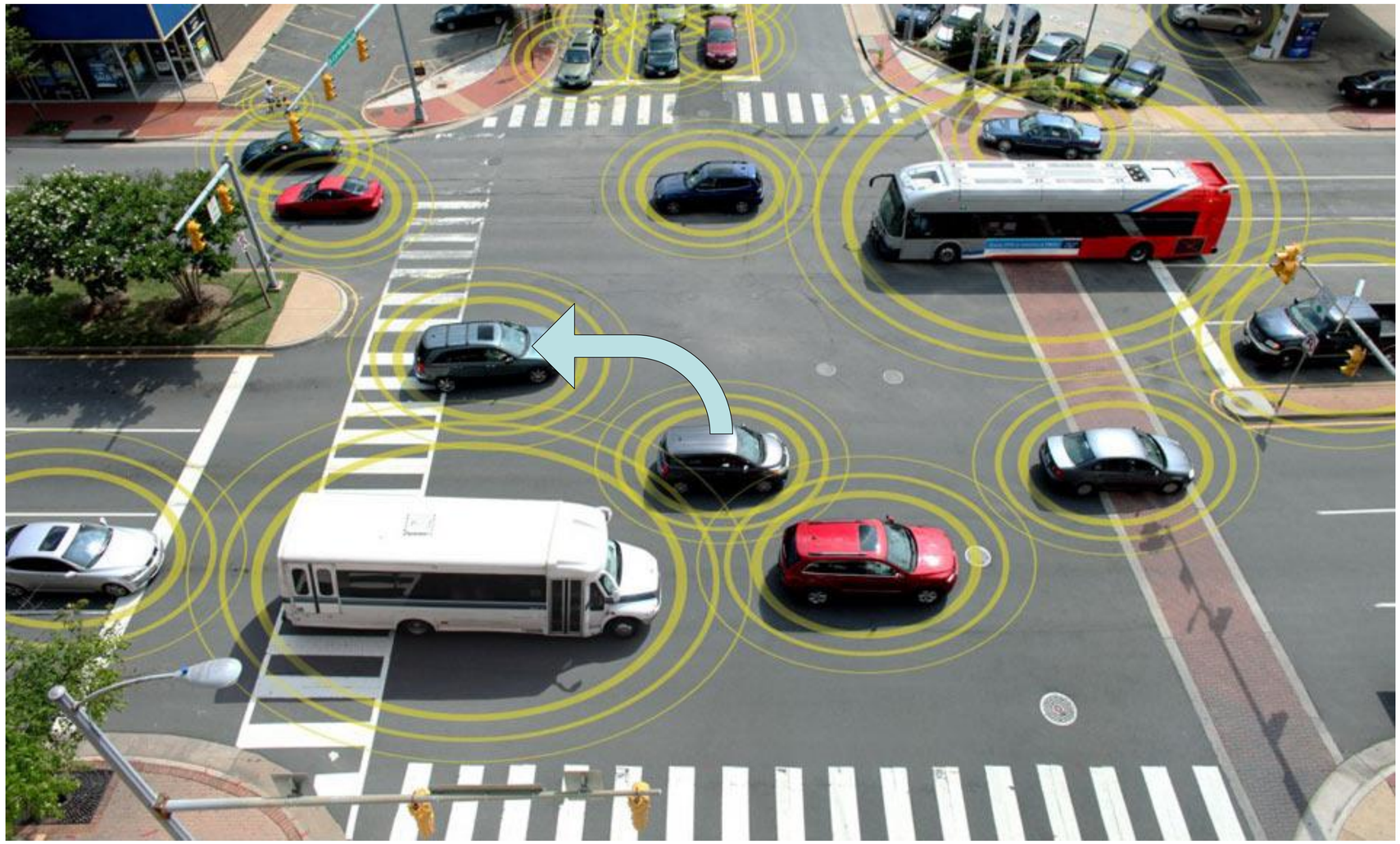
- Introduction: VANETs Technology
- Problem: Reliable Routing
- Solution: The SA Concept
- Solution: SA Levels in Reliable Routing Process
- Conclusion

Introduction

- Vehicular Ad Hoc Networks (VANETs) are an important component of the Intelligent Transportation Systems (ITS) that aim to provide safer transport networks.
- Reliable Routing in VANETs is a very challenging task due to the highly dynamic nature of vehicular network

Introduction

The link between two vehicles is vulnerable to breakage due to the rapid movements of vehicles and the unpredictable behaviour of drivers.



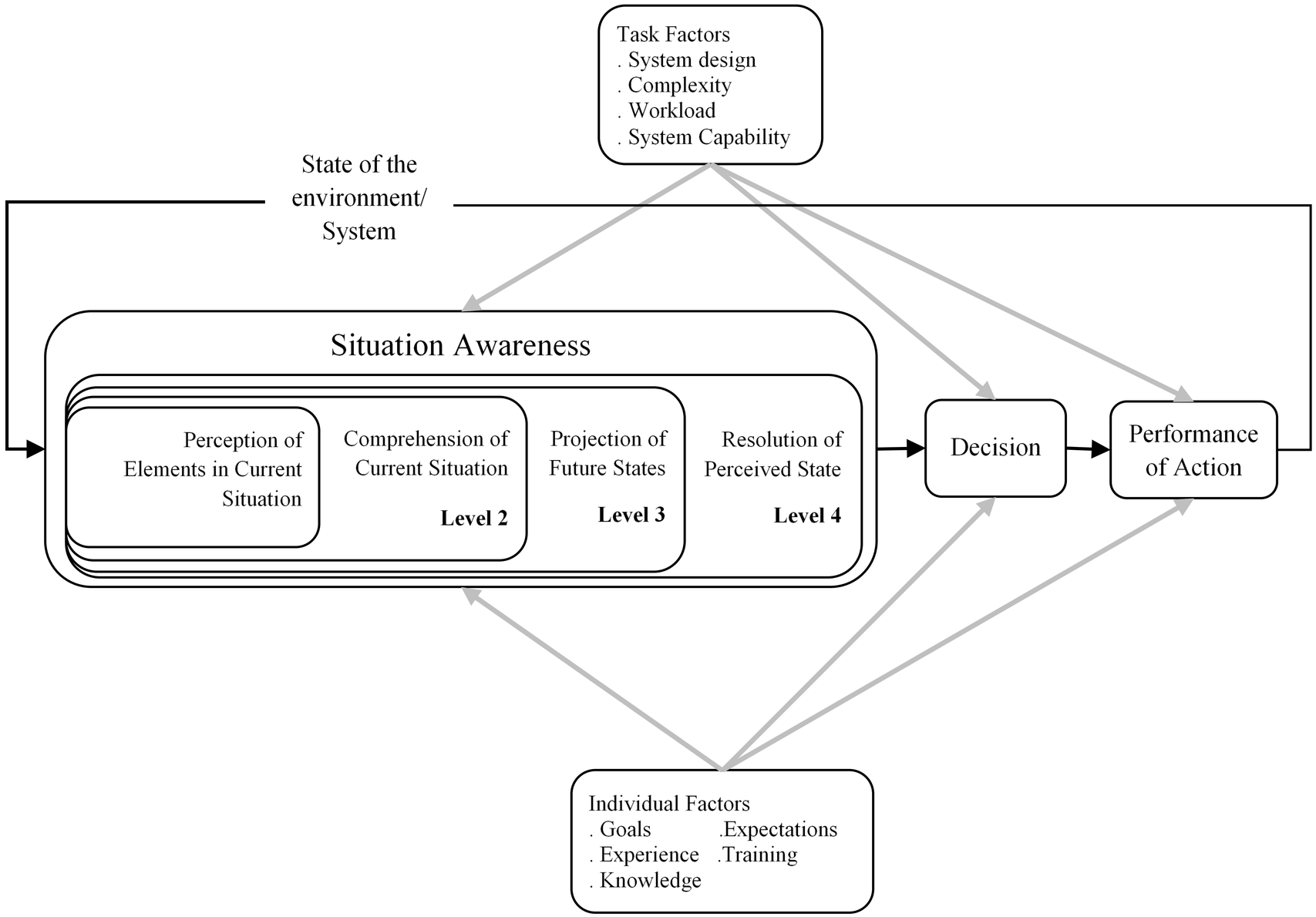
Reliable Routing

- In VANETs, Routing algorithms should be aware of the current network status and to predict the future status in order to choose the most reliable route from the source to the destination.
- They also should prepare certain countermeasures to be taken in case the current reliable route turns out to fail

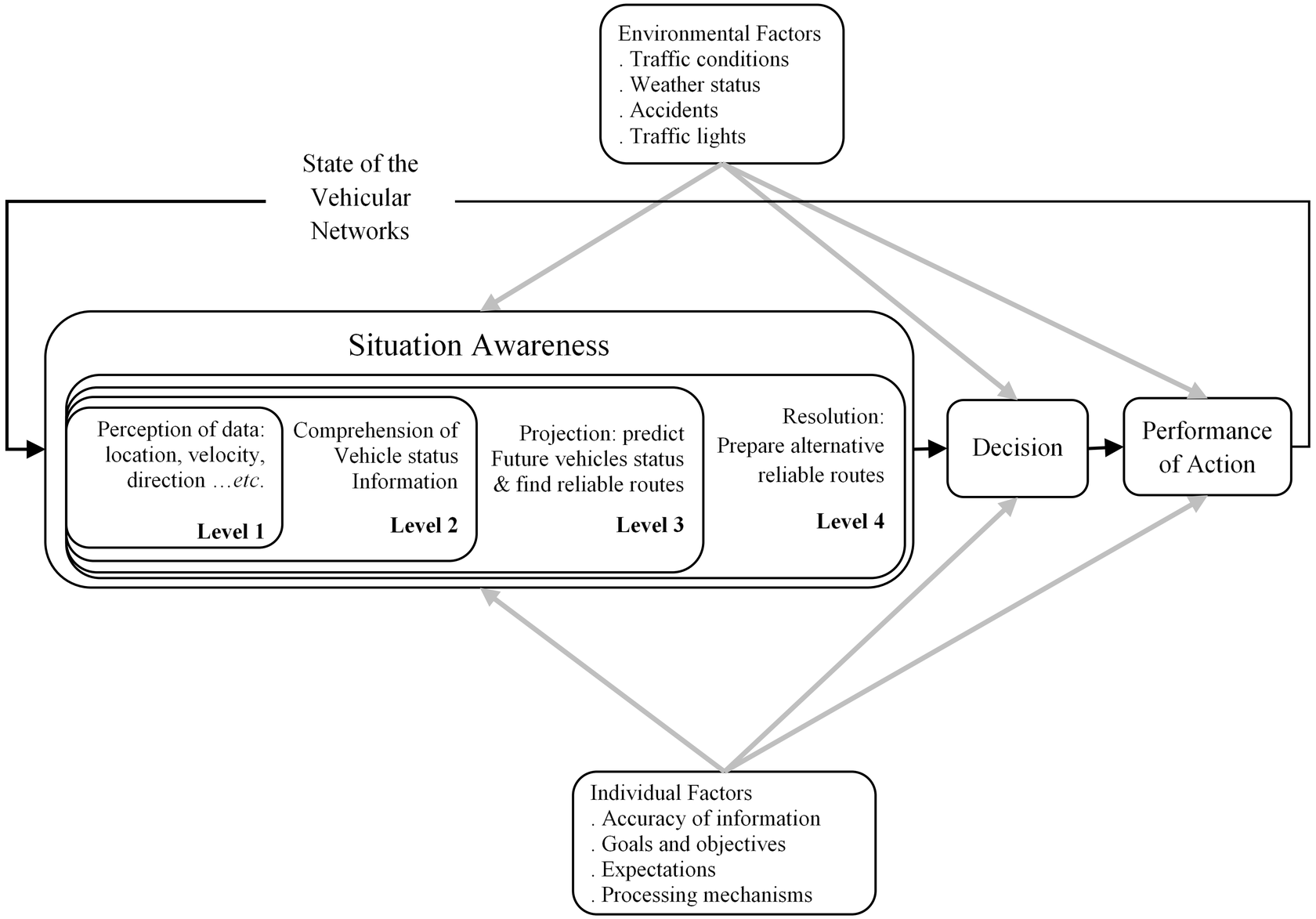
Situational Awareness

- Situational Awareness (SA) is the state of being aware of circumstances that exist around us, especially those that are particularly relevant to us and which we are interested about.
- By this definition, reliable routing in VANETs can be considered as a situational awareness aspect.

The situational awareness model



SA model for reliable routing in VANETs



SA Levels In Reliable Routing

- **Perception**: It refers to the knowledge of location, direction, velocity and acceleration/deceleration of vehicles. The drivers' behaviour in regard to the tendency towards acceleration or deceleration is also an important element.
- These elements provide the needed information about the current vehicular network status and form the basis for the comprehension, projection and resolution levels.

SA Levels In Reliable Routing

- **<u>Comprehension</u>**: Routing algorithm should understand and analyze the available information on the current network status to provide an up-to-date picture for the following SA levels.
- For example, the synthesis of location, direction and velocity of two vehicles information will help to deduce if these vehicles are moving toward each other, away from each other …etc

SA Levels In Reliable Routing

- **Projection**: It refers to the ability to forecast the future vehicular network status and predict the link life time and its reliability value based on the synthesized information from Level 2 SA.
- In this respect, projection tries to answer the following questions, how reliable is this link between two vehicles? And when this link will turn out to fail?

SA Levels In Reliable Routing

- **Resolution**: It refers to necessary actions required to recover the route between the source and the destination in case of links' failures.
- Routing algorithm should prepare an alternate reliable route in case the current one turns out to fail
- This task can be accomplished by considering multiple disjoint routes between the source and the destination vehicles

SA routing: The challenge

- Identifying feasible routes in a multi-hop vehicular network subject to multiple QoS constraints is a Multi-Constrained (Optimal) Path (MC(O)P) problem, which is NP-hard if the constraints are mutually independent.
- This means we solve the problem by ‘exhaustive search’ and if the problem gets too large we cannot solve it.

Use of ant colony techniques

- A routing algorithm (S-AMCQ) has been developed that adapts to the characteristics of the vehicular network's topology.
- S-AMCQ uses the Ant Colony Optimisation (ACO) techniques to compute feasible routes subject to multiple QoS constraints determined by the type of data traffic to be routed and the reliability of the available links.

Local decision making (SA)

- While searching for feasible routes, ants select their next hop when they arrive at intermediate nodes based on a stochastic mechanism called the state transition rule using information available locally at the current time.
- In this way S-AMCQ computes the best route currently available from a node to the destination, if such a route exists, and provides a reliable and robust routing service.

Conclusion

- The application of SA to the reliable routing in VANETs is essential due to the vitality of this process in VANETs.
- Reliable routes should be monitored and applicable countermeasures are needed to respond to reliable route failures.
- **Reference:** Secure and Robust Multi-Constrained QoS Aware Routing Algorithm for VANETs, 2015, Mahmoud Hashem Eiza, Thomas Owens, and Qiang Ni, IEEE Trans. on Dependable and Secure Computing, Vol. 12, No. 1.

Thank you

Questions