

Model development

ADVIESBUREAU
Verkeer en Vervoer

4 *cast*

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4 oktober 2010

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1. Model development;
2. LMS/NRM 2004 Basematrix estimation;
3. LMS/NRM 2004 Assignment: QBLOK:
4. Questions?

Broadly two categories:

- 1. Building models using existing model specifications and existing software;**
- 2. Building models translating the estimated model specifications & definitions into software, building the necessary tools around it and creating a complete and stable model system**

“ the first one is more straight forward than the second one”

What ever model you are building, a lot of data is needed:

“Not only for the base year of the model but for each year you want to forecast with this model”

A quick overview(1):

- **Zoning system;**
- **Geographical networks for car, freight per period of the day;**
- **Geographical networks for slow model;**
- **Geographical networks public transport (PT), per PT mode;**
- **Network attributes: distance, link type, speed, number of lanes, capacity etc;**

Time tables for the public transport;

A quick overview (2):

- Socio-economic variables per zone e.g. number of persons split by sex and age, number of jobs per sector, income distribution, number of students etc, car ownership etc;
- Parking cost per zone & the variable costs per kilometre for car;
- Public transport fares;
- Congestion levels;
- Traffic counts per time-of-day, per direction, split into car and freight (base year);
- Ticket sales, counts for the public transport, split by mode (base year);
- Roadside interviews (base year);
- Per zone, the number of inbound or outbound trips per purpose and mode.

Some characteristics:

- **LMS: 1538 zones, 77000 links, 38000 nodes;**
- **NRM WEST: 3600 zones, 130 000 links, 60000 nodes;**
- **Update LMS/NRM started in 2006, finished in 2010.**



- Complex large scale models need a lot of detailed data;
- There is clear trade-off between the desired detail inside these models and the available data:

“It makes no sense designing a model system which uses detailed information available for the base year, but is not available for future years “

“Assumptions are needed and may result in forecasts of less quality”

“More detail in data often relates to less quality”

How does a model developer look like?



Contents

- Introduction
- Problems
- Where do we get our a-priori matrix from?
- What other data do we need?
- Which software do we need?
- Why using an assignment and what are the consequences?
- Basematrices: some fairy tales.

Introduction

The essence of the LMS/NRM is the “pivot point” technique:

- Future situations are determined on the basis of relative changes to the base year situation;
- Relative changes are translated into “growth factors”;
- Growth factors combined with the basematrices → future matrices;

..... thus:

The basismatrices are the Achilles' heel of the LMS/NRM;

Basematrices with poor quality →

Generates poor predictions!!

Attention for the process of estimating basematrices and monitoring the quality is essential and a must!

Problems

- **An origin-destination (OD) matrix cannot directly be observed:**
 - *day-to day variations;*
 - *The National travel survey sample is too small for getting OD-flows;*
 - *Road site interviews are expensive and cover only a part of one day and one direction;*
 - *A large amount of count information is available but doesn't contain OD information*
- **Strong underspecified estimation problem;**
- **Apriori matrices are needed to solve the estimation problem**

Where do we get our a-priori matrices from?

- The growth factors in the LMS/NRM are derived on the basis of the synthetic OD trips for the base and future year, calculated by the mode-destinations models of the LMS/NRM;
- It is vital that the structure of the synthetic OD-matrices for the base year and the base matrices are consistent.
- A small example.....

.....

consistent

synthetisch Basisjaar

	1	2	
1	10	100	110
2	50	25	75
	60	125	185

synthetisch Toekomstjaar

	1	2	
1	20	150	170
2	75	25	100
	95	175	270

synthetische groei

	1	2	
1	2.00	1.50	1.55
2	1.50	1.00	1.33
	1.58	1.40	1.46

basismatrix

	1	2	
1	100	1000	1100
2	500	250	750
	600	1250	1850

Prognose: synthetische groei x basismatrix

	1	2	
1	200	1500	1700
2	750	250	1000
	950	1750	2700

Gerealiseerde groei: prognose/basismatrix

	1	2	
1	2.00	1.50	1.55
2	1.50	1.00	1.33
	1.58	1.40	1.46

not consistent

basismatrix

	1	2	
1	50	30	80
2	150	10	160
	200	40	240

Prognose: synthetische groei x basismatrix

	1	2	
1	100	45	145
2	225	10	235
	325	55	380

Gerealiseerde groei: prognose/basismatrix

	1	2	
1	2.00	1.50	1.81
2	1.50	1.00	1.47
	1.63	1.38	1.58

.....thus

- When the structure is not consistent, the final growth in the future matrices is different from the predicted growth;
- The difference gets larger when the structure gets more inconsistent;

Therefore for the a-priori matrices the synthetic OD-matrices of the model system are being used.

What other data to we need?

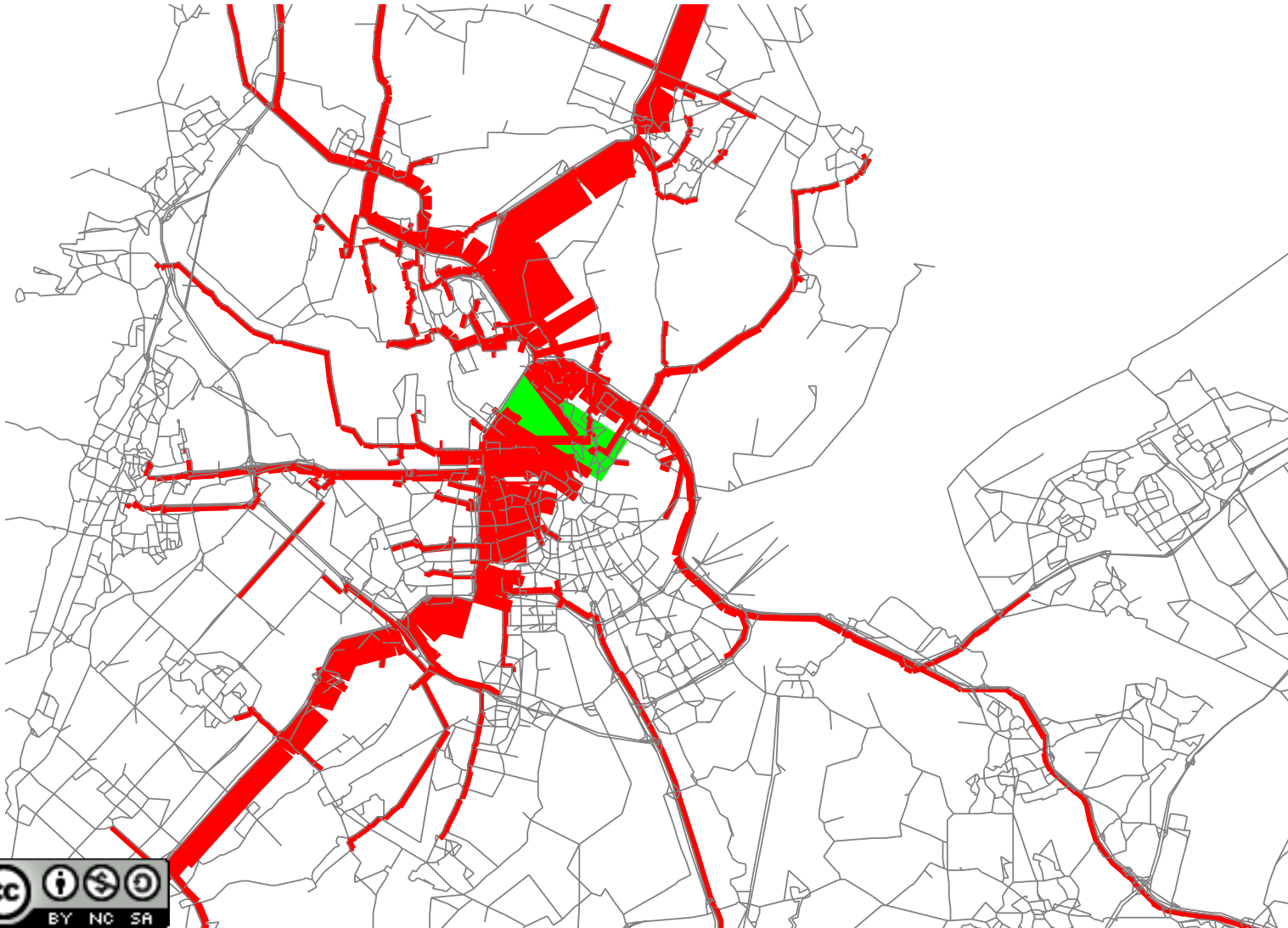
- National travel survey (estimation of production and attraction models, triplength distributions, per travel purpose and total);
- Road site interviews (as a target or for quality checks);
- Special information for the harbors and airports;
- Counts (potential travel demand) per time-of-day, separate for car and freight;
- Networks;
- Socio-economic data;
- Other empirical information that can be of use.

What software do we need?

- **Statistical software (e.g. SPSS);**
- **Transportation planning package (e.g. CUBE/Voyager);**
- **Assignment procedure (QBLOK);**
- **Matrix estimation program (AVVMat);**
- **Special purpose software;**
- **Etc.**

Why do we need an assignment technique?

- The assignment links the OD-flows with the information from traffic counts (‘footprint’);
- During assignment the software keeps track of all the OD-pairs and their proportion that pass a certain count location (selected link procedure);
- The type assignment has a large influence : the proportion with an all-or-nothing technique is 0% or 100%, for a capacity restraint technique 0-100%;
- In the LMS/NRM the capacity restraint technique QBLOK is used.

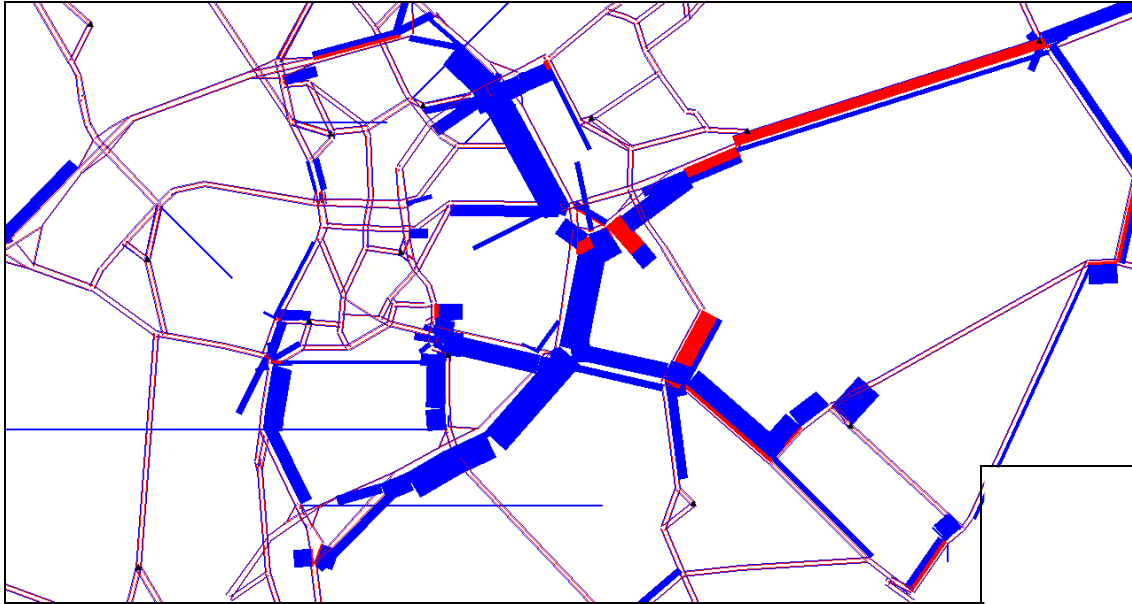


What are the consequences?

- Using a capacity restraint technique implicates that the base matrices need to be estimated in an iterative process:

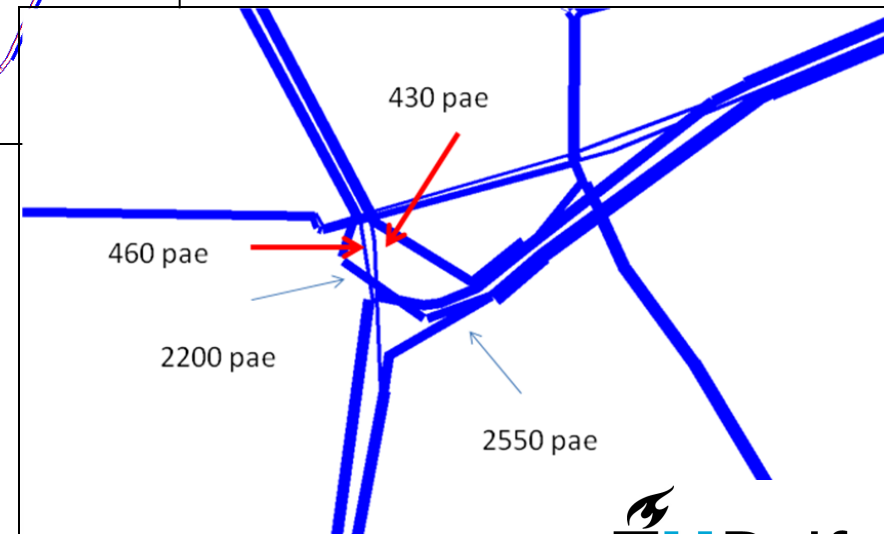
You start with a-priori matrices and the associated routes. After estimation the amount of trips changes and as a result the congestion levels change. When the congestion level changes, the routes change and a new ‘footprint’ is needed.

- The base matrices are strongly linked to the assignment technique.
- Errors in the route-choice (and locations of counts) can have a large effect on the structure of the matrix



← Congestion

Calibration result →



Base matrices a few fairy tails:

- The 24 hour basismatrix is fully symmetric;
- Basematrices are fully observed;
- There exists only one unique basematrix
- Basismatrices can be estimated in a short period

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- The basismatrices are of good quality when they replicate the traffic counts;
- The more empirical information available the better the quality.
- Basismatrices can transferred easily to other model systems

Contents

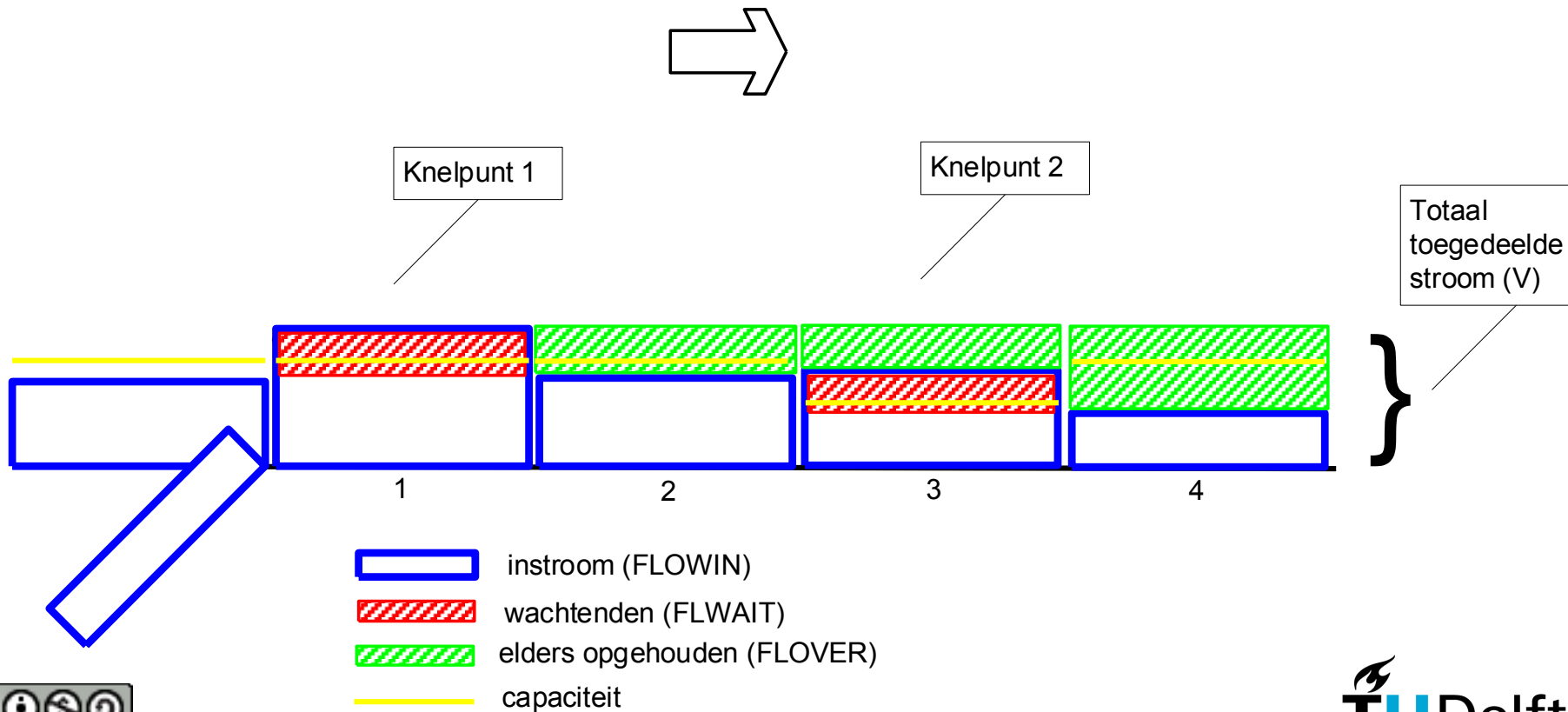
- General characteristics
- Potential demand: “tone methodology”
- Validation
- Focus points

General characteristics:

- **Capacity restraint Multi-userclass assignment technique:**
On the basis of the link capacity, the travel demand and assumptions about the route choice behaviour, traffic is spread over the network.
- **Equilibrium on the base of WARDROP-principle:**
all non used routes are longer than all used routes
- **Quasi-dynamic calculation of the link times: restrictions to the inflow and outflow**

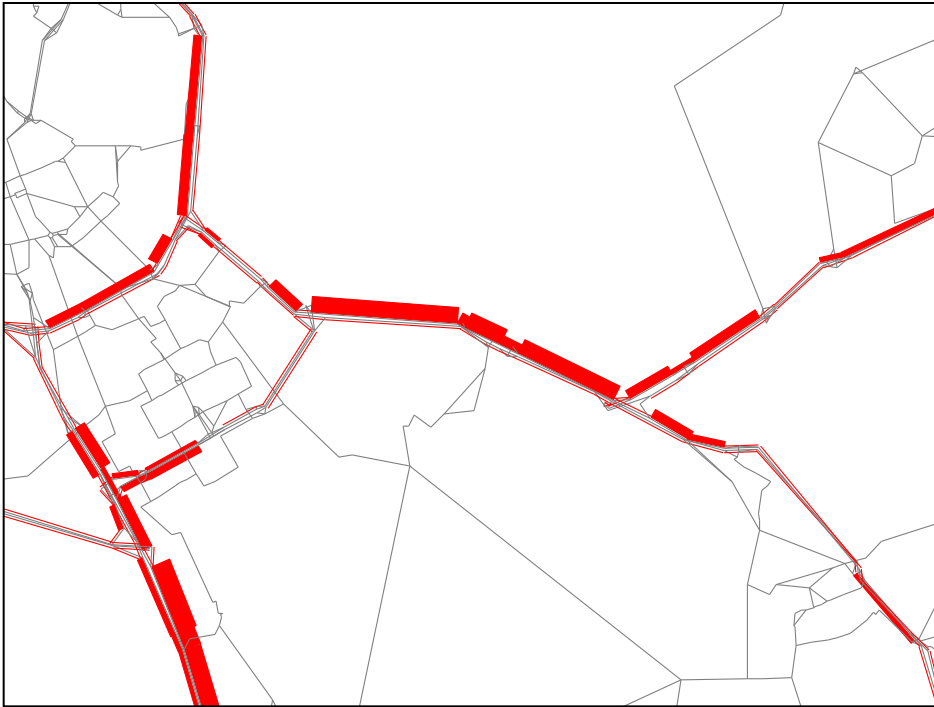
- **Iterative procedure: combination of all-or-nothing assignments based on update travel times.**
 1. AON assignment based on free flow speed
 2. Calculate the congested travel time
 3. Perform a new AON assignment using the calculated congested travel times
 4. Combine the link loads from step 1 and step link loads
 5. Calculate the new congested travel times, etc.
- **Step 4 Mixing the link loads**
 - Optimal mixfactor based on the optimization of an objection function (minimal total travel time) (disadvantage computation time in complex networks)
 - Fixed mixfactors: Volume averaging, all AON assignments have the

- Inflow restriction: no double counting of flows during the calculation of congestion and travel times



- **Outflow restriction: blocking back**

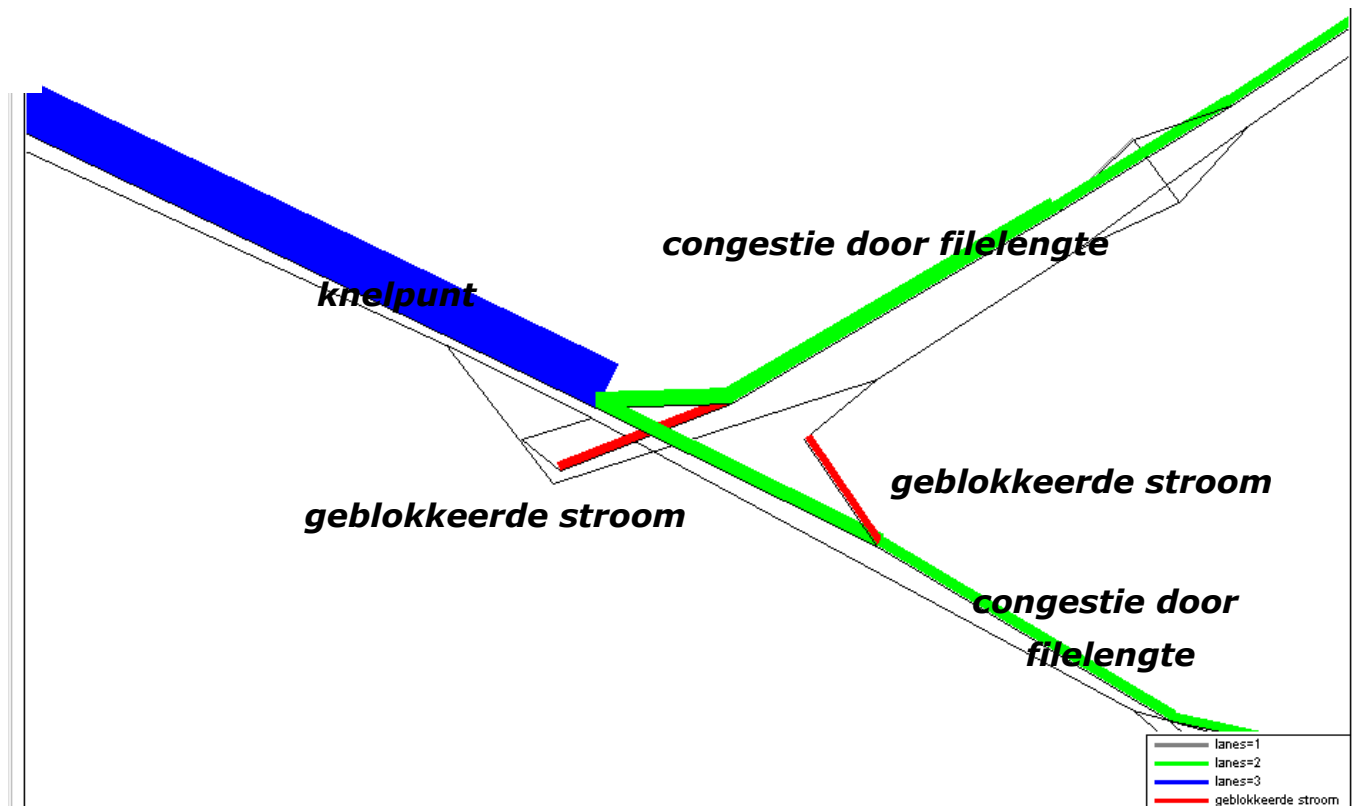
Without blocking back



With blocking back

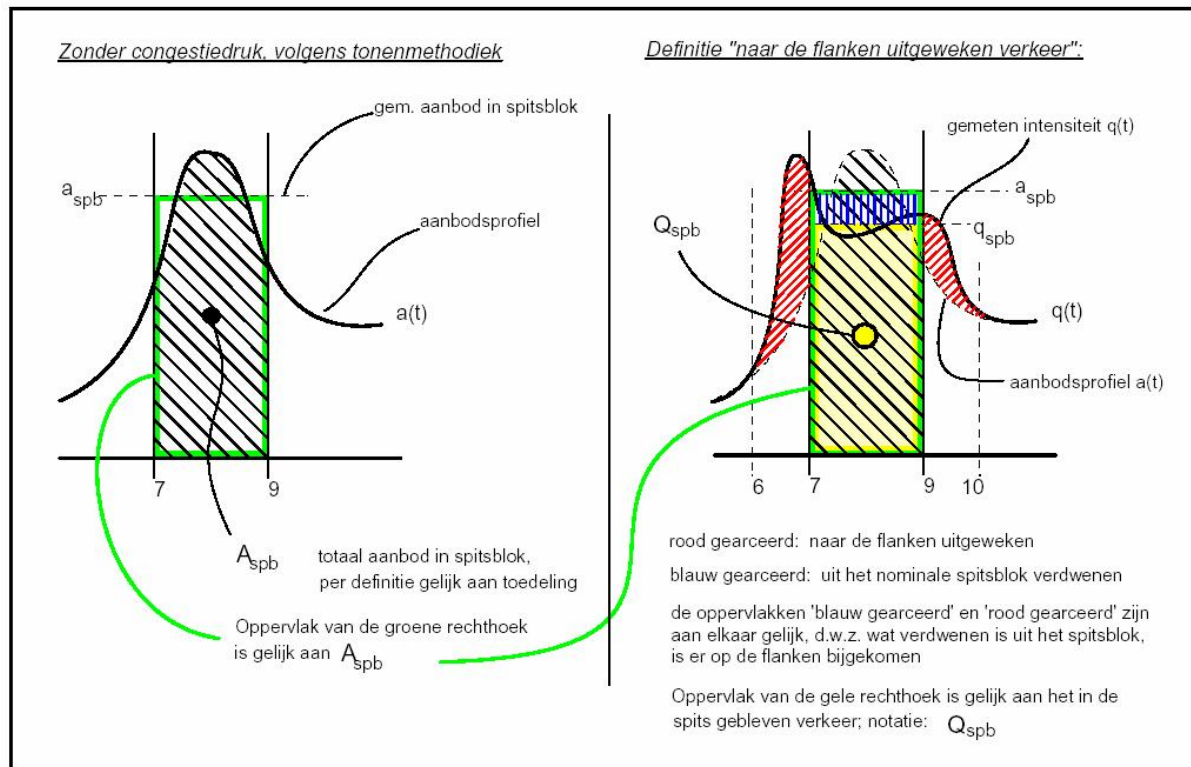


- Congestion modelling: blockades

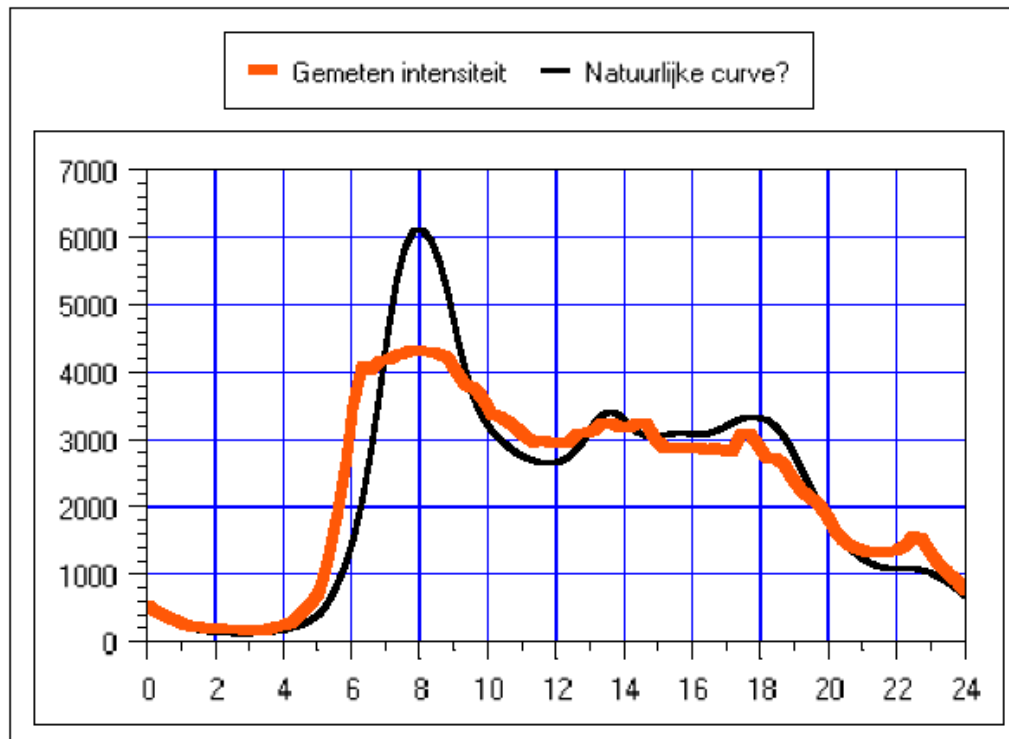


Travel demand

The assignment matrices contain the travel demand according to the so-called Tone methodology (*Transpute*)



- The tone methodology gives you the potential demand that wants to travel within the two-hour peak periods;
- This can be more than the traffic counts for the two hour peak periods;

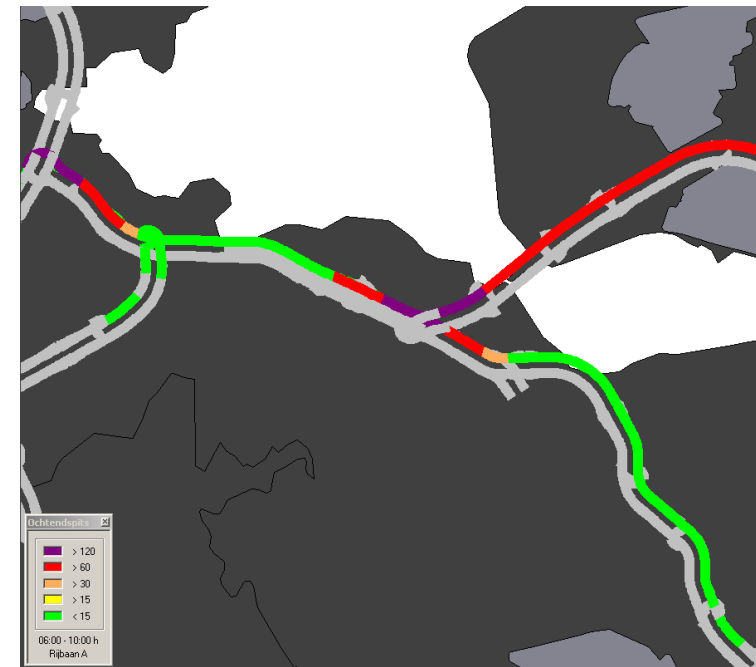


The A2

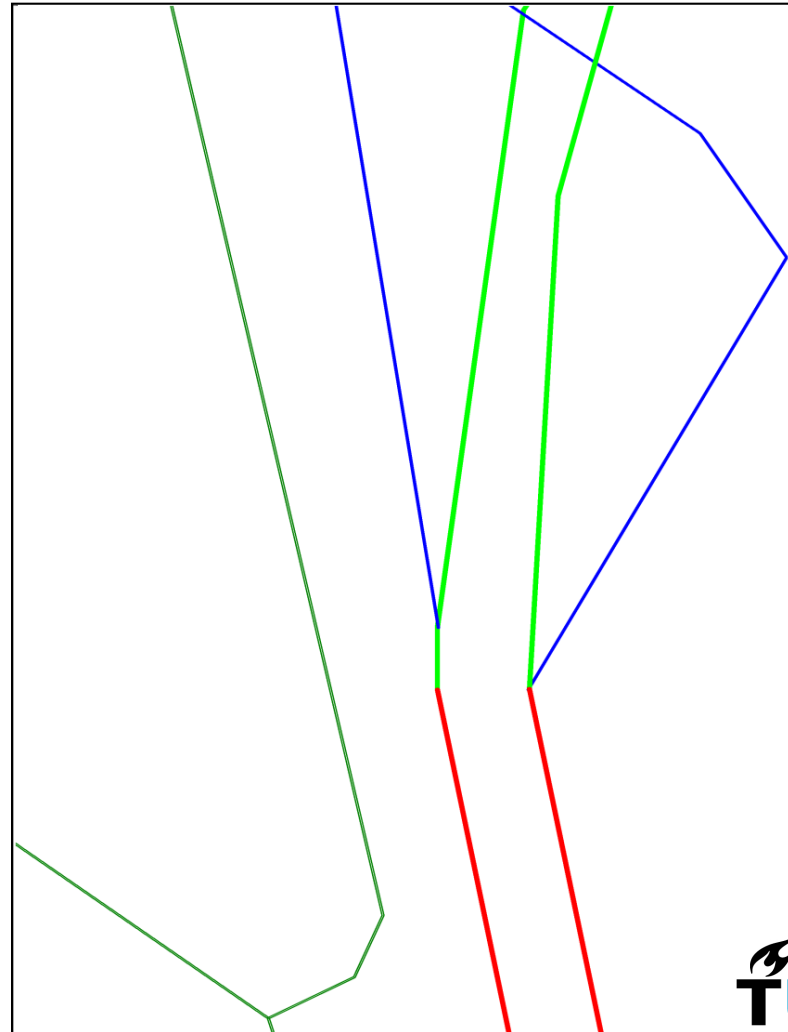
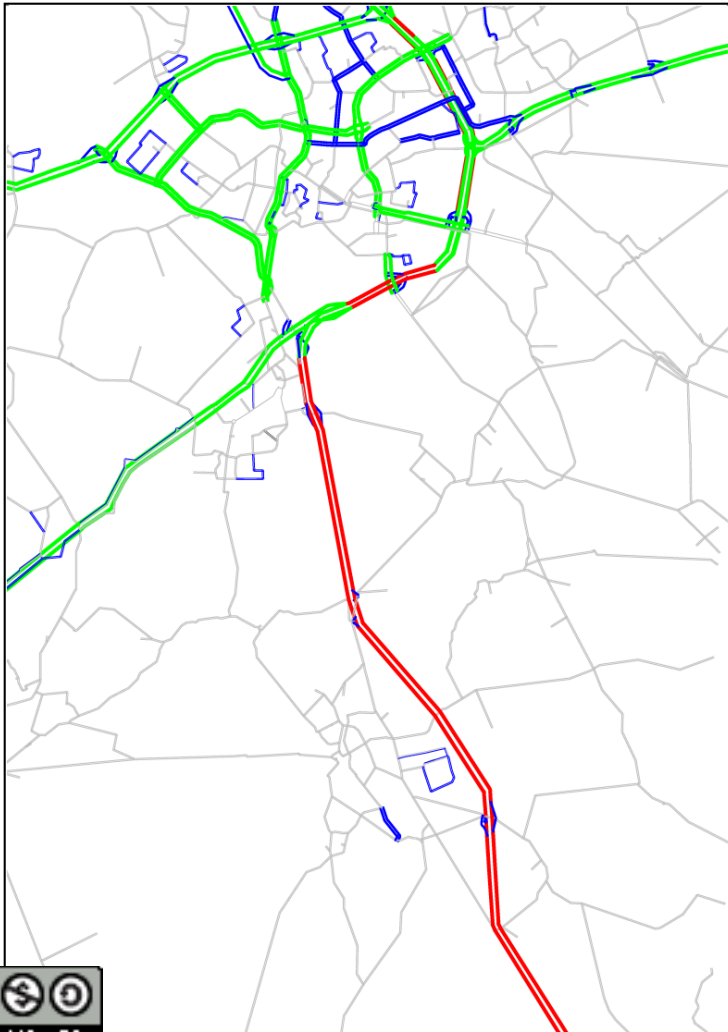
- The basematrices need to be calibrated not on two hour traffic counts but on the (artificial) potential demand;

Validation

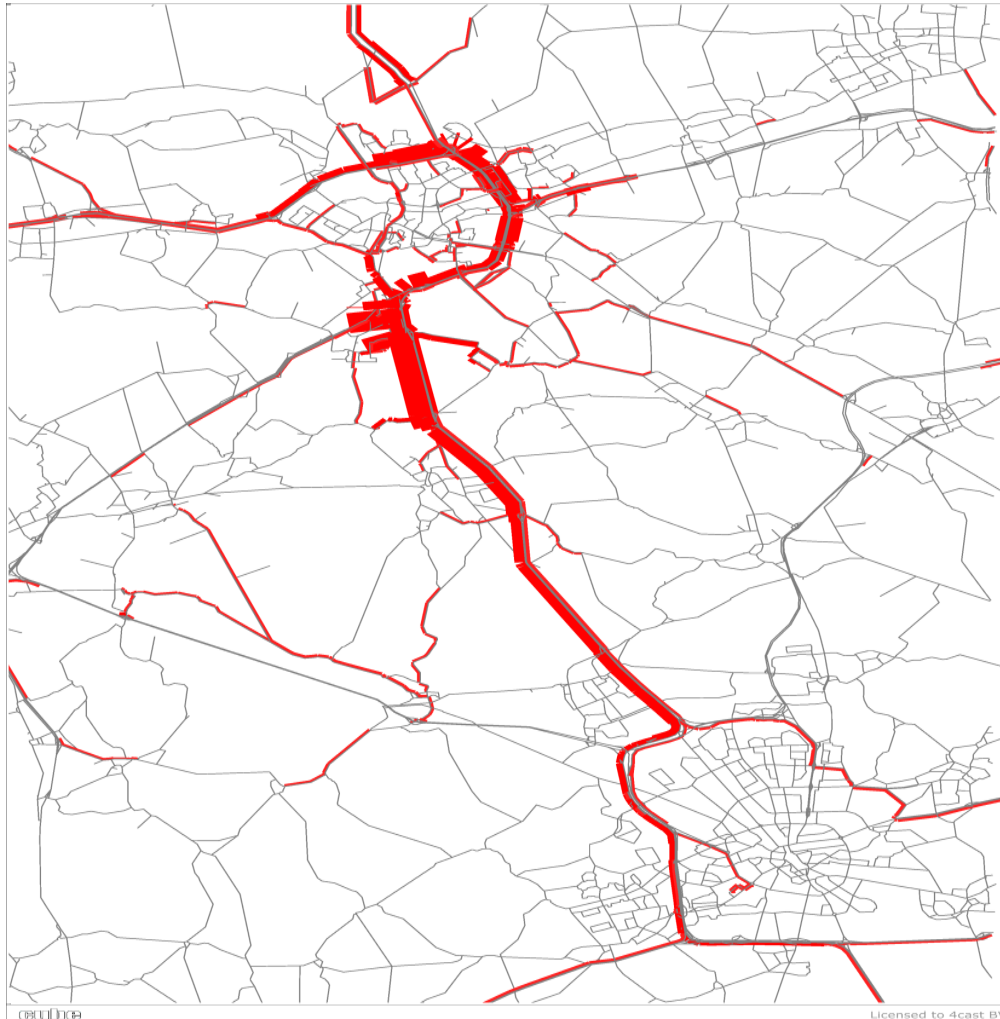
- Qblok is validated against the Flowsimulator (Transpute)



- QBLOK requires high quality for its input
- Traffic must be able to get from the zone onto the network
- Shape points in the network have an effect on the assignment
- Errors in the network or assignment matrices can corrupt the blockade mechanism inside QBLOK



Consequences: effect on traffic flows



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