

Albrecht Dill, BMW AG

12 MAY 22

FINAL EVENT



IMAGinE



Introduction to Cooperative Maneuver Coordination

What is cooperation?



- „Co operatio“ (Latin: to work together):
 - To achieve a common purpose
 - No mutual competition, maybe even common plan
 - opportunity:
 - The benefit can be contrasted with the effort, so that the overall result is the best
- ⇒ Optimal achievement of common goals

- Levels of cooperation:

step	Cooperative driving	Technical communication V2X	Explanation of cooperation	Explanation of communication
0	no	-	-	-
1	yes	no	Basic cooperation	Hand signal or turn signal (blinker)
2	yes	yes (unilateral)	Other vehicles are informed about the state of the communicating car	Communication based on CAM/DENM
3	yes	yes (unilateral)	Other vehicles are provided with additional environment information	Communication additionally based on CPM
4	yes	yes (bilateral)	Single decision making, one vehicle (master) suggests behavior ("central planning"), other vehicles accept or reject it	A suggestion, resulting in yes/no answer
5	yes (bilateral)	yes (bilateral)	Joint decision-making („decentralized planning“) and maneuvering	Response with alternatives to the proposal

- Process of maneuver arrangement



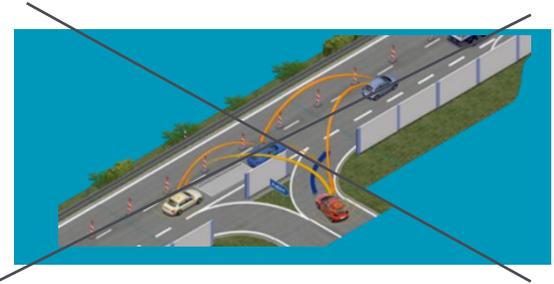
Why do we need IMAGinE?



- Indicator is sufficient for general information and indicating an intention
 - Shortcomings:
 - => ambiguous
 - => no response, no confirmation
 - => risks due to unclear situation and the possibility of misunderstanding
- IMAGinE cooperation includes targeted understandable requests with clearly assignable response.
 - + Prospects:
 - => clear
 - => fast

When does cooperation make sense?

- Problematic today:



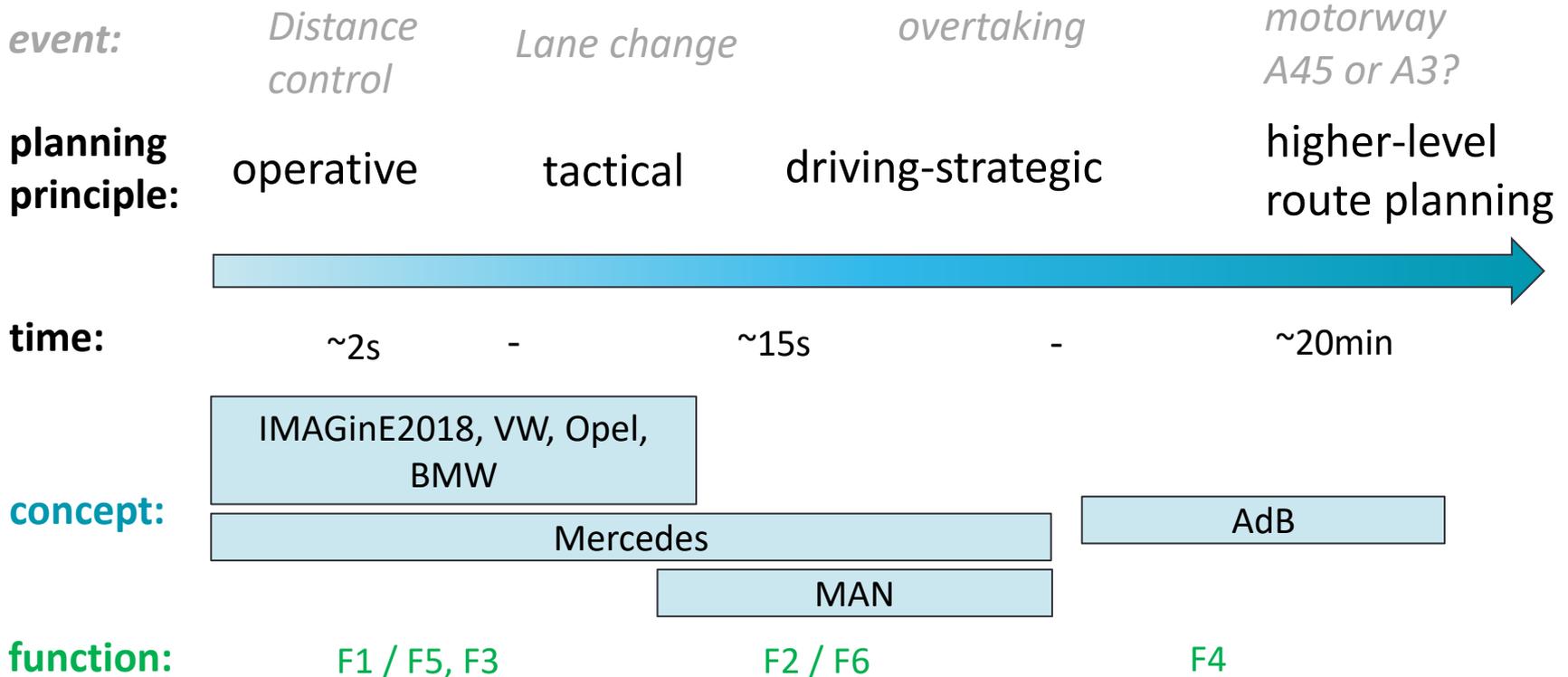
- Prerequisite for cooperation:
 - Voluntary waiver of own right of way
 - Striving for fairness with a balanced relationship between give and take
- When does it make sense?
 - Avoiding unnecessary breaking and emergency situations
 - Support tactical driving tasks
 - Improving traffic flow and driving comfort

Distinguishing features for concepts



- **Communication**
 - **continuous:** participants send out messages about the planned trip cyclically, even if they do not want to request or grant cooperation at the time
 - **Event-based:** Cooperation messages are sent only when the need for cooperation is detected
- **Arrangement**
 - **explicit:** cooperation will be confirmed or revoked explicitly to requesting cars
 - **implicit:** willingness to cooperate will be determined implicitly based on other information (e.g. trajectories)
 - **Role-based:** Vehicles assume or terminate explicitly defined roles (for example lead vehicle or following vehicle within convoy)
- **Control**
 - **local:** participants **coordinate** with each other locally
 - **Infrastructure-based:** goals are pursued via infrastructure information (e.g. route selection)

Distinguishing features of Planning Forecast



THANK YOU

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