Network Transmission Model
A dynamic traffic model at network level

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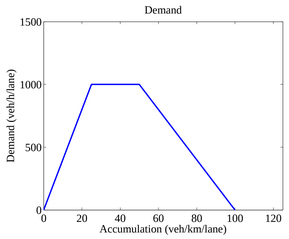
Abstract

New IT techniques allow communication and coordination between traffic measures. To best use this, one needs to coordinate over longer distances. Optimization of the measures is not possible using traditional microscopic or macroscopic simulation models.

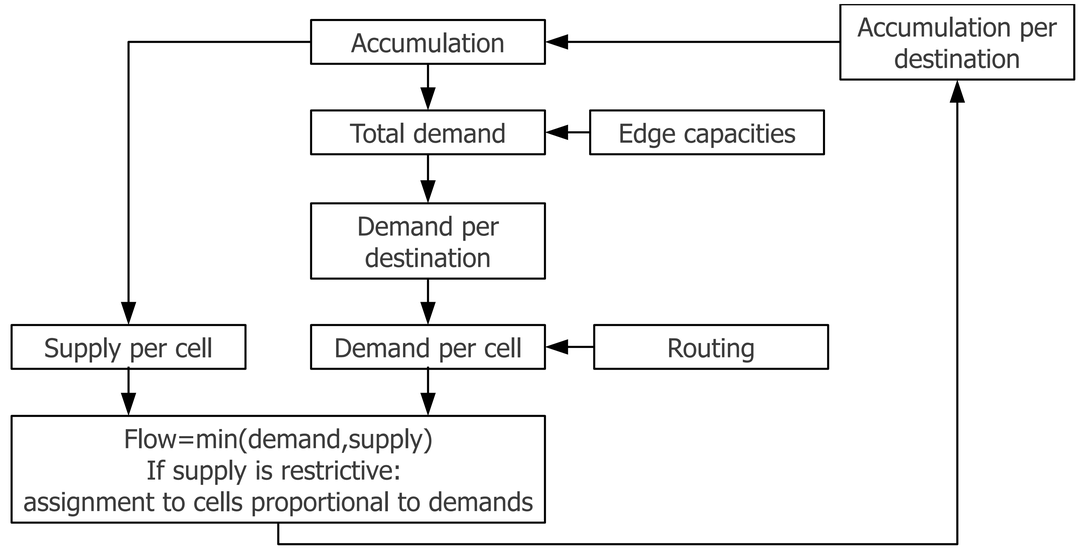
The Network Fundamental Diagram (NFD) describes the relation between flow and density on a network level. This paper introduces a traffic model which uses this relationship, representing traffic and traffic dynamics at a high spatial scale. The model shown to work on an example network. The model can be used to predict the effect of routing information or perimeter control.

Supply & demand

- Supply and demand are based on the NFD.
- **Demand is the same as the NFD for all densities.** This is contrary to the cell transmission model where demand stays high for overcritical situations. However, in networks gridlocks can occur.
- Supply is, similar to the cell transmission model, at capacity at under critical accumulation and follows the NFD for higher accumulations. Supply reduction is essential for blocking back



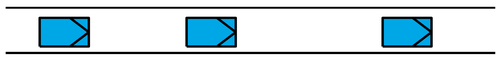
Simulation



Background

Introduction

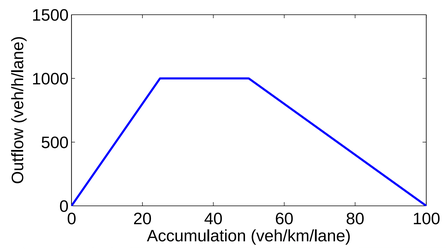
- Modern IT techniques allow for coordination of traffic management measures.
- Larger areas need a longer time horizon for the traffic optimization
- Microscopic and macroscopic simulation programs are too slow for large area and long simulation times

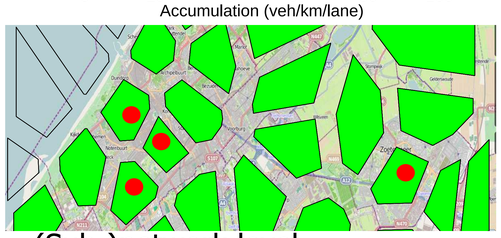


Vehicle level

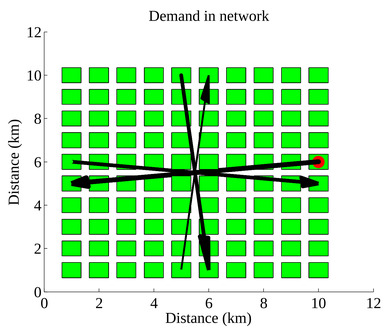
Link level

The **Network fundamental diagram** describes the relationship between accumulation (average density) and the (unrestricted) outflow out of the network





(Sub-)network level



- 20x20 square areas
- 1x1 km each
- Cross demands

Results

- Gridlocks prevented
- Considerable decrease of delay

Case study

Control measures

- Dynamic route guidance
  - based on speeds in areas
  - variable update times
- Gating
  - limit inflow such that accumulation stays under critical accumulation
  - Vary the traffic areas where gating is applied

Next steps

- Calibrate for a real world network
- Implement in a model predictive control framework

Conclusions

We propose a model that describes the traffic dynamics on a network level scale. The base elements are the subnetworks, and the flows from one subnetwork to another are calculated using the proposed scheme. The model accounts for blocking back from downstream as well as internal gridlocks within a cell.

A case study showed how the model can be for traffic control (gating and routing). We used feedback controllers to optimize the traffic stream, but given the limited computation steps the model can also be used in a model predictive control framework.

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Project: there is plenty of room in the other lane

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