((VERONET >>
A framework for self learning, adaptive traffic control including Car2X communication

ANDATA.AT
ARTIFICIAL INTELLIGENCE
LABS

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A3PS Conference
Vienna, Nov. 2015

www.veronet.eu

Who we are:

ANDATA

Engineering office for
- Technical Mathematics
- Mechanical Engineering

Specialized in
- Virtual product development methods, simulation, CAE
- Data Mining
- Artificial Intelligence
- Predictive Control

Locations in
- Hallein / Salzburg
- Vienna

currently >16 employees

Audi

Automotive Safety Technologies

Located in
- Gaimersheim, Germany

currently > 190 employees

Series Development of control algorithms for integral safety systems
- restraint systems
- emergency braking
- warning systems
- …

Automated and Autonomous Driving

Why such a boom?

Expected benefits
with respect to

Comfort

- Enrichment of individual transport
- Giving back time to drivers

Safety

- Reduction/elimination of human errors

Traffic

- Improving traffic quality and efficiency
- Enforcement of cooperative behavior
- Improving predictability
- Avoiding accidents as congestion source

Who takes over responsibility and coordination?

- **Thought experiment:** crowded situation at intersection with automated, self driving vehicles

Nothing different than today!

- Somebody has to take the lead and control
- Traffic control cannot be avoided and skipped

But:

- Self driving cars can be trained to be cooperative
- Traffic control must be refactored/redesigned to take advantage
- **Automation of traffic control**

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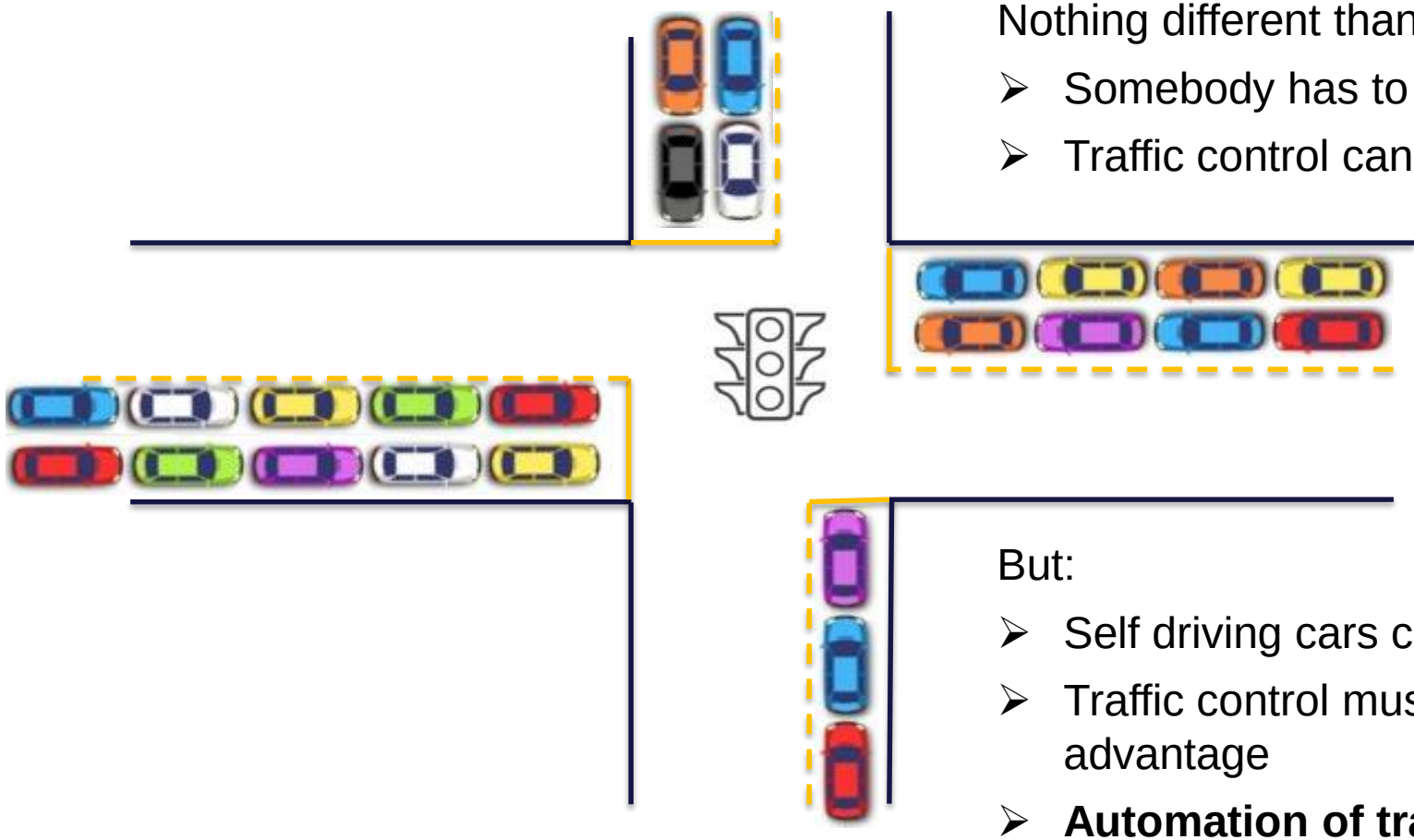

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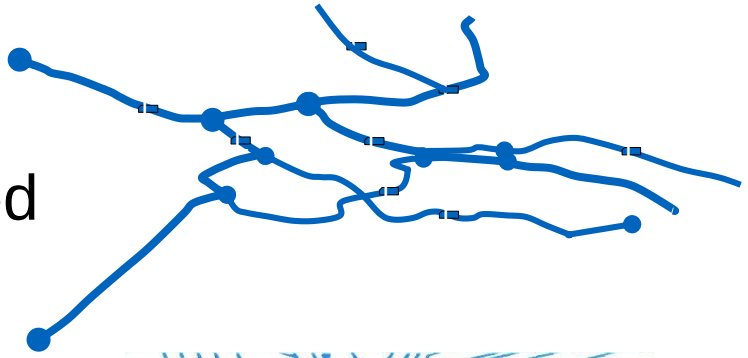
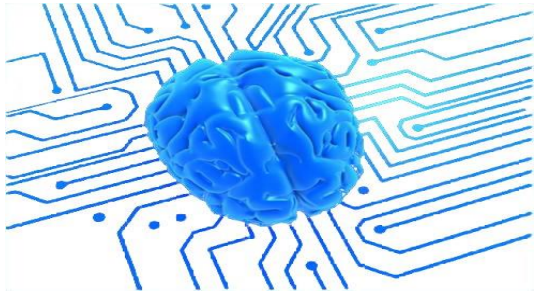
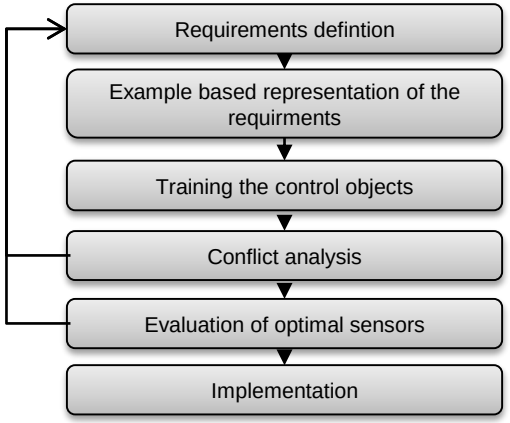
((VERONET>> Solution Concept

- Structure and Architecture
  - Decentralized, subsidiary, hierarchically arranged network of **uniform, modular control objects**
- Mathematics of Control
  - Artificial Intelligence, Machine Learning, data driven modelling
  - Model based predictive control
  - Stochastic Simulation
- Process
  - Requirement driven process model

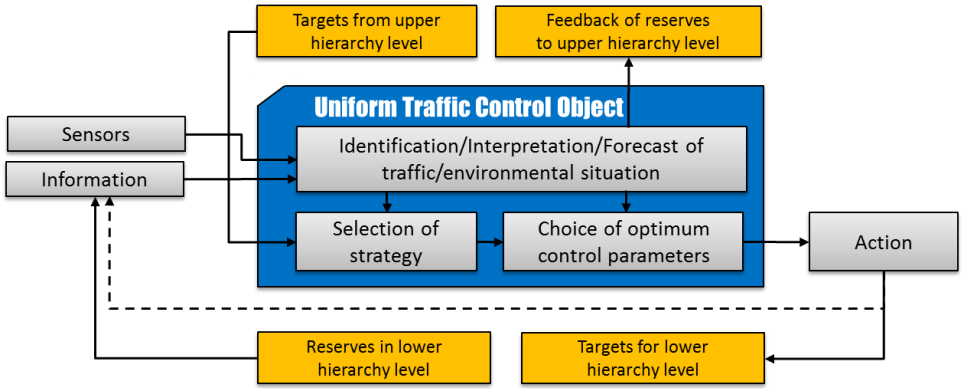


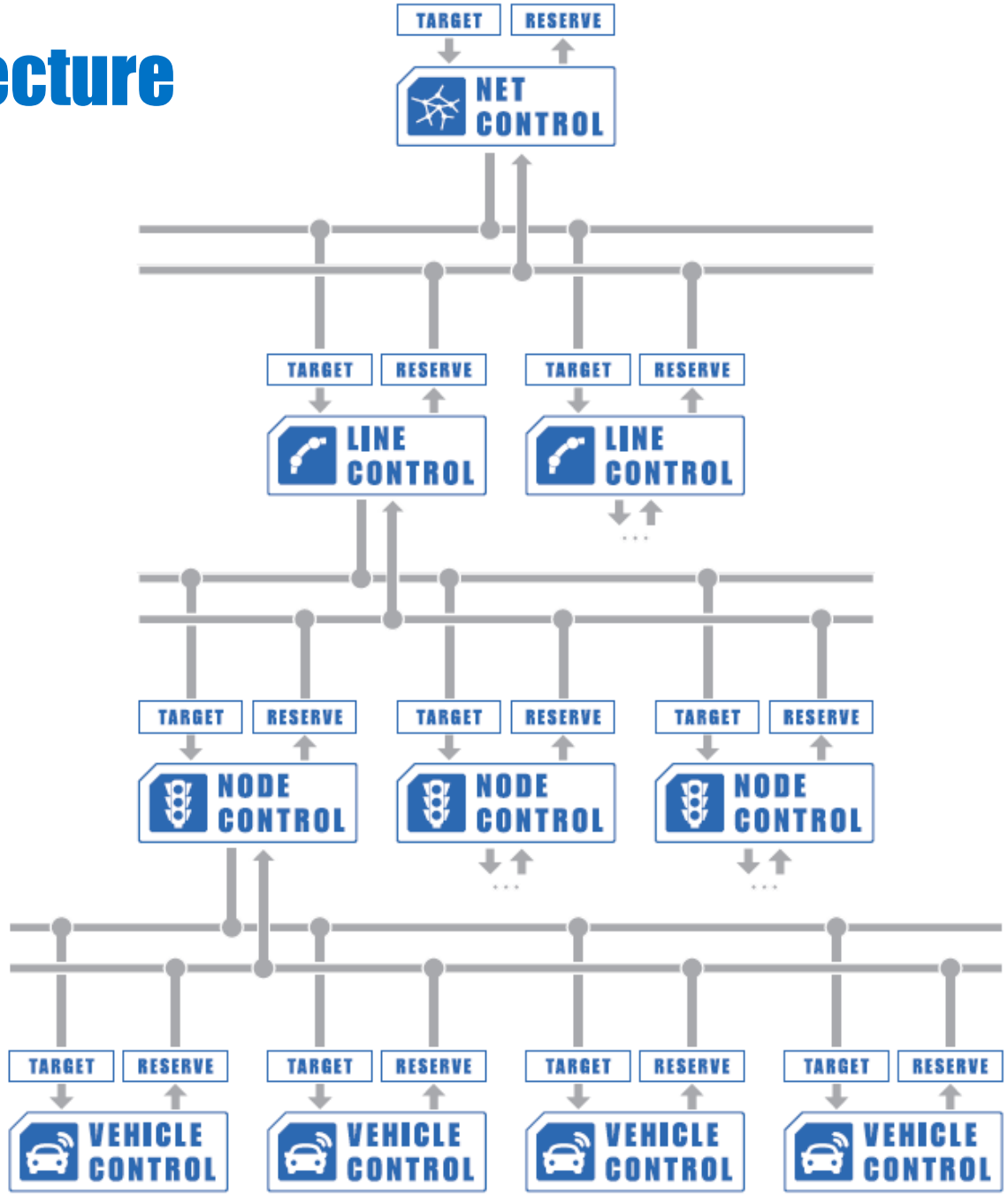




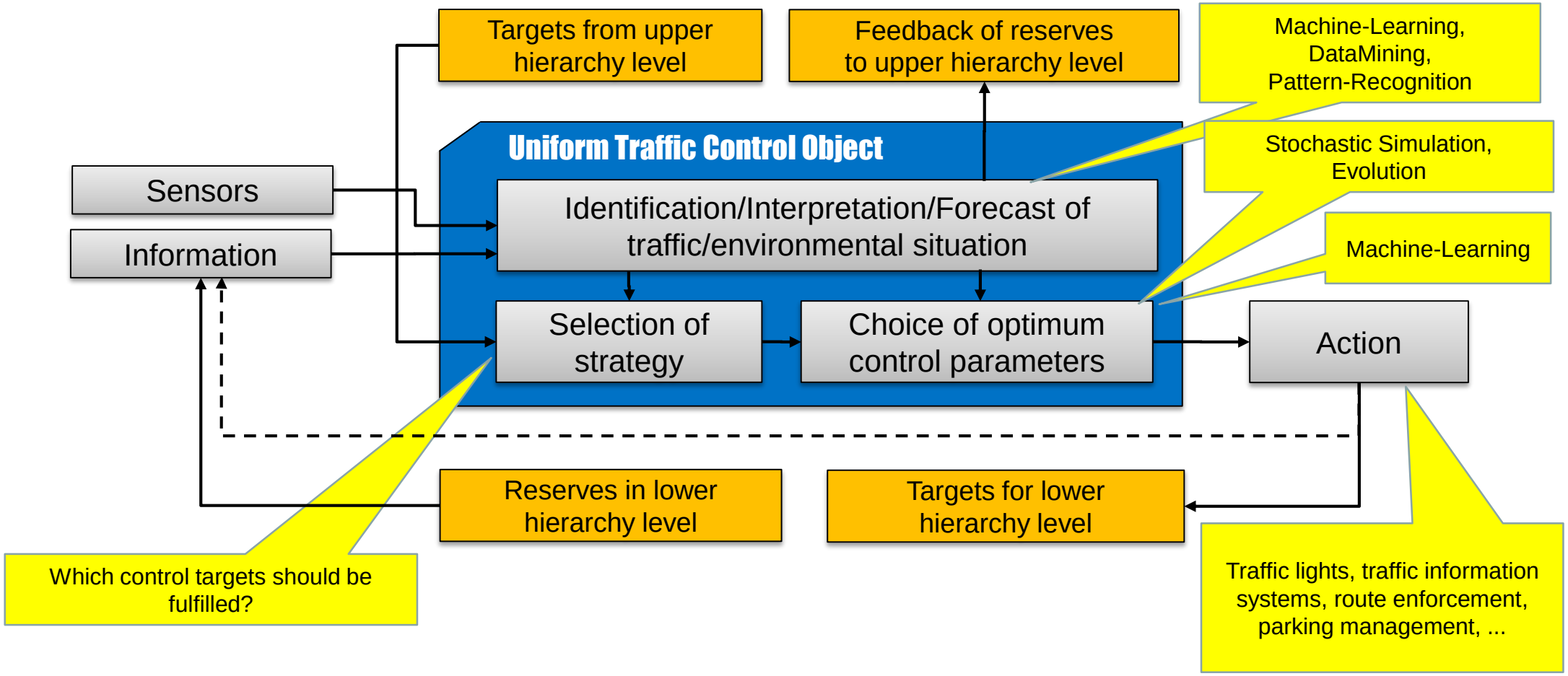
Structure and Control Architecture

- Decentralized
- Hierarchical, cascaded
- Subsidiary
- Modular
- Uniform
- Object oriented

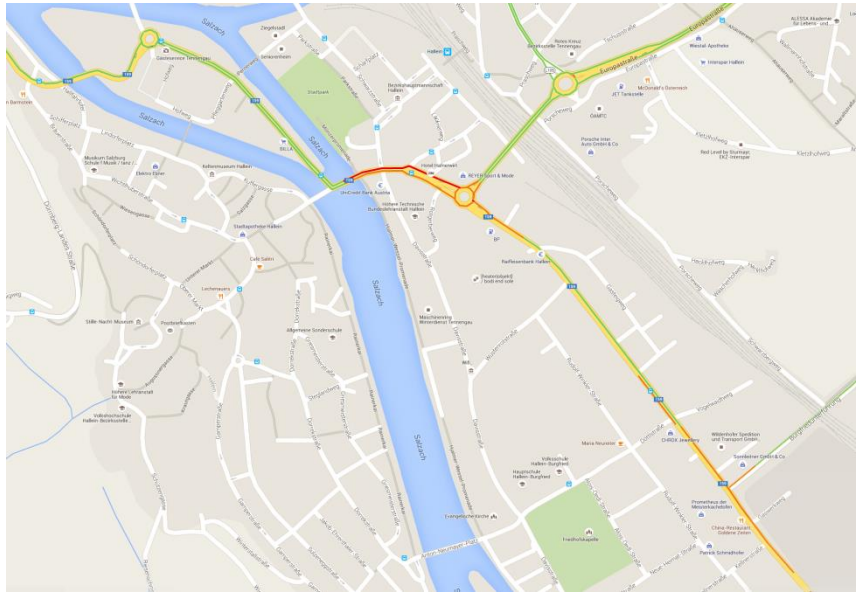


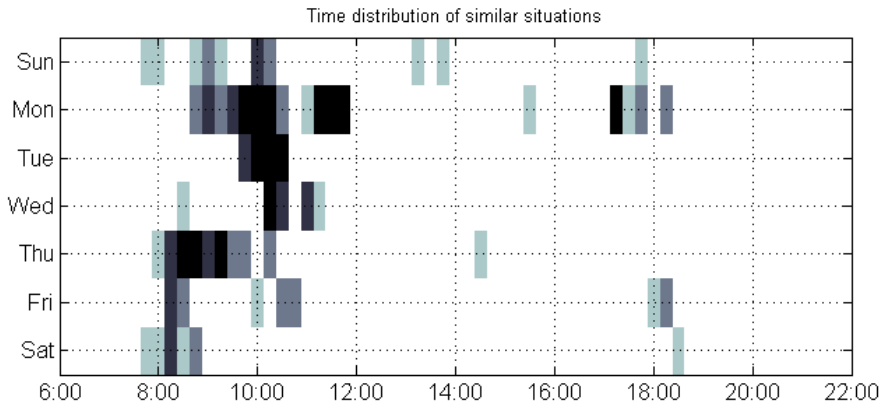


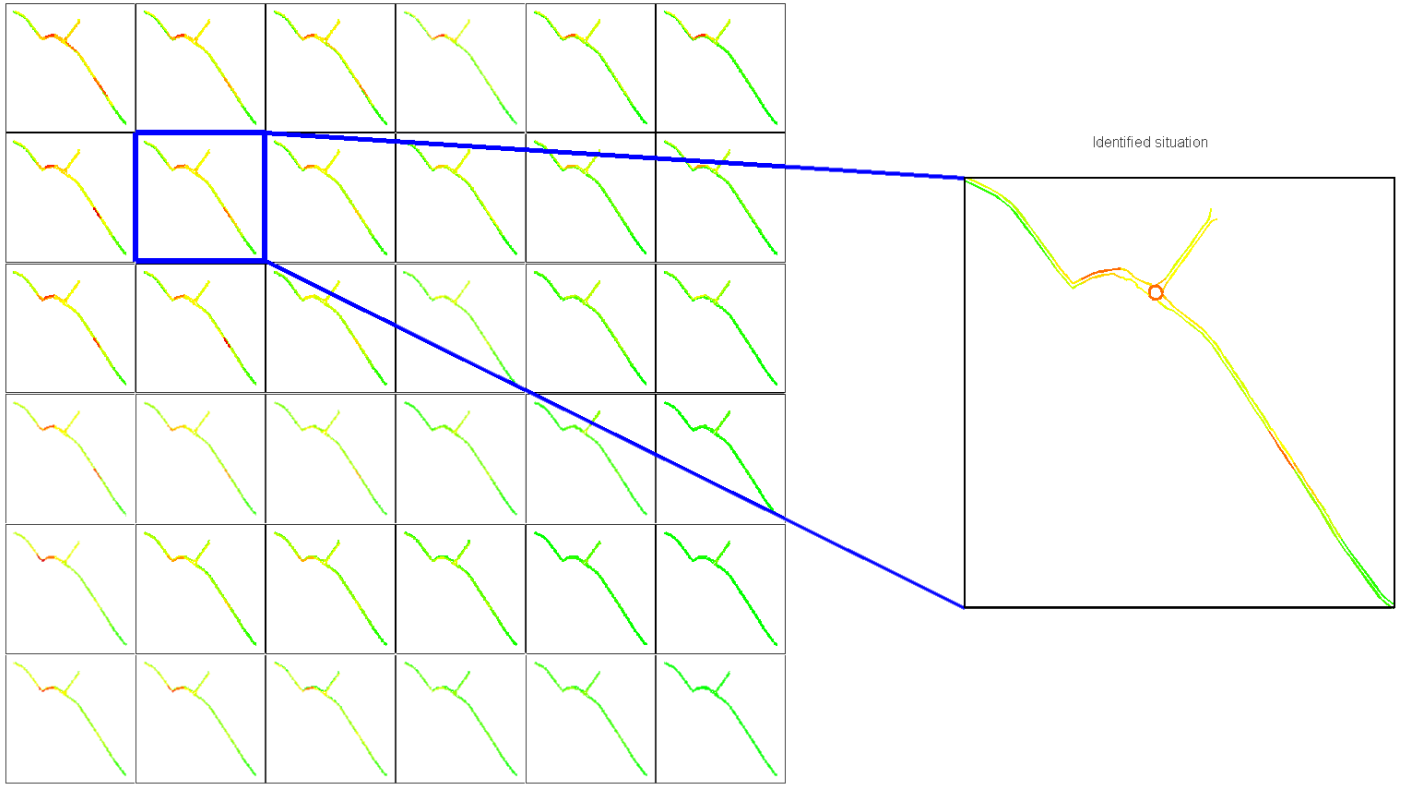
Control Architecture: Unified Control Object



Self Learning System for Automated Identification of Traffic Situations



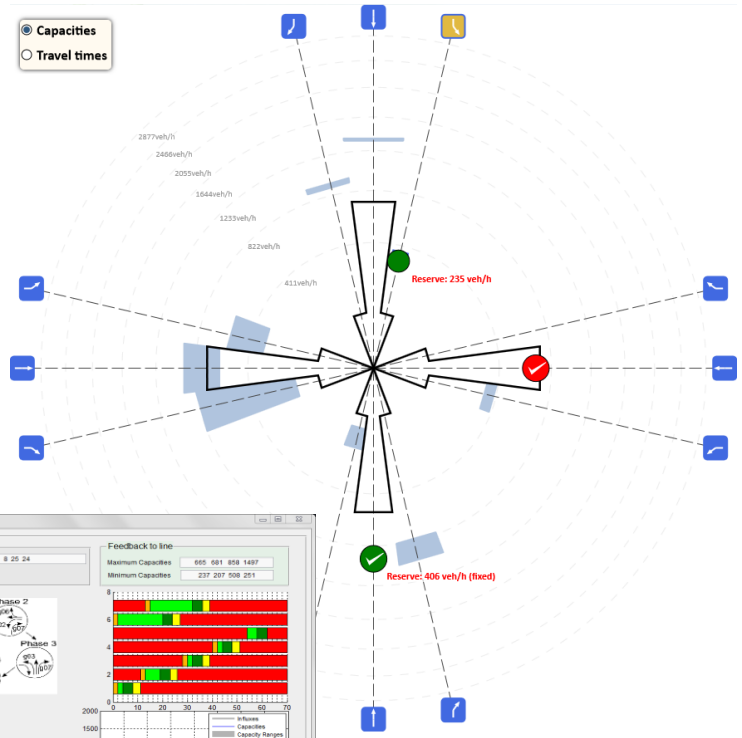


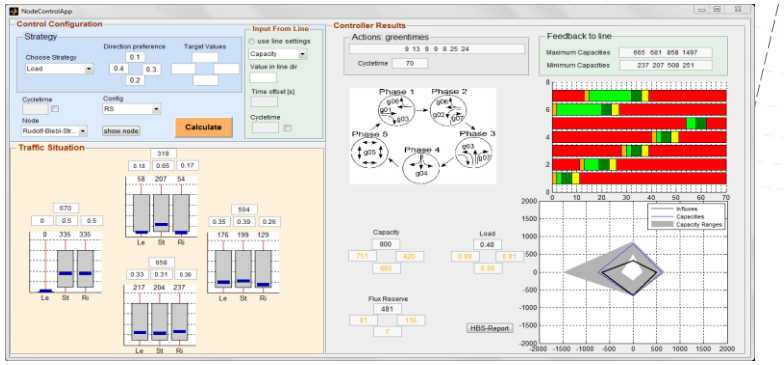


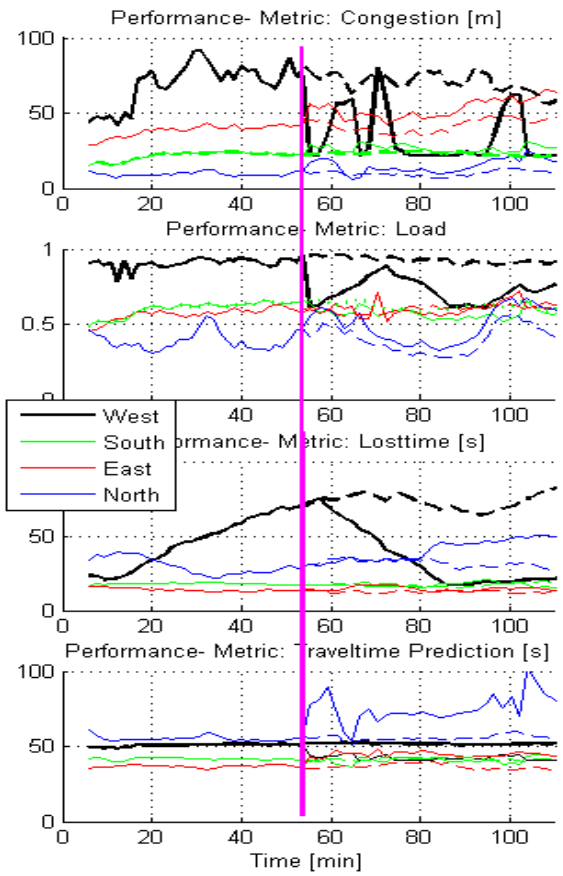
Example Hierarchy Level for Node Control

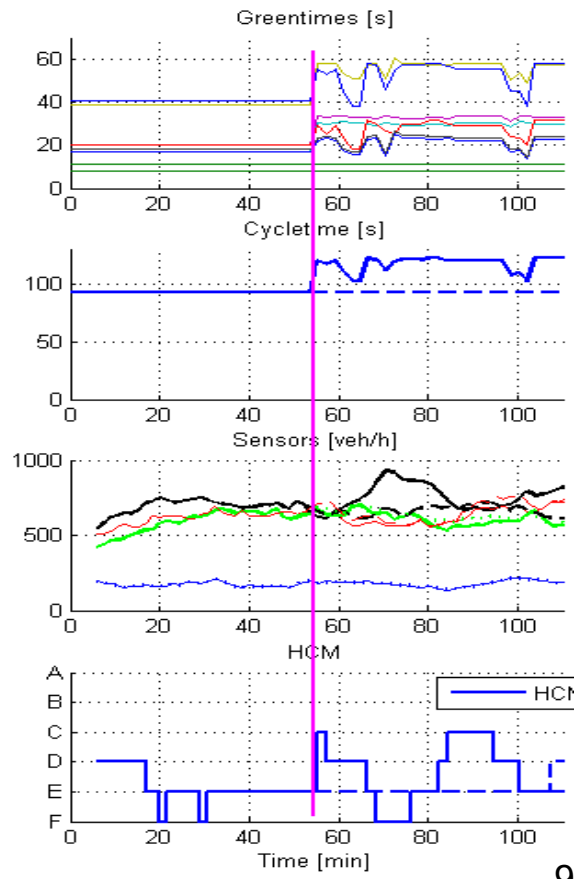
Actions for Node Control:

- phase coordination, turnaround and green times
- unified interface by prescription of targets instead of solutions





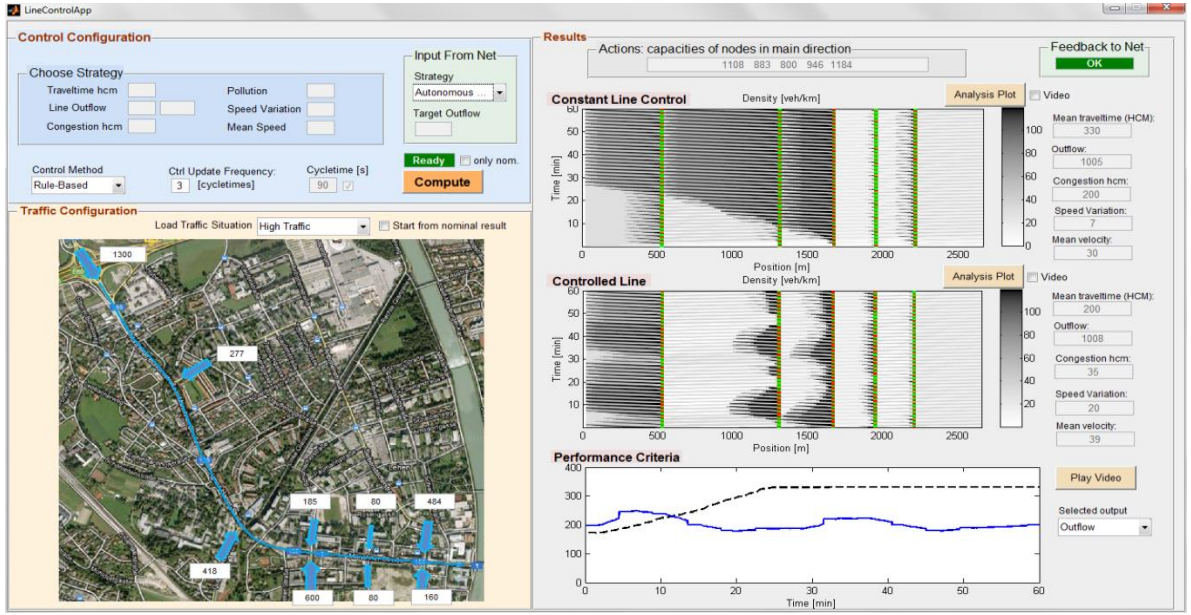


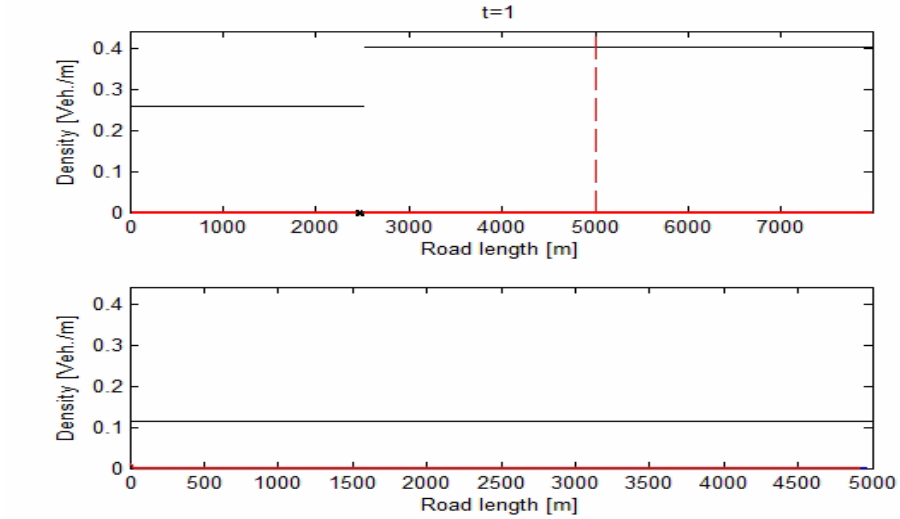


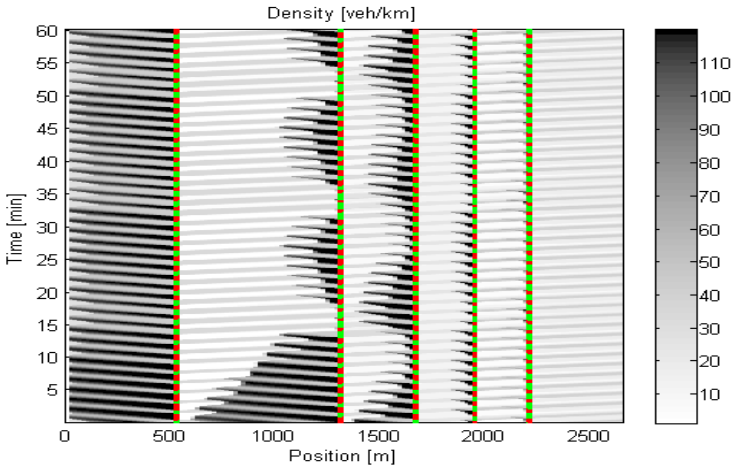
Example Hierarchy Level for Traffic Line Control

Actions for Line Control:

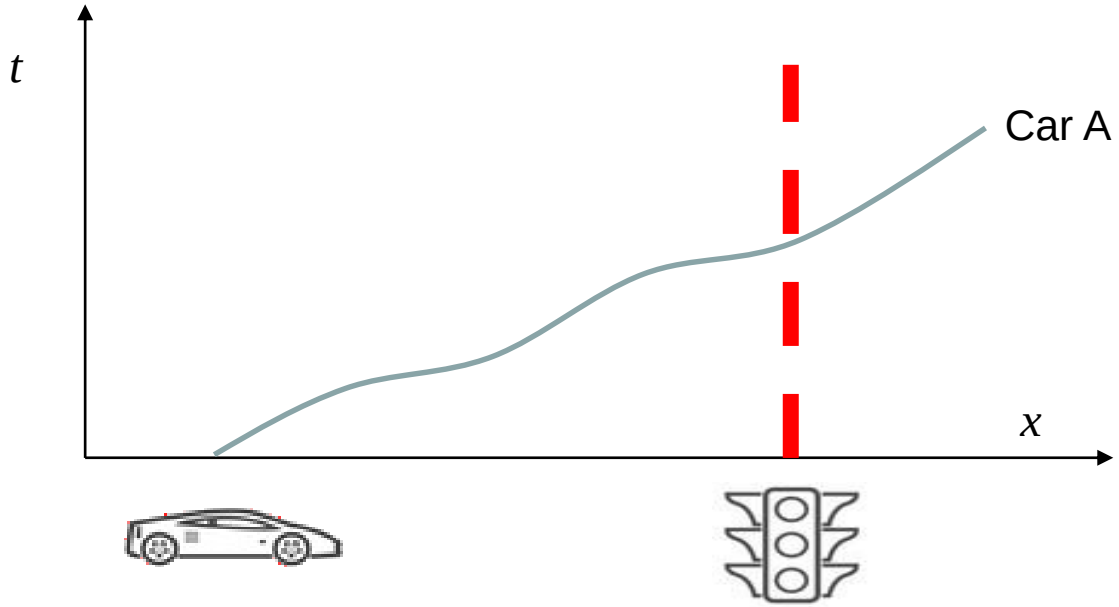
- Targets for Node Control



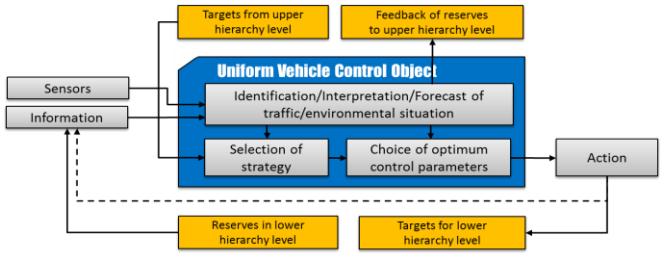


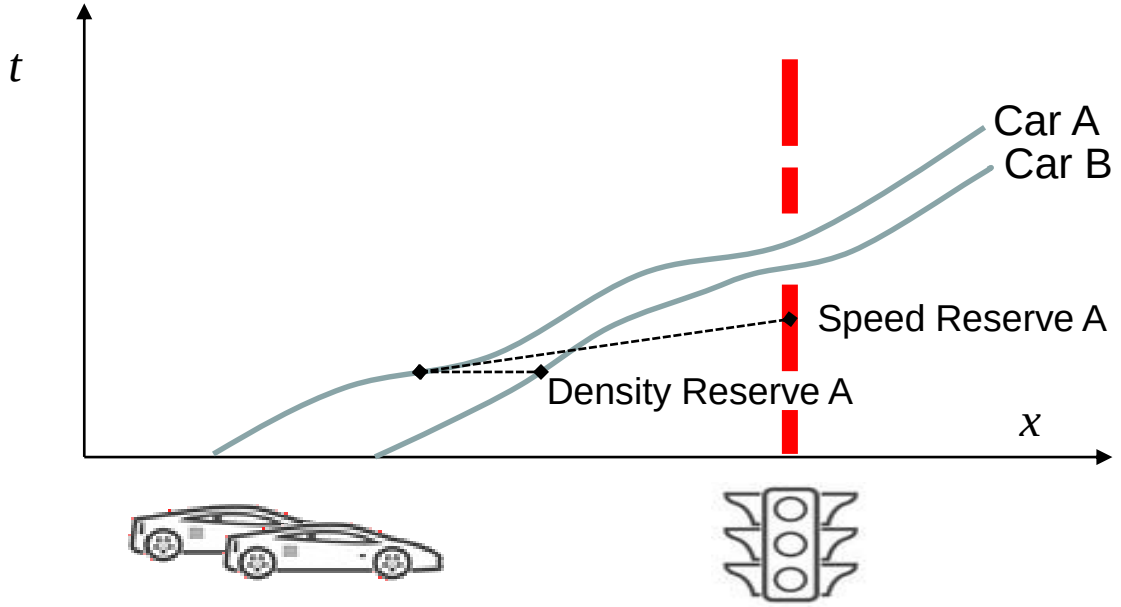


Solution Concept Vehicle Control



Speed Adaption ⟵ (Static) Timing





Reserves ⟷ Situation Interpretation

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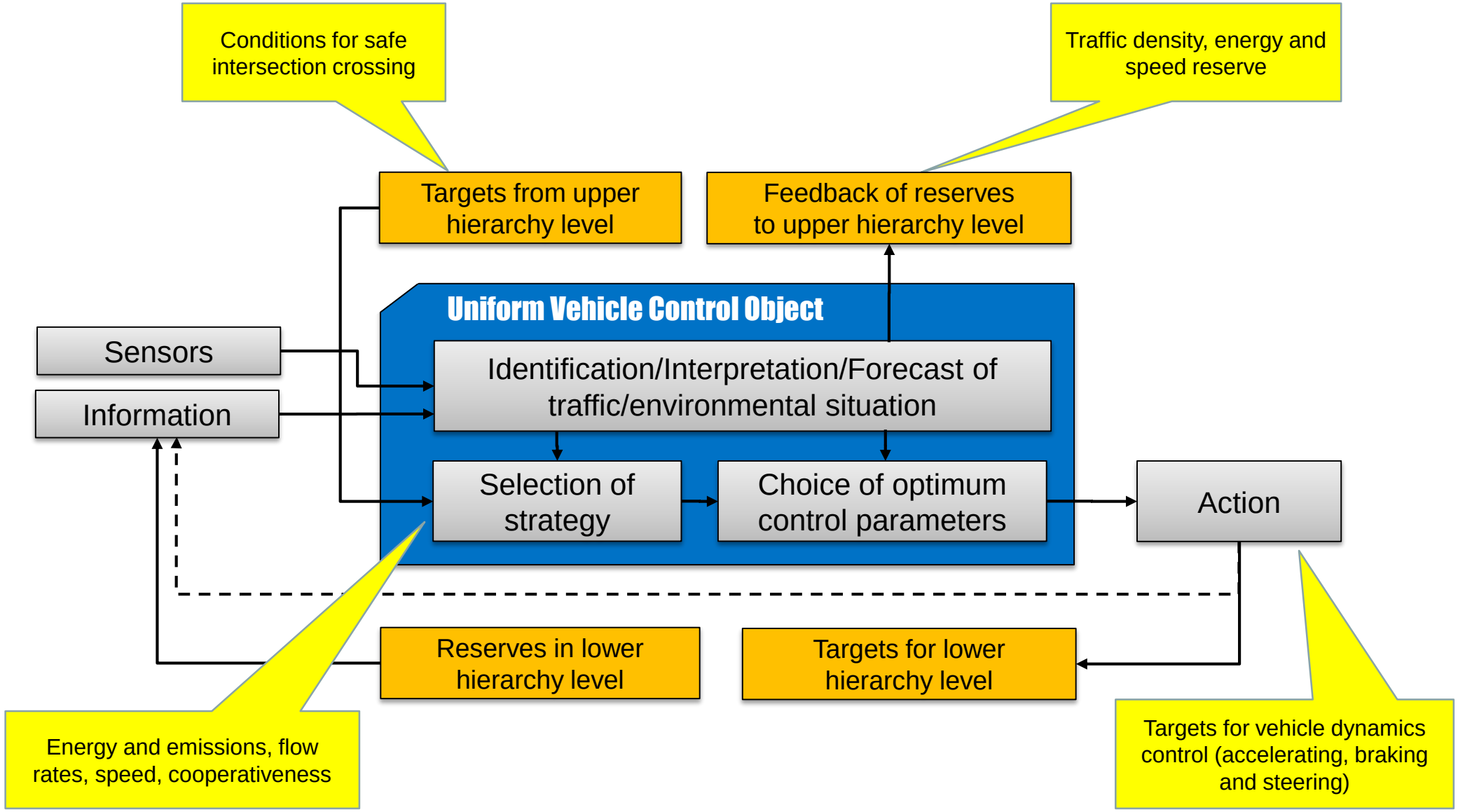
Choice of strategy

Control execution ⟸ Control targets

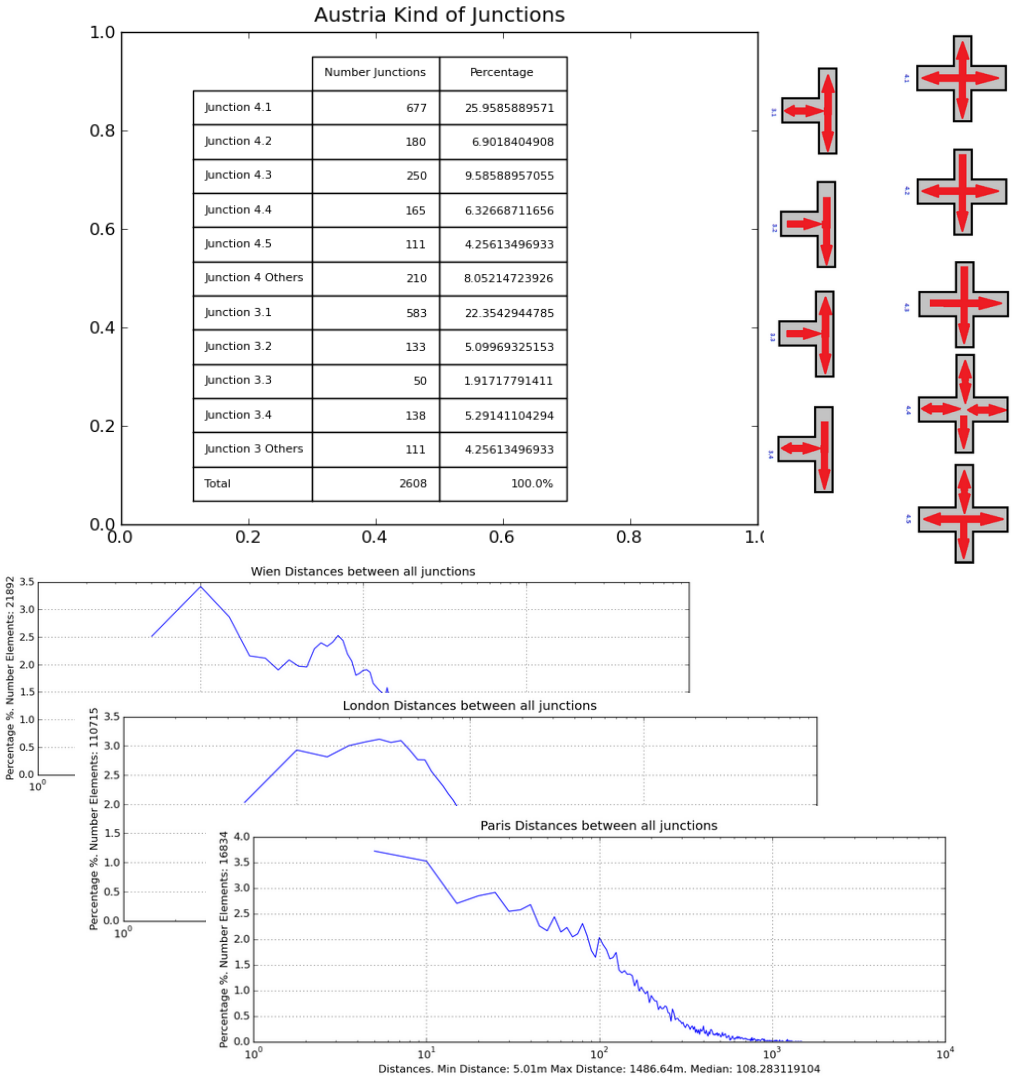
↓

Control Adaption

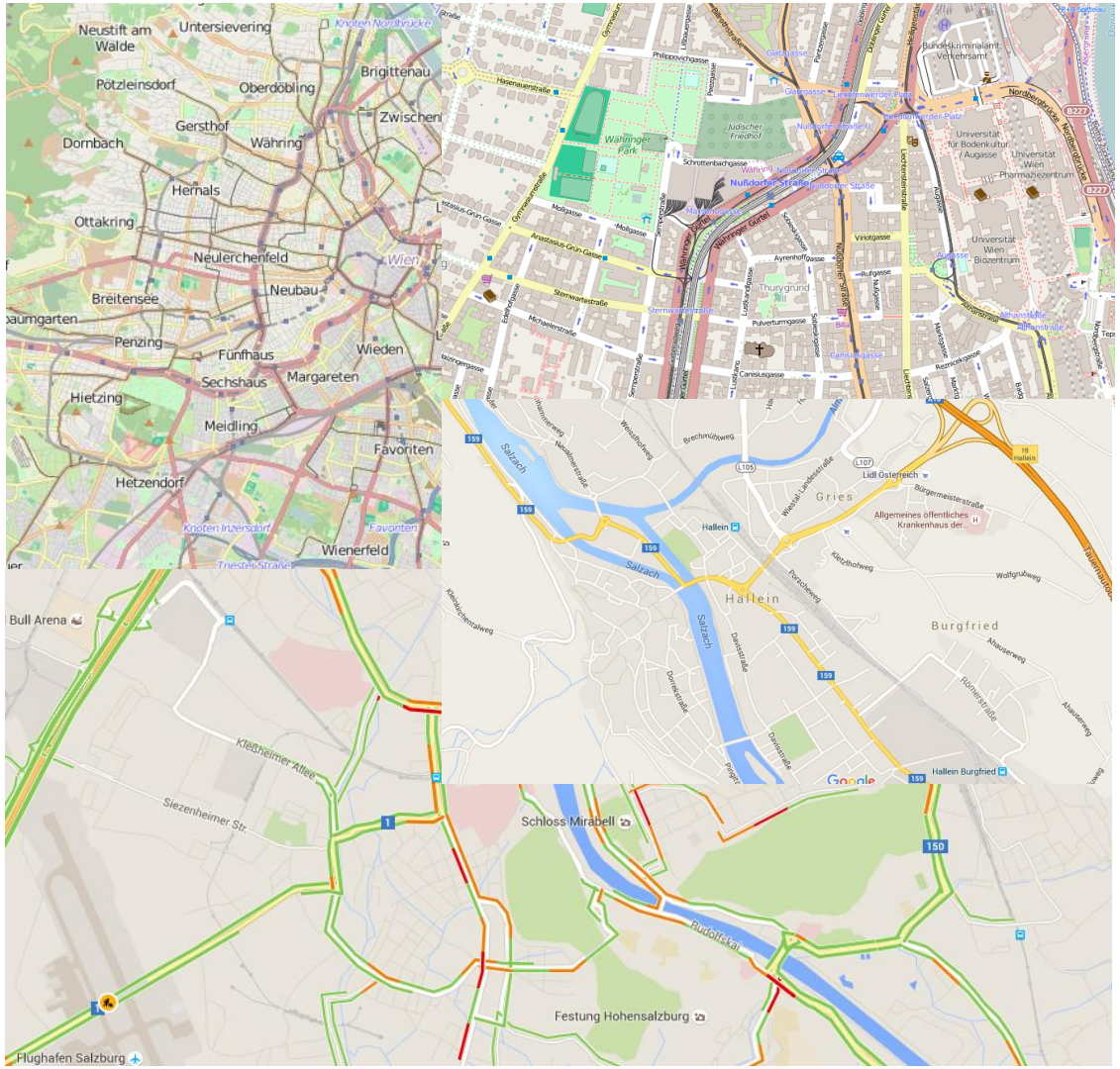
Example Hierarchy Level Vehicle Control



Training „Traffic Brain“ for all kind of (Inter)Sections



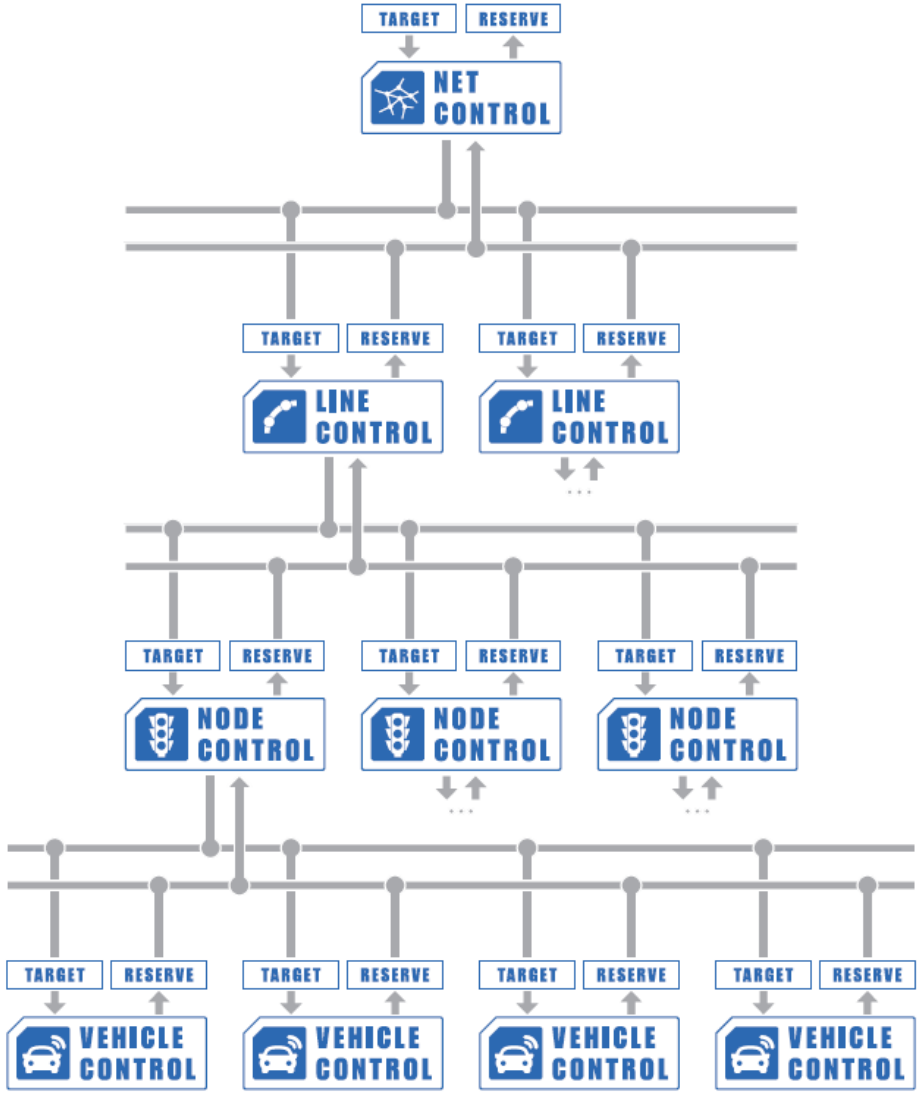
	Number Junctions	Percentage
Junction 4.1	677	25.9585889571
Junction 4.2	180	6.9018404908
Junction 4.3	250	9.58588957055
Junction 4.4	165	6.32668711656
Junction 4.5	111	4.25613496933
Junction 4 Others	210	8.05214723926
Junction 3.1	583	22.3542944785
Junction 3.2	133	5.09969325153
Junction 3.3	50	1.91717791411
Junction 3.4	138	5.29141104294
Junction 3 Others	111	4.25613496933
Total	2608	100.0%



Conclusion & Outlook

- Traffic control cannot be a bypassed in the wake of upcoming V2X-communication and automated driving
- Rather traffic control has to be refactored and automated to take advantage of the new possibilities
- Introduction of VERONET as a general control framework and architecture for distributed traffic control including V2X-communication and automated driving
- Development of the necessary new control algorithms is in work (for network control) and partially already available (for node and line control)
- Extension to vehicle control and development for optimal and robust cooperative control strategies is in work

Embedded into an Integral Architecture



Thank you for your attention!

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