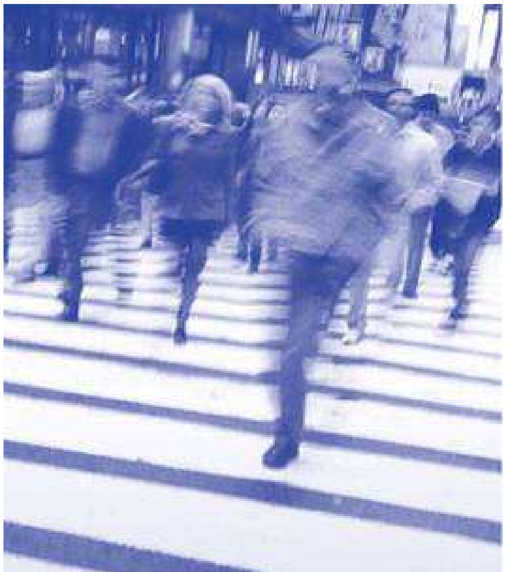

CIVITAS
Cleaner and better transport in cities

AALBORG

Aalborg

T.70.1 Congestion Monitoring and Counteracting using Telematics

City of Aalborg
February 2011.

THE CIVITAS INITIATIVE
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1. Introduction

1.1 Background CIVITAS

CIVITAS - cleaner and better transport in cities - stands for CIty-VITAlity-Sustainability. With the CIVITAS Initiative, the EC aims to generate a decisive breakthrough by supporting and evaluating the implementation of ambitious integrated sustainable urban transport strategies that should make a real difference for the welfare of the European citizen.

CIVITAS I started in early 2002 (within the 5th Framework Research Programme);
CIVITAS II started in early 2005 (within the 6th Framework Research Programme) and
CIVITAS PLUS started in late 2008 (within the 7th Framework Research Programme).

The objective of CIVITAS-Plus is to test and increase the understanding of the frameworks, processes and packaging required to successfully introduce bold, integrated and innovative strategies for clean and sustainable urban transport that address concerns related to energy-efficiency, transport policy and road safety, alternative fuels and the environment.

Within CIVITAS I (2002-2006) there were 19 cities clustered in 4 demonstration projects, within CIVITAS II (2005-2009) 17 cities in 4 demonstration projects, whilst within CIVITAS PLUS (2008-2012) 25 cities in 5 demonstration projects are taking part. These demonstration cities all over Europe are funded by the European Commission.

Objectives:

to promote and implement sustainable, clean and (energy) efficient urban transport measures
to implement integrated packages of technology and policy measures in the field of energy and transport in 8 categories of measures
to build up critical mass and markets for innovation

Horizontal projects support the CIVITAS demonstration projects & cities by :

Cross-site evaluation and Europe wide dissemination in co-operation with the demonstration projects
The organisation of the annual meeting of CIVITAS Forum members
Providing the Secretariat for the Political Advisory Committee (PAC)
Development of policy recommendations for a long-term multiplier effect of CIVITAS

Key elements of CIVITAS

CIVITAS is co-ordinated by cities: it is a programme “of cities for cities”
Cities are in the heart of local public private partnerships
Political commitment is a basic requirement
Cities are living ‘Laboratories' for learning and evaluating

1.2 Background ARCHIMEDES

ARCHIMEDES is an integrating project, bringing together 6 European cities to address problems and opportunities for creating environmentally sustainable, safe and energy efficient transport systems in medium sized urban areas.

The objective of ARCHIMEDES is to introduce innovative, integrated and ambitious strategies for clean, energy-efficient, sustainable urban transport to achieve significant impacts in the policy fields of energy, transport, and environmental sustainability. An ambitious blend of policy tools and measures will increase energy-efficiency in transport, provide safer and more convenient travel for all, using a higher share of clean engine technology and fuels, resulting in an enhanced urban environment (including reduced noise and air pollution). Visible and measurable impacts will result from significantly sized measures in specific innovation areas. Demonstrations of innovative transport technologies, policy measures and partnership working, combined with targeted research, will verify the best frameworks, processes and packaging required to successfully transfer the strategies to other cities.

1.3 Participant Cities

The ARCHIMEDES project focuses on activities in specific innovation areas of each city, known as the ARCHIMEDES corridor or zone (depending on shape and geography). These innovation areas extend to the peri-urban fringe and the administrative boundaries of regional authorities and neighbouring administrations.

The two Learning cities, to which experience and best-practice will be transferred, are Monza (Italy) and Ústí nad Labem (Czech Republic). The strategy for the project is to ensure that the tools and measures developed have the widest application throughout Europe, tested via the Learning Cities' activities and interaction with the Lead City partners.

1.3.1 Leading City Innovation Areas

- The four Leading cities in the ARCHIMEDES project are:
- Aalborg (Denmark);
- Brighton & Hove (UK);
- Donostia-San Sebastián (Spain); and
- Iasi (Romania).

Together the Lead Cities in ARCHIMEDES cover different geographic parts of Europe. They have the full support of the relevant political representatives for the project, and are well able to implement the innovative range of demonstration activities.

The Lead Cities are joined in their local projects by a small number of key partners that show a high level of commitment to the project objectives of energy-efficient urban transportation. In all cases the public transport company features as a partner in the proposed project.

2. Aalborg

The City of Aalborg, with extensive experience of European cooperation and having previously participated in CIVITAS I (VIVALDI) as a 'follower' city, is coordinating the consortium and ensures high quality management of the project. The City has the regional public transport authority (NT) as a local partner, and framework agreements with various stakeholder organisations.

Aalborg operates in a corridor implementing eight different categories of measures ranging from changing fuels in vehicles to promoting and marketing the use of soft measures. The city of Aalborg has successfully developed similar tools and measures through various initiatives, like the CIVITAS-VIVALDI and MIDAS projects. In ARCHIMEDES, Aalborg aims to build on this work, tackling innovative subjects and combining with what has been learned from other cities in Europe. The result is an increased understanding and experience, in order to then share with other Leading cities and Learning cities.

Aalborg has recently expanded its size by the inclusion of neighbouring municipalities outside the peri-urban fringe. The Municipality of Aalborg has a population of some 194,149, and the urban area a population of some 121,540. The ARCHIMEDES corridor runs from the city centre to the eastern urban areas of the municipality and forms an ideal trial area for demonstrating how to deal with traffic and mobility issues in inner urban areas and outskirts of the municipality. University faculties are situated at 3 sites in the corridor (including the main university site). The area covers about 53 square kilometres, which is approximately 5 % of the total area of the municipality of Aalborg. The innovation corridor includes different aspects of transport in the urban environment, including schools, public transport, commuting, goods distribution and traffic safety. The implementation of measures and tools fit into the framework of the urban transport Plan adopted by the Municipality.

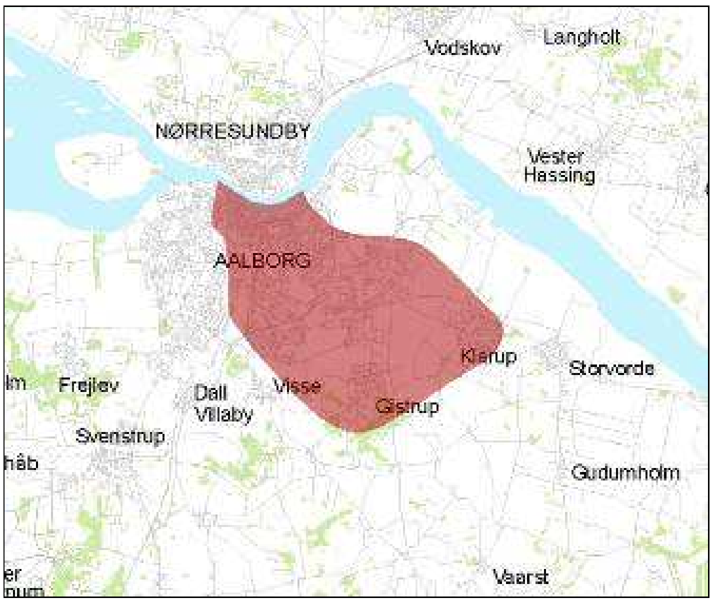


Figure 1 The Archimedes corridor in Aalborg

3. Background to the Deliverable

In Aalborg, as in most other cities of the same size, congestion is an increasing problem. The situation in Aalborg is particularly difficult as the Limfjord divides the city into two parts, connected only by a bridge in the city centre and a highway tunnel in the periphery of the city. Over a distance of 65 km, these are the only two road connections across the fjord.

These two road connections across the fjord are intensively used for local traffic inside the municipality of Aalborg, and for regional traffic, where most traffic to and from Vendsyssel, an area at some 3.400 km^2, have to pass. At the same time, the international traffic (to Sweden and Norway) including many HGVs, goes through the tunnel connection. This makes the two connections a 'bottleneck'.

The traffic flow is normally acceptable outside peak hours, but there are rising congestion problems in peak hours, and the size of peak hour is growing. At the same time, the number of roads influenced by congestion is rising and congestion is not limited to the major roads but spreads out to other roads in the city.

If only a small amount of the traffic could be moved to less congested times or roads, major infrastructure investments could be avoided or postponed, travellers' time comprising a substantial socio-economic value could be saved and the negative impact on environment and fuel consumption from cars idling in queues could be reduced.

To address these consequences of rising congestion, the City of Alborg decided to follow three parallel approaches.

1. A proportionate amount of resources has to be spent on developing the infrastructure on the right time and at the right location. To achieve the required overview of the situation to make the appropriate allocation and prioritisation of resources, a congestion monitoring system is needed. In addition, this system needs to be able to show the variations in congestion over the day and year, and the long-term trends from year to year.

2. The travel behaviour of road users has to be influenced to move traffic away from peak hour and most congested roads. This has to be achieved by using historical data from the congestion monitoring system to inform the road users on expected travel speed on different times and routes. This Information should be given both before and during travel.

3. The traffic flow on the roads has to be optimised based on present traffic load on the road network. This can be achieved by letting an adaptive signal control system manage the prioritisation in the most important intersections.

The implementation of this task 8.3 has been based on the output from task 11.8., R70.1 "Study of next generation navigation system".

3.1 Summary Description of Task

The purpose of this task is to limit congestion problems by following the three approaches outlined above and put into practice by:

1. Collecting information on accessibility from road users and use these data
    a. for planning purposes – arguing for resources and allocating the resources to the roads most needing resources. and
    b. to influence road users' choice of travel time and travel route, by making expected travel times available for them via GIS congestion map and in-car navigation units.
2. Implementing an intelligent intersection controlling system to demonstrate impact of adaptive signal controlling on the main ring route.

1) Data on accessibility - and thereby congestion level – for all roads in the Aalborg area, collected by navigational units in cars, have been acquired. Data is collected by a great number of private cars equipped with navigation units. To supplement data collection, 100 navigational units were purchased and distributed to local taxis. The amount of data is sufficient for doing analyses at road segment level, divided into seasons and time of day.

1a) A congestion monitoring system has been developed, based on these data. The monitoring system is handling speed data on individual road segments for 5 minutes intervals for each day-type. The monitoring system can be used for user specific planning analyse purposes.

1b) Finalised analyses for the major road network on speed levels and congestion factors insides and outsides the two peak hours and for the 4 seasons have been carried out on the same data, and have been made accessible for road users on the Internet in the form of KML files on Google Maps.

Every three months new speed profiles are downloaded to the car' navigation units, thereby helping the driver to avoid congested times or routes. These speed profiles are refined each quarter based on driving times collected from the cars previous quarter.

2) On a part of the main ring route in Aalborg a new adaptive signal control system, a SPOT system has been implemented. The system controls the red and green lights according to traffic flow in adjacent intersections. The main ring route has been chosen as the demonstration area because the reconstruction of the harbour front is causing a shift of traffic from this area to the main ring route.

4. Congestion Monitoring and Counteracting using Telematics in Aalborg

4.1 Description of work done

4.1.1 Planning

Data based Congestion monitoring and information

When this task was first described in the proposal to EU, no organised car-based collection of congestion data was ongoing, and the only technical possibility seemed to be to develop and install a dedicated data collection unit in a small number of cars. Such a setup, for economical reasons only using data from 10 cars, was described in the technical workplan of this measure. The possibility to use existing data from 400 taxis as a supplement was taken into consideration.

At the time of implementation the technical possibilities had changed. Research showed that a manufacturer of car navigation units, TomTom, had implemented data collection in their navigation units. The TomTom units in all cars collect the information about driven speed on all road segments together with date and time for all trips, regardless of whether the unit is used or not – unless the user refuses during installation. When connected to a PC this information is uploaded to TomTom. Consequently, TomTom has more than 3,000,000,000,000 speed measurements.

For the Aalborg area, this means that any congestion analyses can be carried out on even the smallest road segment with much better precision, than if we did our own data collection.

At the same time, analyses of the existing taxi data showed that the resolution was only one observation per three minutes. This was shown to be too infrequent to satisfy the increasing ambitions for congestion analyses.

Consequently, it was decided to try to persuade TomTom to join some kind of cooperation, giving the City of Aalborg access to the congestion data. After some negotiations, it was agreed that the City of Aalborg could buy these data, on the terms that the data could not reach the company's competitors. The city of Aalborg was the first public body outside the Netherlands, to utilize the TomTom data for traffic planning and information.

The quality of the data is far beyond everything foreseen in the ARCHIMEDES contract, and so are the possibilities for using the data. The expenses for this solution though, are also higher than budgeted in the project. It was decided to buy these data and let the City of Alborg themselves pay the extra costs that were not foreseen in the ARCHIMEDES budget.

It was also decided to buy 100 navigation units from TomTom to be installed in 100 local taxis driving in the Aalborg area to further accelerate the data accumulation.

As a result of exchanging 10 dedicated units for 100 standard navigation units, the way the drivers' behaviour was influenced before and during driving had to be rethought.

Instead of giving information back into 10 dedicated units during driving, it was decided to use the standard navigation units. With the chosen approach, it is possible to update speed profiles in all the navigation units with more accurate driving times every time the maps are updated. This includes the units in the 100 taxis. Each quarter they deliver new data to TomTom, and in the same process, they receive mere precise speed profiles, based on data, from their own cars and from all other users of TomTom units, from the previous quarter. In this way they are improving their own route guidance each time they deliver data, and this is the motivation for a positive cooperation from the taxi drivers.

The 'before trip' information is implemented via the internet, as planned on the time of preparing the original measure description. But instead of presenting static pictures, where different colours represented different speed levels on the roads, an interactive Google Maps solution has been developed. On the map you can choose to see congestion level or speed level, you can choose between the two peak hours, and between the four seasons of the year.

Adaptive Signal Controlling System

Implementing the SPOT system is a task more or less independent from the data tasks, as this element involves controlling behaviour by intelligently controlling traffic light.

The original task description was based on a demonstration project with an adaptive signal controlling system on the main ring route. The main ring route was chosen as the demonstration area because, as a consequence of the renewing of the Harbour front - of which measure 42 'Provision for soft modes' is a part - a lot of traffic shifted from the harbour front to the ring route. So it is an objective for this sub task to test if an adaptive controlling system can handle the increased amount of traffic, avoiding an increase in congestion level, causing traffic queuing and increasing energy consumption.

After the demonstration road stretch had been defined, and the system specified, a contract was signed with two suppliers – one for the system and one for electrical work in the streets.

After the contracts had been signed a project working group with participation from the suppliers and the City of Aalborg has conducted the detailed planning and implementation.

4.1.2 Implementation

4.1.2.1 Data collection

The data on accessibility is collected by the supplier of navigation units, TomTom.

During all trips TomTom units collects data on speed level on all road segments with date and time stamps. This data collection is active on all trips regardless of whether the device is used for route guidance or not. When connected to a PC for map update, free update of road network or other functions, the collected data is uploaded to TomTom – unless this have been rejected during first setup of the device.

Due to the great number of devices, and the strategy of continuous data collection in all situations, the uploaded data sums up to enormous amounts.

Before the City of Aalborg bought the data, TomTom did some analyses to evaluate if there were enough data on the roads in Aalborg to do significant analyses. It was concluded that even on a small data sample only including data for the morning peak hour in the summer season (only defined as 6 weeks) there were enough data to do reliable congestion analyses.

But to accelerate the data collecting even further the City of Aalborg bought 100 navigation units that were installed in 100 local taxis running in the Aalborg area – as a replacement for the supposed 10 dedicated data collecting units. As one taxi runs maybe 6-8 times more a year than an ordinary car, the 100 units accumulates as much data as 600-800 private cars – and on all roads, where a private car typically does most of the mileages on the same road between home and work.

Figure 2 Member of the City Council Arne B Schade (R) hands over the 100 navigation units to Aalborg Taxa.

At TomTom, data is kept in raw data form, but anonymous, for special analysis as origin / destination matrices or accessibility analyses. These data are used for the peak hour analysis that the city of Aalborg is presenting on Google maps on the internet.

Furthermore, the data is aggregated to higher levels for use in the navigation units. These data are used as the foundation for the congestion monitoring system in Aalborg.

4.1.2.2 Setting up a congestion monitoring system

Based on the data from the navigation units, a congestion monitoring system was set up. The system was designed for internal use in the Traffic & Road department, to support the planning processes. An external consultant was hired to develop the monitoring system based on the TomTom data and integrating both numerical analyses and GIS functionality.

Data model

The congestion monitoring system uses aggregated data, as the amount of data is so huge, that it would not be possible to handle all data in the model locally. As the data model is developed at TomTom primarily for use in car navigation units, a great effort is put into simplifying the model and limiting the data size without losing any information. This is achieved by aggregating data for each road segment for each day of the week and in 5 minutes intervals, keeping this information in a relational database.

When generating the database, all speed measurements for one road segment are divided into the 7 days of the week and 5 minutes intervals. With the night-time free flow speed as index 100 and each 5 minutes average as a percentages thereof, a profile for each day for the road segment is calculated. After all profiles have been calculated, the profiles are compared and the necessary numbers of standard profiles are created. So for each day of the week each road segment is related to one of the standard profiles. When knowing the values of each road segment's 7 speed profiles and the road segments' free flow speeds and lengths, it is possible to calculate the speed on the segments, the travel time for the segments and the congestion level – by comparing with free flow speed - for every 5 minutes for a given day of the week.

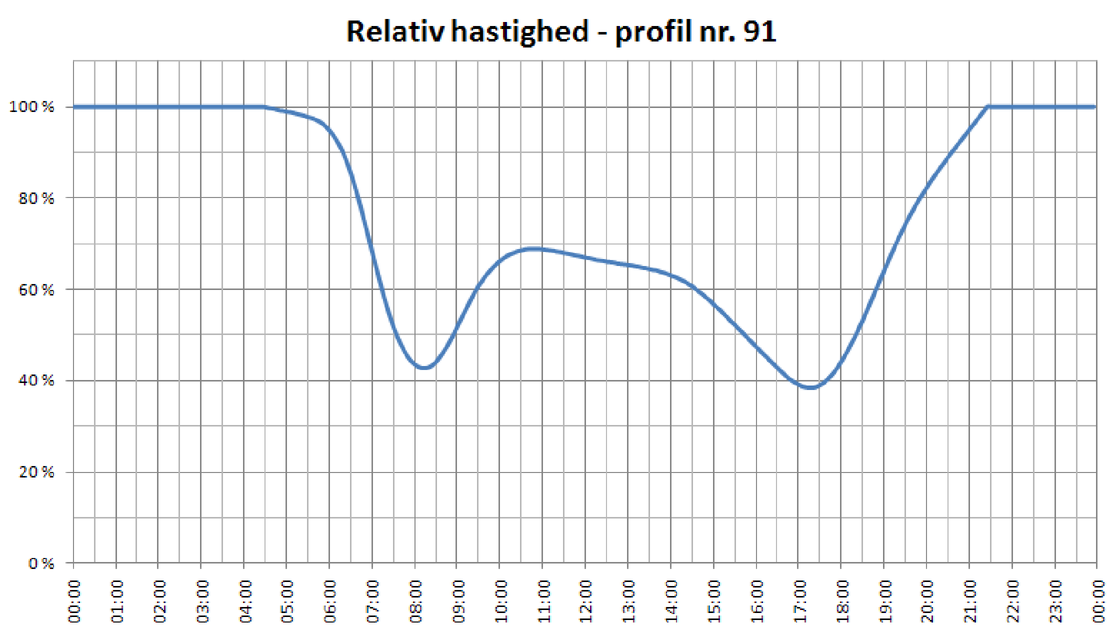


Figure 3 A speed profile showing severe congestion in peak hours, but also in daytime between these times

The dataset in the congestion system is aggregated over 2-3 years, and is not separated on date level. That is, it is not possible to do analyses on specific dates or seasons, but it is possible to analyse trends by comparing changes from dataset to dataset.

First use of data indicated that there could be two types of problems.

The speed profile data model is very simple and fast to work with, and a resolution of 5 minutes is more than enough for most purposes. However, the data is collected and refined with the purpose of being used in navigation units. Use of data compared with daily experiences from Aalborg indicates that the data are sufficient for measuring and predicting the traffic flow in normal situations, where breakdown of traffic does not usually occur, but we are uncertain if the data is not biased by not taking into account data from cars when the traffic is at a complete stop.

Secondly, working with the data shows that analysis done on raw data (KMZ files) gives a different level of congestion than analysis done on the aggregated speed profile data. It has not been possible to indentify the reason for this yet. Even though speed profile data are aggregated over 2 years, and the KMZ file analysis is done on raw data from the latest year, this should not influence the result. This implies that there could be some kind of systematic bias in the data. It is possible that both problems are indicators of the same bias.

Analysis based on the speed profiles indicates significant lower speed in night hours and significant higher speed in peak hours. That is, the expected travel time in night hours is overestimated compared to real traffic flow and the expected travel time in peak hours is underestimated compared to real traffic flow. This might be a reasonable approach for use of data in the cars, but for analyse purposes the raw data based KMZ files gives a much better picture of the real world traffic situation.

Functions in the congestion monitoring system

A congestion monitoring system has been developed. The purpose of the system is make it possible to complete analyses on speed level and congestion level, to be used as input to, and qualifying, the planning process. The analyses shall be used to map the long term growths in congestion to secure the appropriate allocation of resources to the expansion of road structure, and the mapping of *'bottlenecks'* in the road structure shall be used for allocating available resources to the roads most needing those resources.

In order to have better use of the valuable Speed Profiles from TomTom for the traffic planners in the city of Aalborg, an Excel program integrating with ArcGIS has been made to gain a quick overview of the measured travel speeds on specific road stretches.

A function in ArcGIS has been developed to select the segment identification numbers from the Tele Atlas road network database for each road segment in a specific road stretch, and to export these to the Excel program.

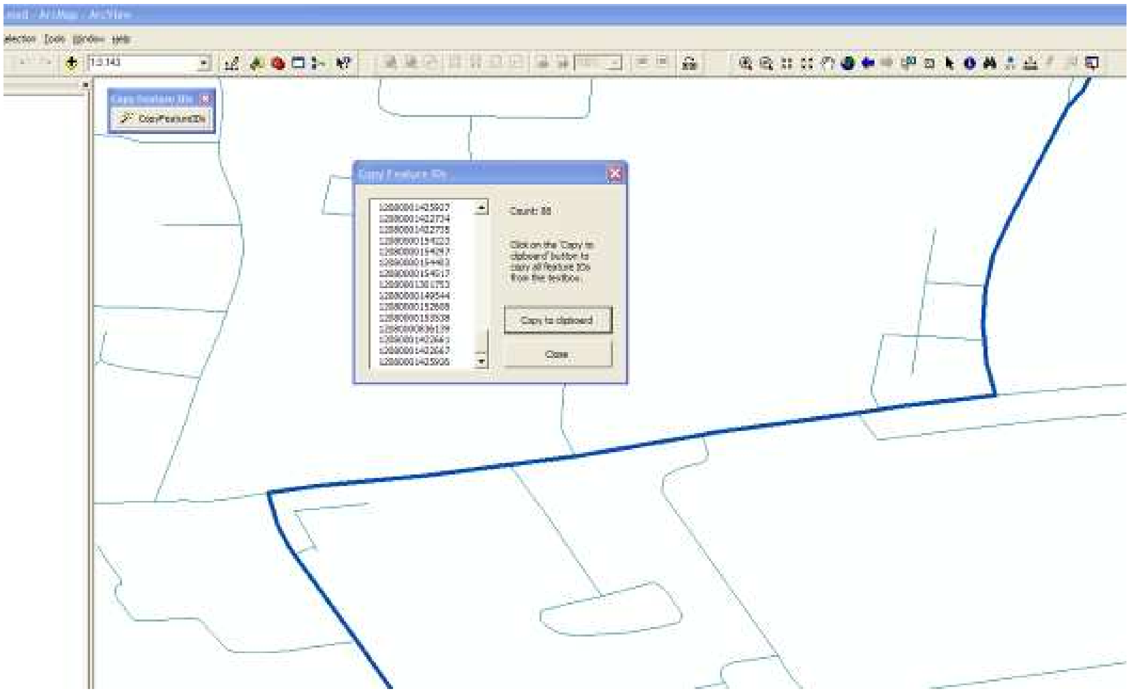


Figure 4 Example of road selection dialog in GIS system

In the Excel program, the list of segment IDs is imported, and two different types of Excel charts illustrating travel speed and free flow speed are automatically created. It is possible to create Google KMZ files showing the same information in 3D on a geographic background locally in Google Earth or on the Internet at Google Maps.

It is also possible to create Google KMZ files showing all road segments in the entire road network which at times are subject to traffic congestion above a defined level.

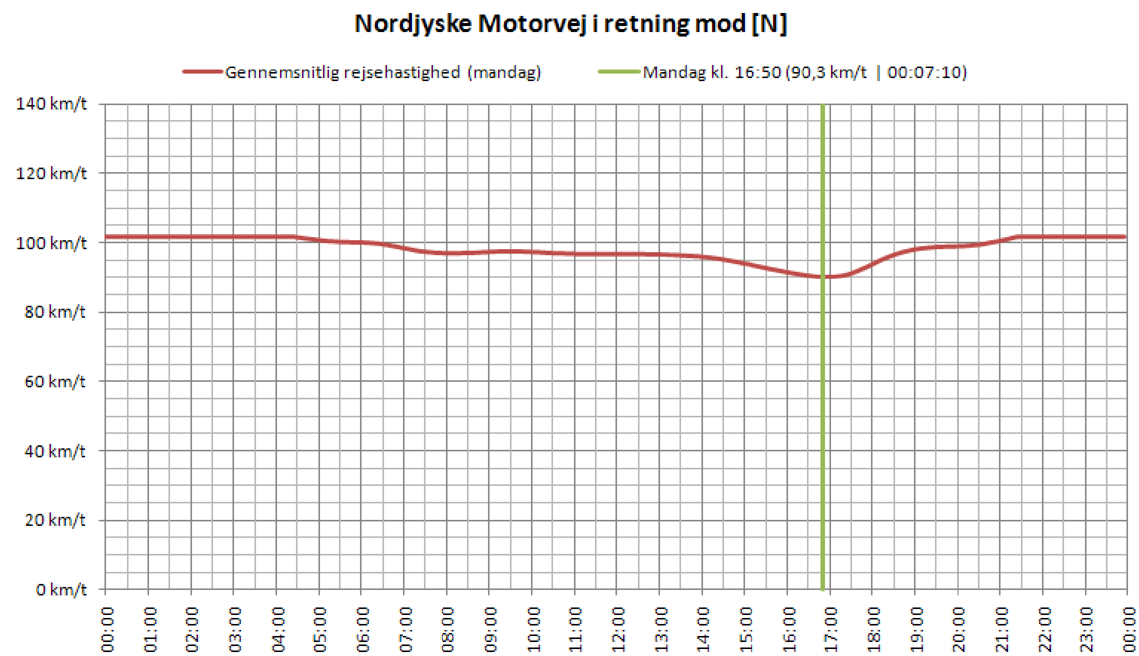


Figure 5 Output from congestion monitoring system. Average travel speed for a stretch of 11 km on the highway - calculated for each 5 minutes intervals.

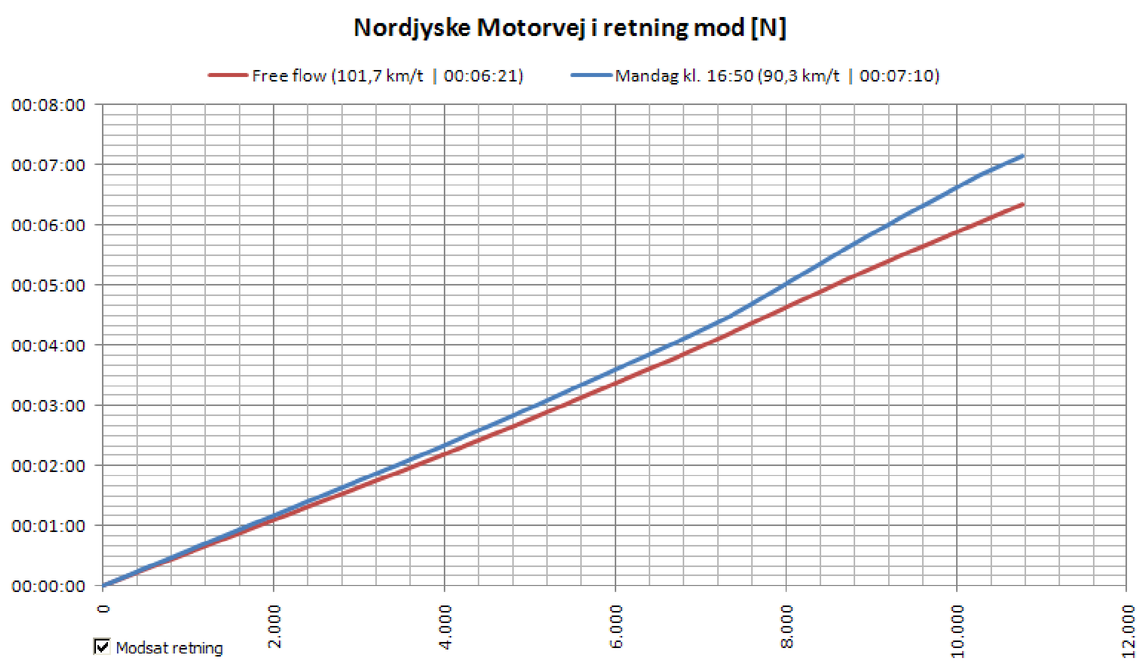


Figure 6 Output from congestion monitoring system. Accumulated travel time for a stretch of 11 km on the highway. Selected day of week and time, compared to free flow

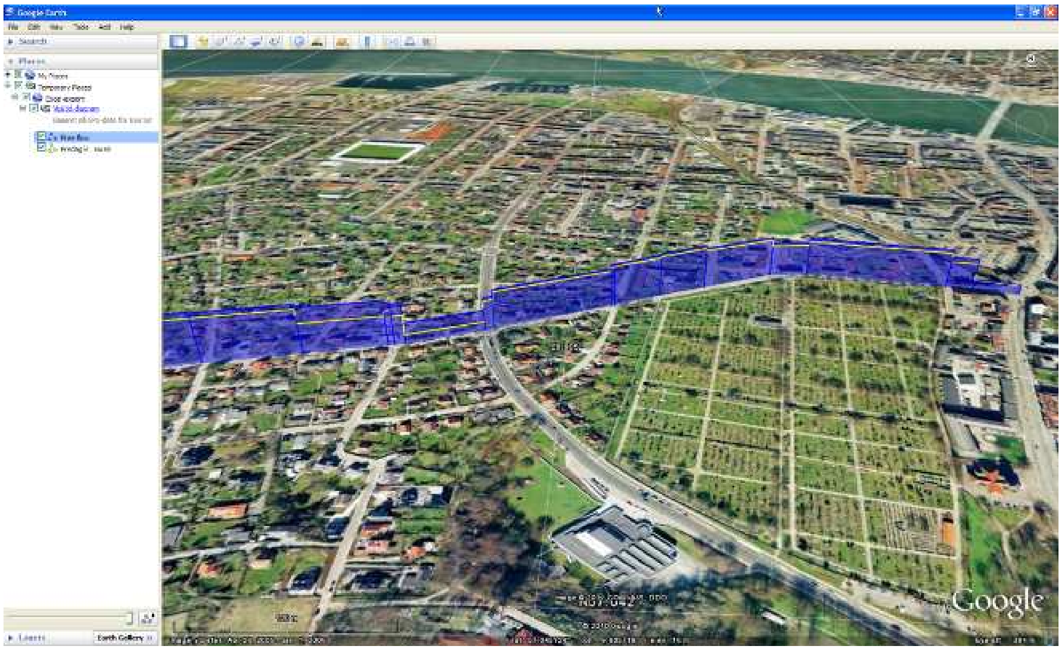


Figure 7 Output from congestion monitoring system. Google Earth file showing expected speed level for selected day of week and time (yellow) compared to free flow (blue) in 3D on a geographic background.

Figure 8 Output from congestion monitoring system. Google Earth file showing '*bottlenecks*' (yellow) above defined level (here 60%) on a geographic background

4.1.2.3 Presentation of Congestion data to road users

With the purpose to influence road users' choice of travel time and travel route, expected travel times are presented to the road users via two channels:

1. before a trip via congestion maps on the Internet and
2. during trips via the speed profiles in the navigation units.

Datamodel

These analyses are done at TomTom directly on raw data from all trip segments with no previous aggregation of data. Thus, it has been possible to complete the analyses on one calendar year, to divide the data into seasons and to exclude data from Danish Bank Holidays from analyses of weekdays etc. As analysis is done on raw data it has been possible to do the analyses on user defined peak hours, and not on the predefined 5 minutes intervals.

Data from the next calendar year will be received from TomTom by end February 2011 and will make it possible to complete time trends analyses.

Pre-trip information on the Internet.

As part of ARCHIMEDES measure 9 (Modernising Travel Information), the information on expected speed and congestion level for the major road network in Aalborg is presented on the Internet at [trafikken.dk/nordjylland.](trafikken.dk/nordjylland)

Interactive Google maps are used as the media, showing speed and congestion data from analyses contained in kmz files.

Firstly, the city of Aalborg identified the major network, and then special analyses were done on raw data at TomTom. That is, analyses were completed on all individual measurements in the database without any previous aggregation.

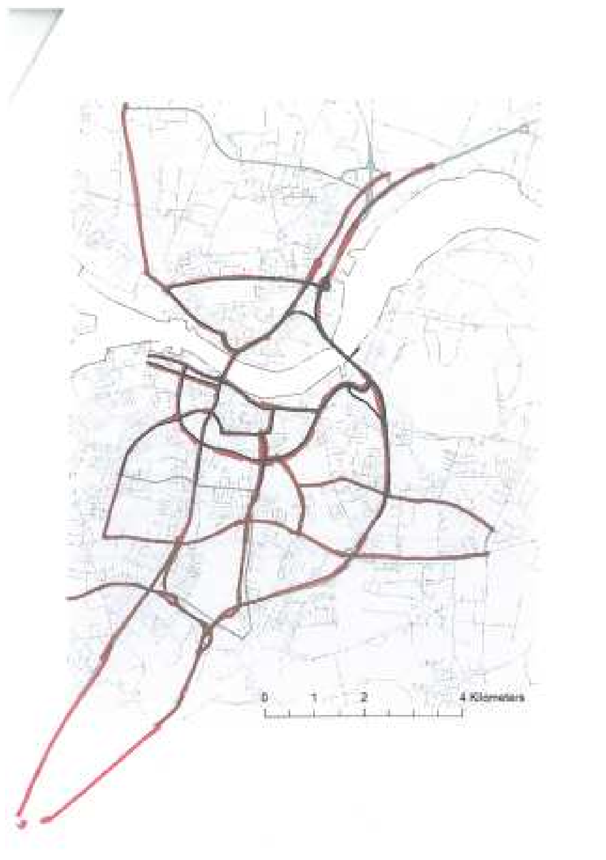


Figure 9 Drawing, showing first definition of Major Road network.

Analyses have been completed on road segment level for the selected road network. Data for weekdays have been sorted by year, four seasons and time of day (Morning peak hour, day time, evening peak hour, night time, whole day). For each of these combinations analyses have been done for speed level and for level of congestion. The 40 resulting analyses for all road segments have been combined into 40 kmz files – with information labels on road segment level. The result can utilised by all users of the national transport information site [trafikken.dk/nordjylland.](trafikken.dk/nordjylland)

When entering the site, as a default you can see the speed level for the present time of year and time of day. Peak hour, winter and speed in the example on Figure 10. Other seasons, day times or congestion view can be selected by moving the check marks.

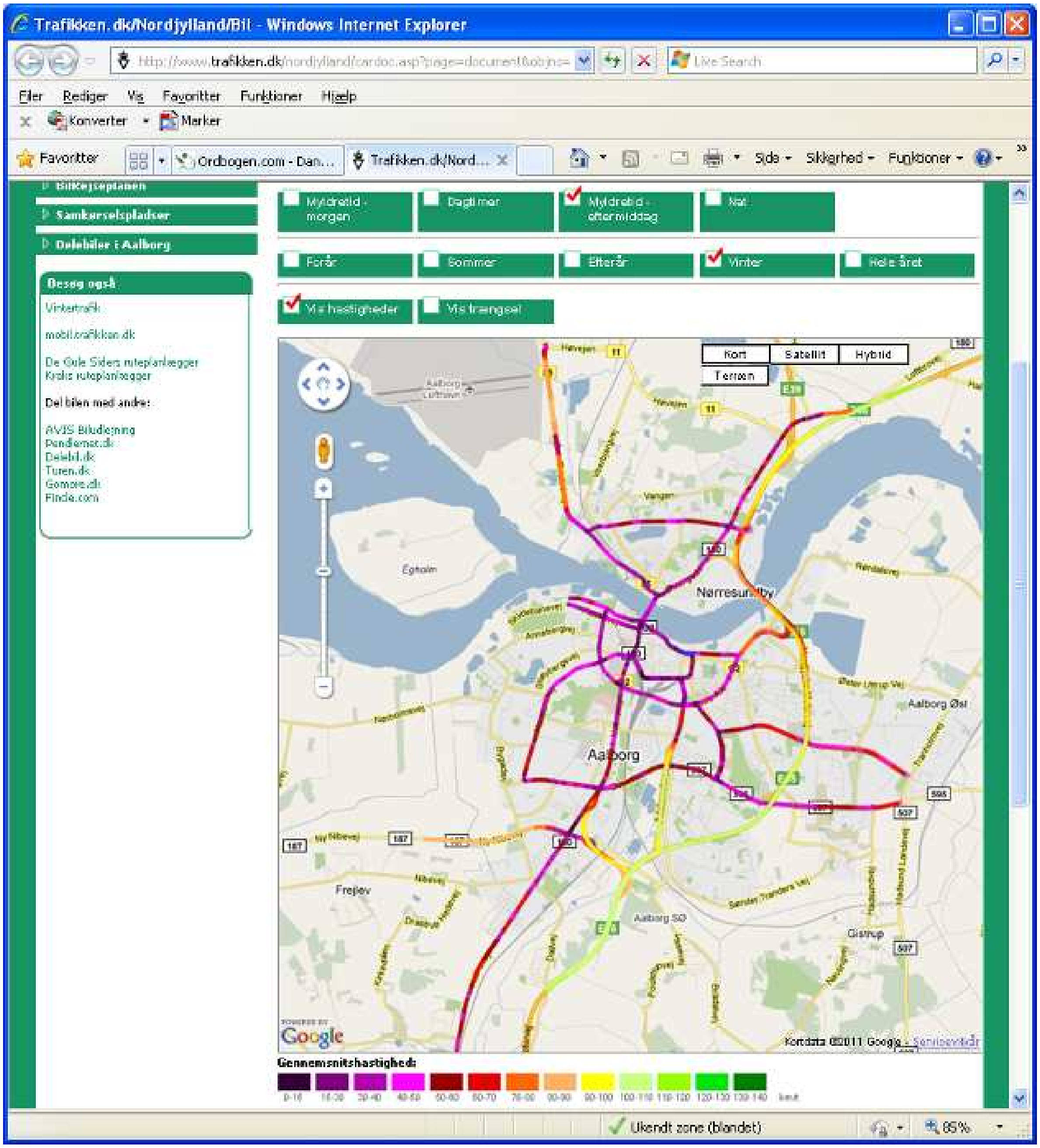


Figure 10 Opening picture on traffic information site. In the green top dialog you can choose between seasons, times of day and speed or congestion level. This figure shows speed level

Figure 11 Road users can zoom in to see the speed profile or congestion level on each road segment in his commuter route. In this example, the label shows the congestion level as ratio between speed in morning peak hour (16.94 km/h) and in night free flow (51.23 km/h).

When zooming closer into the map, you can see the different speed levels in the different directions of the road in peak hours compared to free flow.

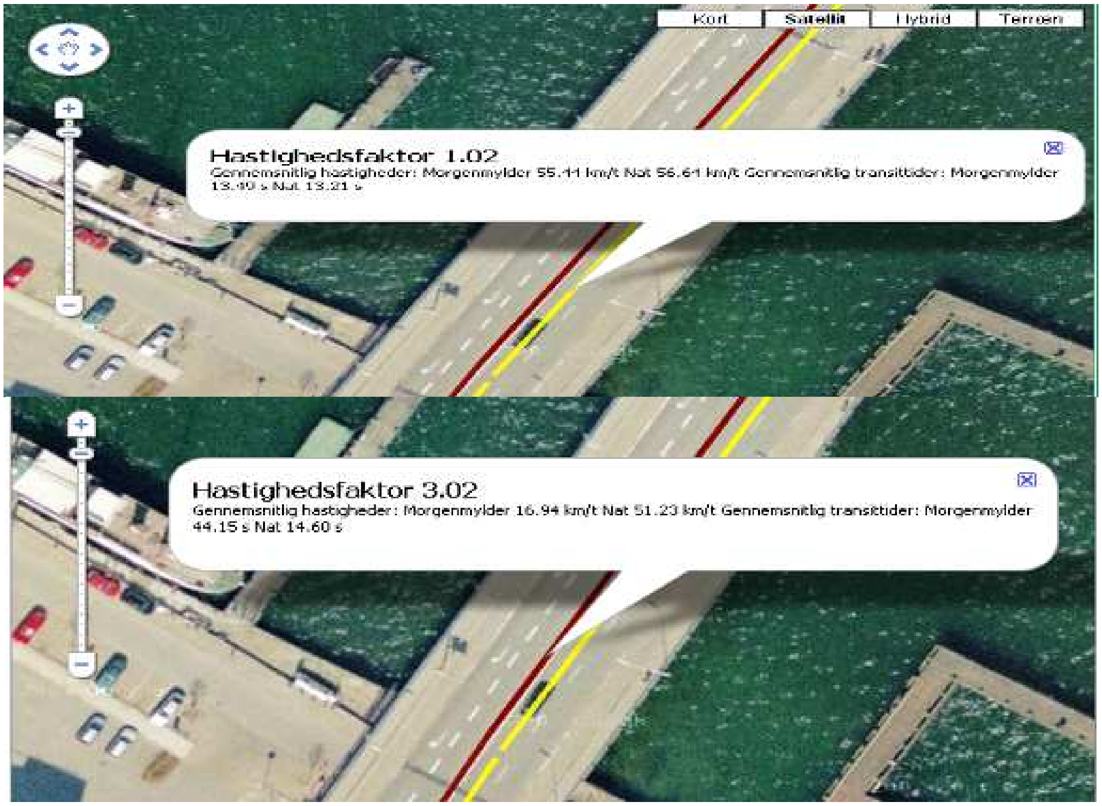


Figure 12 Very different congestion level towards or from City in peak hour. Almost no effect from city, but speed reduced to 1/3 of night level towards City.

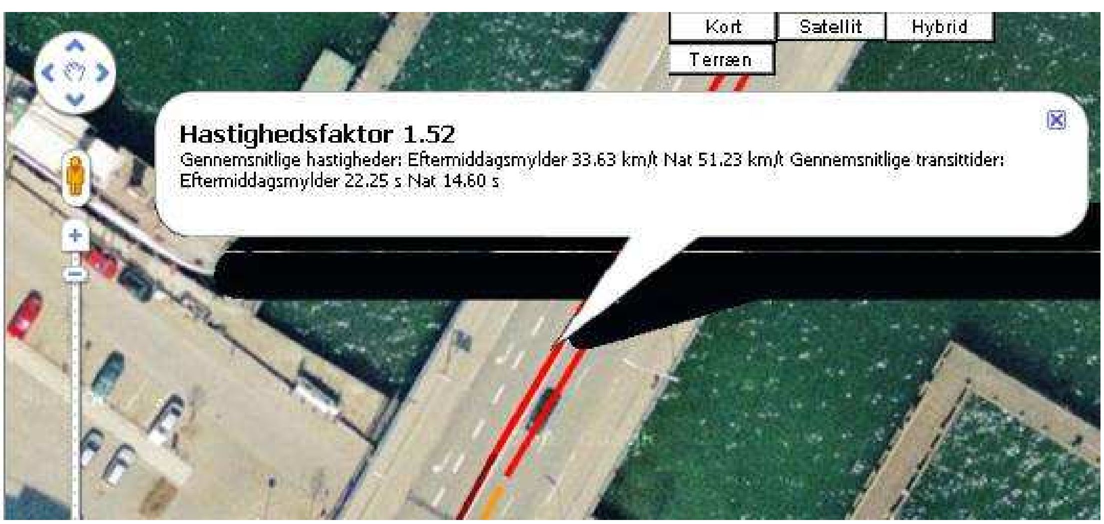


Figure 13 In the afternoon peak hour moderate effect in both directions

When choosing a different season, you can evaluate the effect of 'time of year'

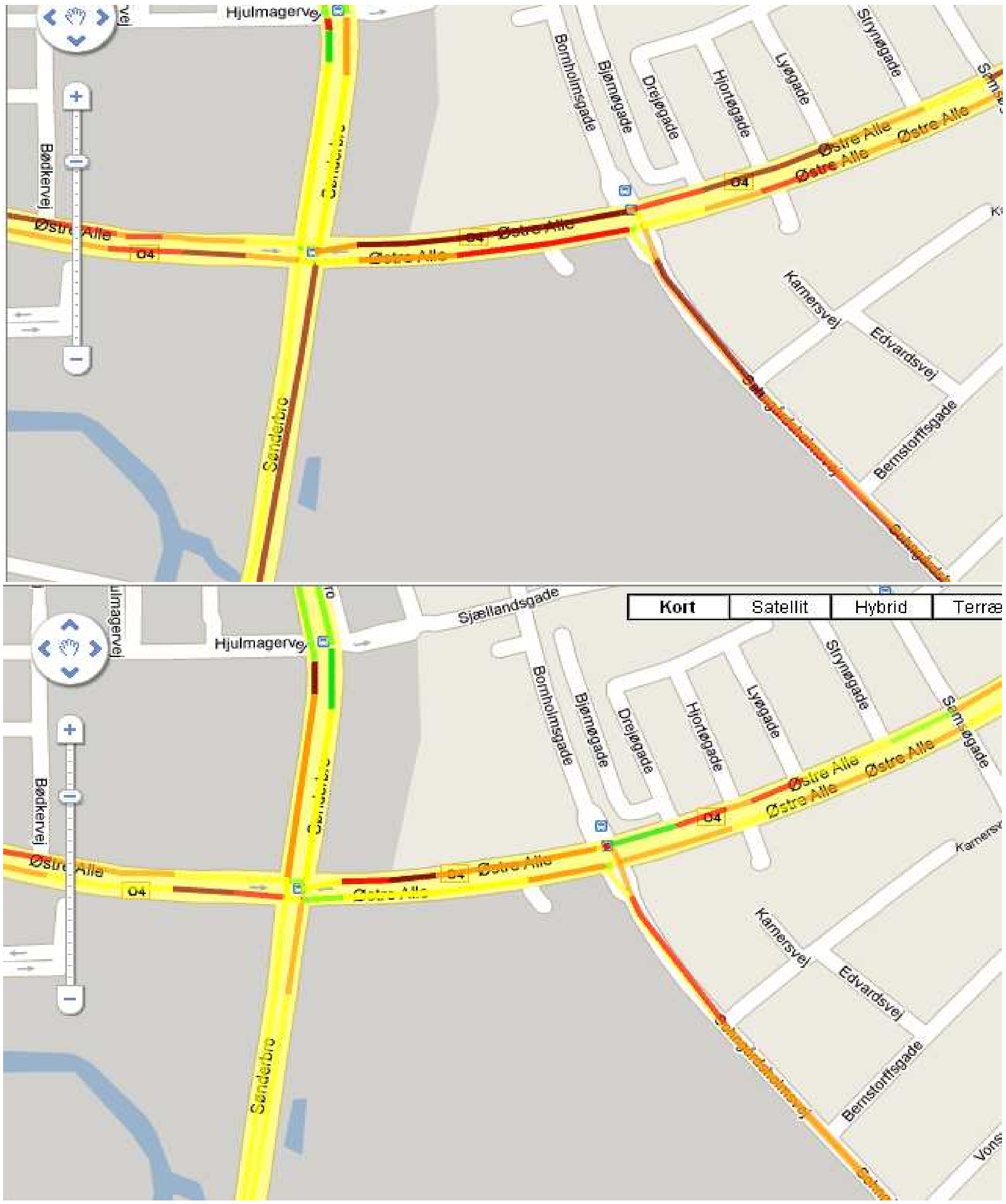


Figure 14 Congestion in the winter (top) – Less in the summer (below)

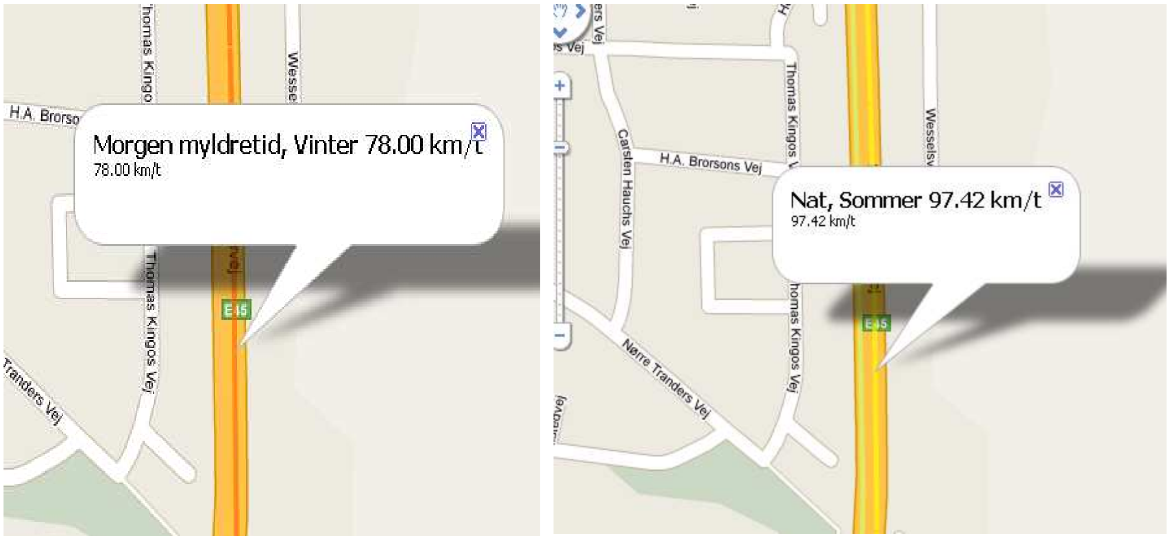


Figure 15 Motorway Congestion in peak hour…. ..but well above speed limit in the night

Tomtom has an internet base route planner, routes.tomtom.com that uses the same data as the navigation units. This services also benefits from the improved quality of data, due to the greater amount of observations, thanks to the 100 extra units in taxis.

Speed profiles in the navigation units.

Another part of the task is to try making congestion information available for road users in the cars. In the first description in the DoW, it was supposed that it would be necessary to install 10 dedicated units in test cars to archive this. As described above this approach is replaced by installing 100 standard navigation units in taxis and furthermore to use the navigation units already present in the private cars in the Aalborg area.

When communicating congestion level to car drivers the benefit from this approach is that the information goes, not only to 10 test cars or 100 taxis, but to all users of TomTom systems, that is, many thousands of potential road users over the project period.

As described above, data are collected each day by TomTom users including the 100 taxis. Four times a year a new road network is calculated with new more precise speed profiles for all roads. This information is downloaded to the navigation units and the unit becomes more and more able to avoid congested roads in the route planning. The user can even plan ahead in time and thus avoid congested time periods.

Only updating the speed profiles on the road network four times a year means that the information is not Real Time and does not take any accidents or road construction work into account when planning. This is handled by the standard TMC[1] and HQ traffic[2] functions outsides the ARCHIMEDES project. It would have been very interesting and challenging to work with real time data in this task. Regrettably this is not possible – and using historical

[1] Traffic Message Channel (TMC) is a technology for delivering traffic and travel information to drivers used by the public authorities.

[2] HQ traffic is a proprietary GSM based technology used by TomTom for delivering traffic information to drivers with TomTom subscription

data updated 4 times a year is still better than planned in the original technical description of this measure.

4.1.2.4 Implementation of an adaptive signal control system.

With the purpose of optimising the traffic flow on the demonstration part of the main ring route an adaptive signal control system (SPOT system) was implemented.

Figure 16 The SPOT stretch marked with blue on the main ring route

The SPOT system replaced an existing control system based on a coordinated and fixed time intersection signal control. In some of the intersections the phases in the traffic lights were controlled on the basis of measurements of traffic flow from the access roads in each intersection.

The SPOT system is adaptive in the sense that each signal is controlled more dynamically as a part of a model that calculates a prognosis for the traffic flow at all the intersections in the SPOT area, aiming to minimise the accumulated waiting time for road users in the system. Where the optimisation of one intersection in the present system is only dependant on measurements of the traffic flow going into the intersection, in the SPOT system the optimisation also takes into account traffic going out of the other intersections in the road network comprising the system. As one of the parameters in the optimisation are priority requests from the bus prioritisation system for public transport, public transport can be given priority by giving buses a higher weighting factor, while other means of transport are still taken into consideration.

The order for the new system comprised the development of new plans for detectors around all intersections and installation of requested detectors:

- New fall-back signal plans and signal plans controlled by SPOT for each intersection
- New controllers and new hardware in some of the intersections.
- The central software system and a hosting contract for the central system.
- New routers in intersections and the change to a new communication network.

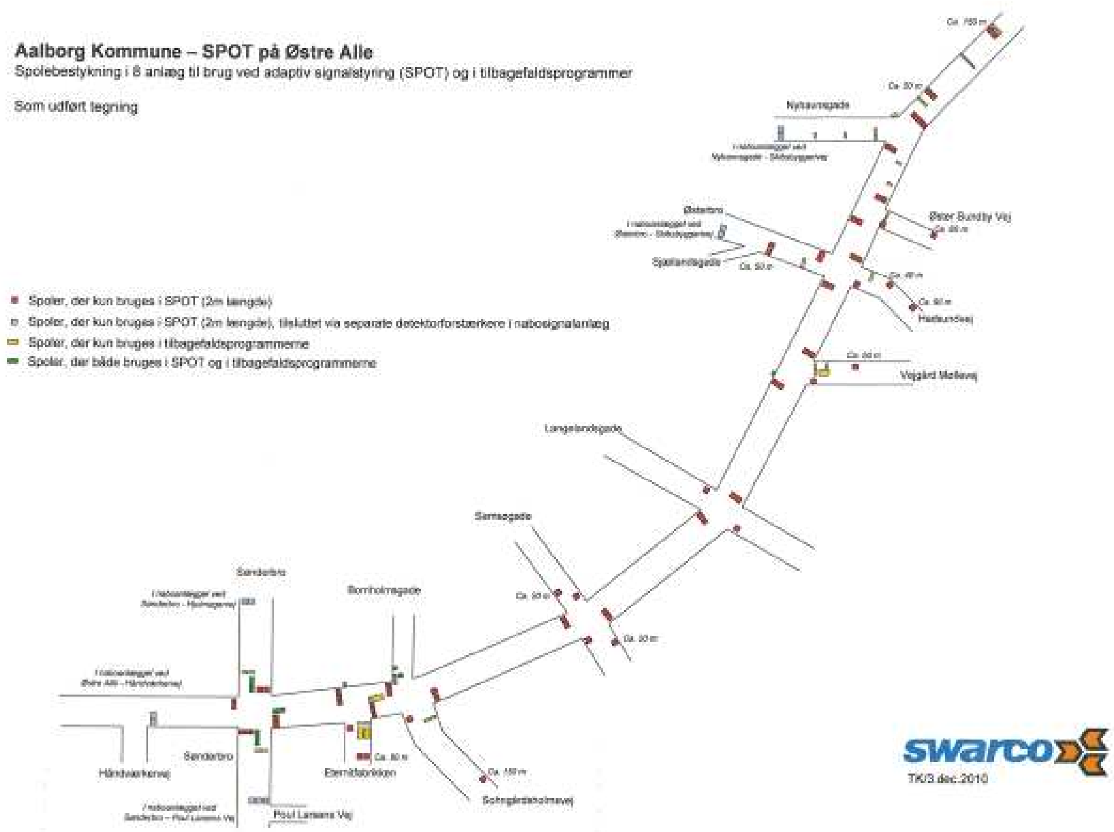


Figure 17 Location of the signals and detectors on the SPOT stretch

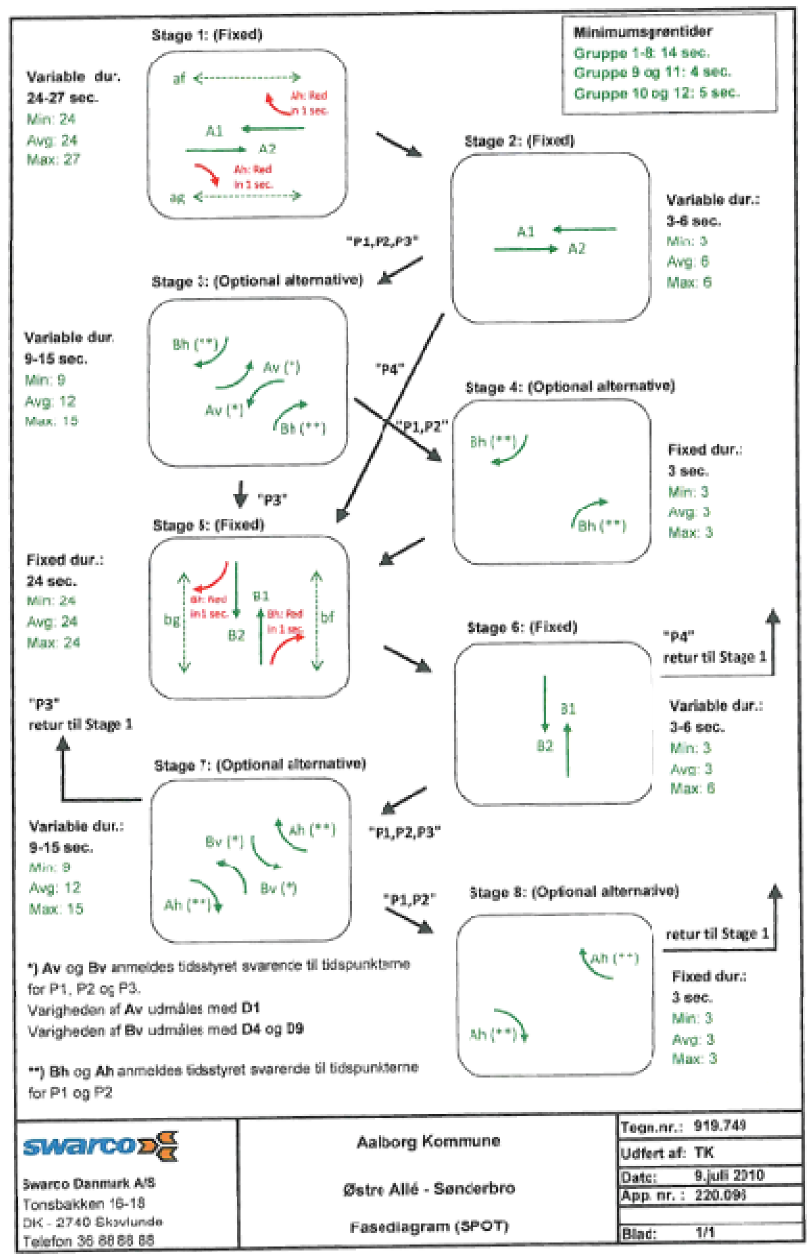


Figure 18 illustrating one of the signal phase plans used as basis for the adaptive control

Measurements of driving times through the area were established via a number of control trips carried out by students to establish before-data for evaluation.

At the time for producing this deliverable the physical implementation of the SPOT system is completed. A Pre-test has been conducted, but revealed some minor malfunctions. The test was cancelled and corrections initiated. So at the present, there are no experiences from practical use to pass on. It is still the plan to carry out the formal Site Acceptance Test on the 21st February 2011.

4.2 Communication

Cooperation

During the process of implementing these tasks, the city of Aalborg had good cooperation with suppliers and other stakeholders.

In this report, we wish to stress the cooperation with TomTom and with Aalborg Taxa.

TomTom have been open for using their data for purposes other than they were created for. They were willing to go into an open and constructive dialogue for setting up a solution that fits the aim described in the ARCHIMEDES project.

One of the reasons that it succeeded for the City of Aalborg to establish this cooperation, were that we were able to initiate a dialogue with persons placed high enough in the R&D department of TomTom in the Netherlands, and that the City of Aalborg was prepared to take part in meetings with the right people in Stockholm and in Amsterdam to get the cooperation established and working.

In the cooperation with Aalborg Taxa, the taxi organisation, has been willing to join the project in a positive manner. They have been prepared to see that the project would be to mutual benefit for both parties. The management of Aalborg Taxa have been prepared to take responsibility for motivating the drivers to join the project, for overcoming the possible barrier of the drivers fear for having their driving habits registered/monitored, and for taking over the daily responsibility for administrating the navigation unit including handling support to software and hardware errors.

As previously mentioned a project group with participation from the two suppliers in the SPOT project and the City of Aalborg have acted as working group for the detail planning and implementation of SPOT.

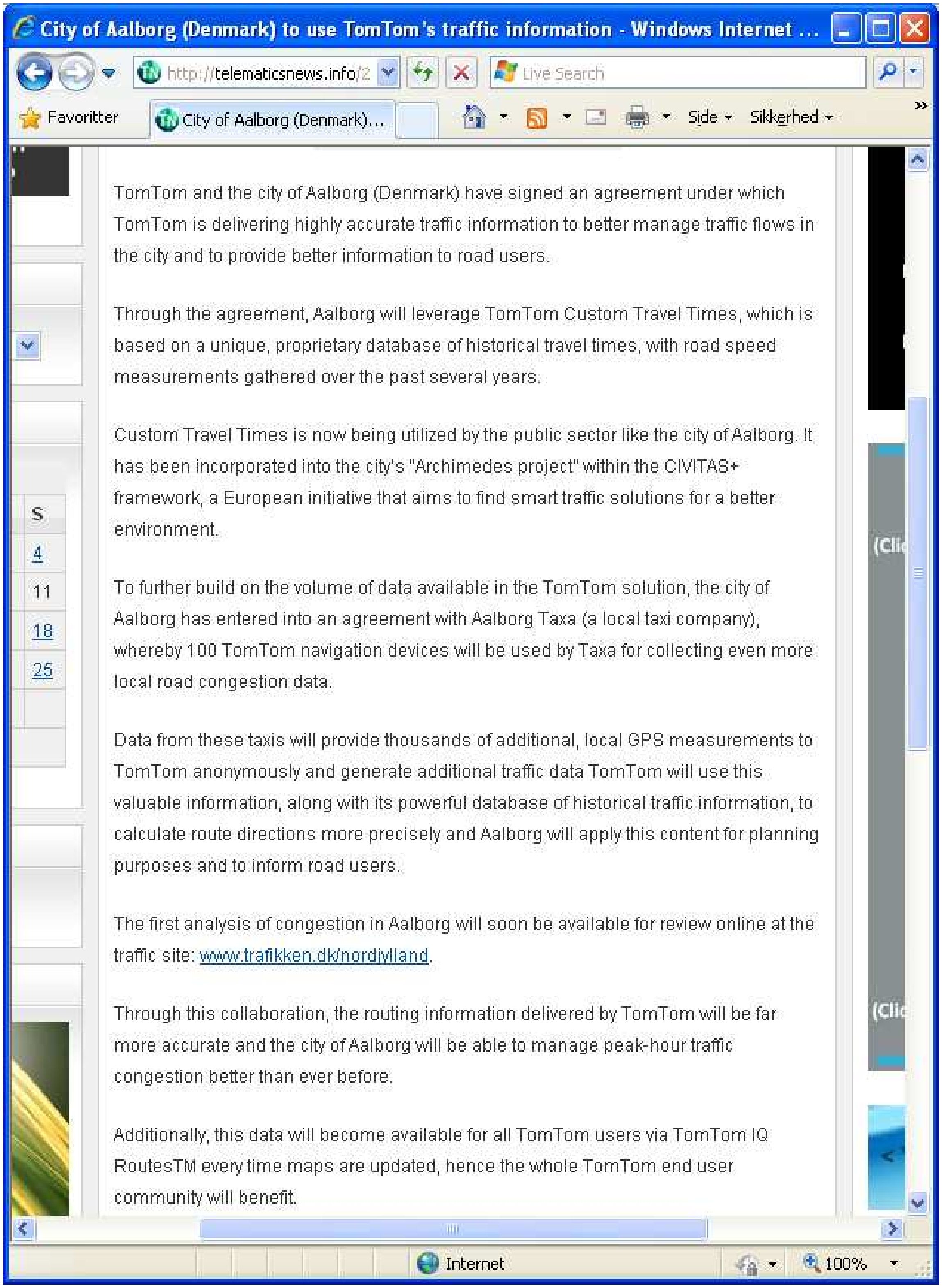
Press coverage.

When signing the contract between TomTom and the City of Aalborg, when joining the cooperation with Aalborg Taxa, and when releasing the congestion information system on trafikken.dk/nordjylland, there was good press coverage of the project.

When signing the contract TomTom and the City of Aalborg a common press release was issued. Likewise, a common press release with Taxa was released describing the project and the cooperation when handing over the 100 units to Aalborg Taxa.

The first press release was shown on a great number of internet news sites in different languages, where as the second press release was aimed at the national press.

As one example, Figure 19 shows, the press release was uploaded on, www.telematicsnews.info.



TomTom and the city of Aalborg (Denmark) have signed an agreement under which TomTom is delivering highly accurate traffic information to better manage traffic flows in the city and to provide better information to road users.

Through the agreement, Aalborg will leverage TomTom Custom Travel Times, which is based on a unique, proprietary database of historical travel times, with road speed measurements gathered over the past several years.

Custom Travel Times is now being utilized by the public sector like the city of Aalborg. It has been incorporated into the city's "Archimedes project" within the CIVITAS+ framework, a European initiative that aims to find smart traffic solutions for a better environment.

To further build on the volume of data available in the TomTom solution, the city of Aalborg has entered into an agreement with Aalborg Taxa (a local taxi company), whereby 100 TomTom navigation devices will be used by Taxa for collecting even more local road congestion data.

Data from these taxis will provide thousands of additional, local GPS measurements to TomTom anonymously and generate additional traffic data TomTom will use this valuable information, along with its powerful database of historical traffic information, to calculate route directions more precisely and Aalborg will apply this content for planning purposes and to inform road users.

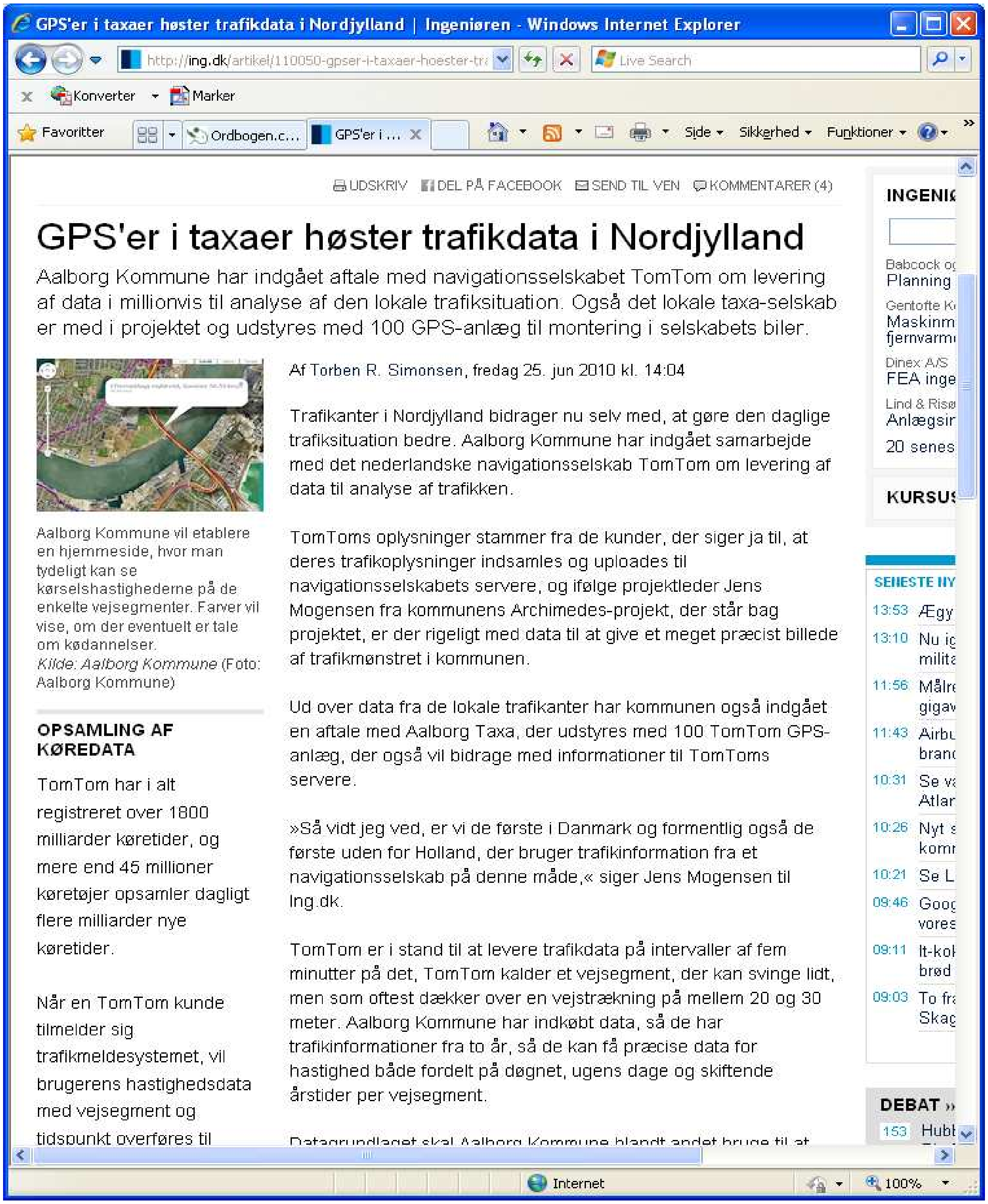
The first analysis of congestion in Aalborg will soon be available for review online at the traffic site: www.trafikken.dk/nordjylland.

Through this collaboration, the routing information delivered by TomTom will be far more accurate and the city of Aalborg will be able to manage peak-hour traffic congestion better than ever before.

Additionally, this data will become available for all TomTom users via TomTom IQ RoutesTM every time maps are updated, hence the whole TomTom end user community will benefit.

Figure 19 Telematicsnews.info showing part of the press release on the cooperation between TomTom and the City of Aalborg

Also, the newspaper and internet site for the Danish engineers wrote an article on the subject



GPS'er i taxaer høster trafikdata i Nordjylland | Ingeniøren - Windows Internet Explorer

UDSKRIV DEL PÅ FACEBOOK SEND TIL VEN KOMMENTARER (4)

GPS'er i taxaer høster trafikdata i Nordjylland

Aalborg Kommune har indgået aftale med navigationsselskabet TomTom om levering af data i millionvis til analyse af den lokale trafiksituation. Også det lokale taxa-selskab er med i projektet og udstyres med 100 GPS-anlæg til montering i selskabets biler.

Aalborg Kommune vil etablere en hjemmeside, hvor man tydeligt kan se kørselshastighederne på de enkelte vejsegmenter. Farver vil vise, om der eventuelt er tale om kødannelser. *Kilde: Aalborg Kommune* (Foto: Aalborg Kommune)

Af Torben R. Simonsen, fredag 25. jun 2010 kl. 14:04

Trafikanter i Nordjylland bidrager nu selv med, at gøre den daglige trafiksituation bedre. Aalborg Kommune har indgået samarbejde med det nederlandske navigationsselskab TomTom om levering af data til analyse af trafikken.

TomToms oplysninger stammer fra de kunder, der siger ja til, at deres trafikoplysninger indsamles og uploades til navigationsselskabets servere, og ifølge projektleder Jens Mogensen fra kommunens Archimedes-projekt, der står bag projektet, er der rigeligt med data til at give et meget præcist billede af trafikmønstret i kommunen.

Ud over data fra de lokale trafikanter har kommunen også indgået en aftale med Aalborg Taxa, der udstyres med 100 TomTom GPS-anlæg, der også vil bidrage med informationer til TomToms servere.

»Så vidt jeg ved, er vi de første i Danmark og formentlig også de første uden for Holland, der bruger trafikinformation fra et navigationsselskab på denne måde,« siger Jens Mogensen til Ing.dk.

TomTom er i stand til at levere trafikdata på intervaller af fem minutter på det, TomTom kalder et vejsegment, der kan svinge lidt, men som oftest dækker over en vejstrækning på mellem 20 og 30 meter. Aalborg Kommune har indkøbt data, så de har trafikinformationer fra to år, så de kan få præcise data for hastighed både fordelt på døgnet, ugens dage og skiftende årstider per vejsegment.

OPSAMLING AF KØREDATA

TomTom har i alt registreret over 1800 milliarder køretider, og mere end 45 millioner køretøjer opsamler dagligt flere milliarder nye køretider.

Når en TomTom kunde tilmelder sig trafikmeldesystemet, vil brugerens hastighedsdata med vejsegment og tidspunkt overføres til

Figure 20 Article at site for Danish engineers. Headline: 'GPS in taxis to collect traffic data in North Jutland'

Apart from making publicity for the CIVITAS – ARCHIMEDES Project, and the TomTom – City of Aalborg cooperation, the different articles helped to promote the traffic information site created as part of measure 9 and the subpage created in this task.

Taxaer skal undersøge vejnettet

FORSINKELSER: Aalborg Kommune vil hjælpe bilister gennem myldretiden

Af Henrik Kongsgaard
henrik.kongsgaard@nordjyske.dk

AALBORG: 100 chauffører hos Aalborg Taxa skal nu hjælpe alle andre bilister med at spare benzin og tid. Uden at taxachaufførerne selv bruger en eneste time på projektet.

Det sker ved hjælp af 100 helt nye gps-enheder, som i disse dage bliver installeret i hyrevogne hos Aalborg Taxa. Gps'erne indsamler automatisk data om, hvor nemt det er at komme frem på vejene, og oplysningerne bliver i løbet af få uger offentligt tilgængelige på internettet.

Trafikanterne vil dermed kunne hente information om, hvor og hvornår myldretiden er værst. Dermed vil de kunne vælge at køre en anden vej eller måske køre hjemmefra 15 minutter tidligere eller senere.

Gps-enhederne er stillet til rådighed af Aalborg Kommune, som har to grunde til gerne at ville have indsamlet data om fremkommelighed på vejene:

- Meget at spare

- Dels tror vi, at der er meget tid og benzin at spare, hvis folk kører ad andre ruter og på andre tidspunkter end der, hvor myldretiden er værst. Og dels kan vi bruge oplysningerne i vores egen planlægning af, hvor på vejnettet vi skal bruge ressourcerne, konstaterer Jens Mogensen, der leder Aalborg Kommunes arbejde med at finde miljørigtige løsninger på transportområdet som del af EU-projektet Archimedes.

I stedet for selv at lave et nyt system til indsamling af data har kommunen valgt at købe oplysningerne hos gps-producenten TomTom og at indgå samarbejde med Aalborg Taxa om indsamlingen.

Når den enkelte chauffør har sagt ok til, at gps-enheden må indsamle data til TomTom, sker overførslen automatisk til producentens enorme database, hver gang chaufføren eksempelvis opdaterer vejkortet. På den måde er Aalborg Taxa med til at øge TomToms viden om, hvordan trafikken flyder, og firmaet kan således gøre sine rute- og tidsanvisninger mere præcise.

TomTom leverer derefter en række centrale oplysninger til Aalborg Kommune, som lægger dem ud på internetadressen www.trafikken.dk/nordjylland.

Gennemsnitshastigheder

- På et kort vil man kunne se, hvordan trafikken typisk glider på hverdage, med angivelse af gennemsnitshastigheder. Man kan klikke på de enkelte veje og få oplysninger om, hvordan det ser ud i fire tidsintervaller: Om morgenen i myldretiden, om eftermiddagen i myldretiden, i dagtimerne uden for myldretiden og i aften-/nattetimerne, fortæller Jens Mogensen.

Statistikken bliver også opdelt på de fire årstider, så man eksempelvis kan se, hvordan en given strækning plejer at håndtere trafikken om vinteren.

Senere vil systemet kunne udbygges, så trafikanterne kan finde data om hver enkelt ugedag, og muligvis med en oversigt helt ned til fem-minutters intervaller.

Oversigten gælder de store veje i den centrale del af Aalborg. Det vil i grove træk sige fra motorvejen omkring Svenstrup og nordpå til Aalborg Lufthavn, samt fra Aalborg Universitet til vestbyen.

Jens Mogensen regner med, at statistikken er klar på internettet senest om en måneds tid.

- Vi har lige et enkelt problem. Det handler om at få adskilt to kørselsretninger, oplyser han.

Figure 21 Article in the regional newspaper, Nordjyske: Taxis to investigate the road network'

The regional newspaper had more articles on the project. Among others the one shown in Figure 21 with the headline: 'Taxis to investigate the road network' and the sub heading: 'Delayes: The city of Aalborg wants to help roads users through peak hour.'

In the internet version of the regional newspaper, the focus in the article was also on the cooperation with Taxa - for some reason they chose to tilt the picture:

100 taxaer skal

undersøge vejnettet - Indland - Nordjyske.dk - Forsi...

100 taxaer skal

undersøge vejnettet

Arne Schade (S) fra kommunens teknik- og miljøudvalg overrakte forleden de 100 gps-enheder til Aalb
Taxas næstformand, Henrik Knudsen (tv).

24. juni 2010 17:02

Af: Henrik Kongsga

FORSINKELSER: Aalborg Kommune vil hjælpe bilister gennem myldretiden

AALBORG: 100 chauffører hos Aalborg Taxa skal nu hjælpe alle andre bilister med at spare benzin og tid. Uden at taxachaufførerne selv bruger en eneste time på projektet.

Det sker ved hjælp af 100 helt nye gps-enheder, som i disse dage bliver installeret i hyrevogne hos Aalborg Taxa. Gps?erne indsamler automatisk data om, hvor nemt det er at komme frem på vejene, og oplysningerne bliver i løbet af få uger offentligt tilgængelige på internettet.

Trafikanterne vil dermed kunne hente information om, hvor og hvornår myldretiden er værst. Dermed vil de kunne vælge at køre en anden vej eller måske køre hjemmefra 15 minutter

AVISANNONCE

THISTED KOMMUNE

BIL-/MASKINVÆRKSTED MED TILHØRENDE BEBOELSE

Ukendt zone (blandet)

Figure 22 Regional newspaper - net site : '100 taxis to investigate the road network'

The national radio did some news spots on the project. Figure 23 shows the stations internet site.

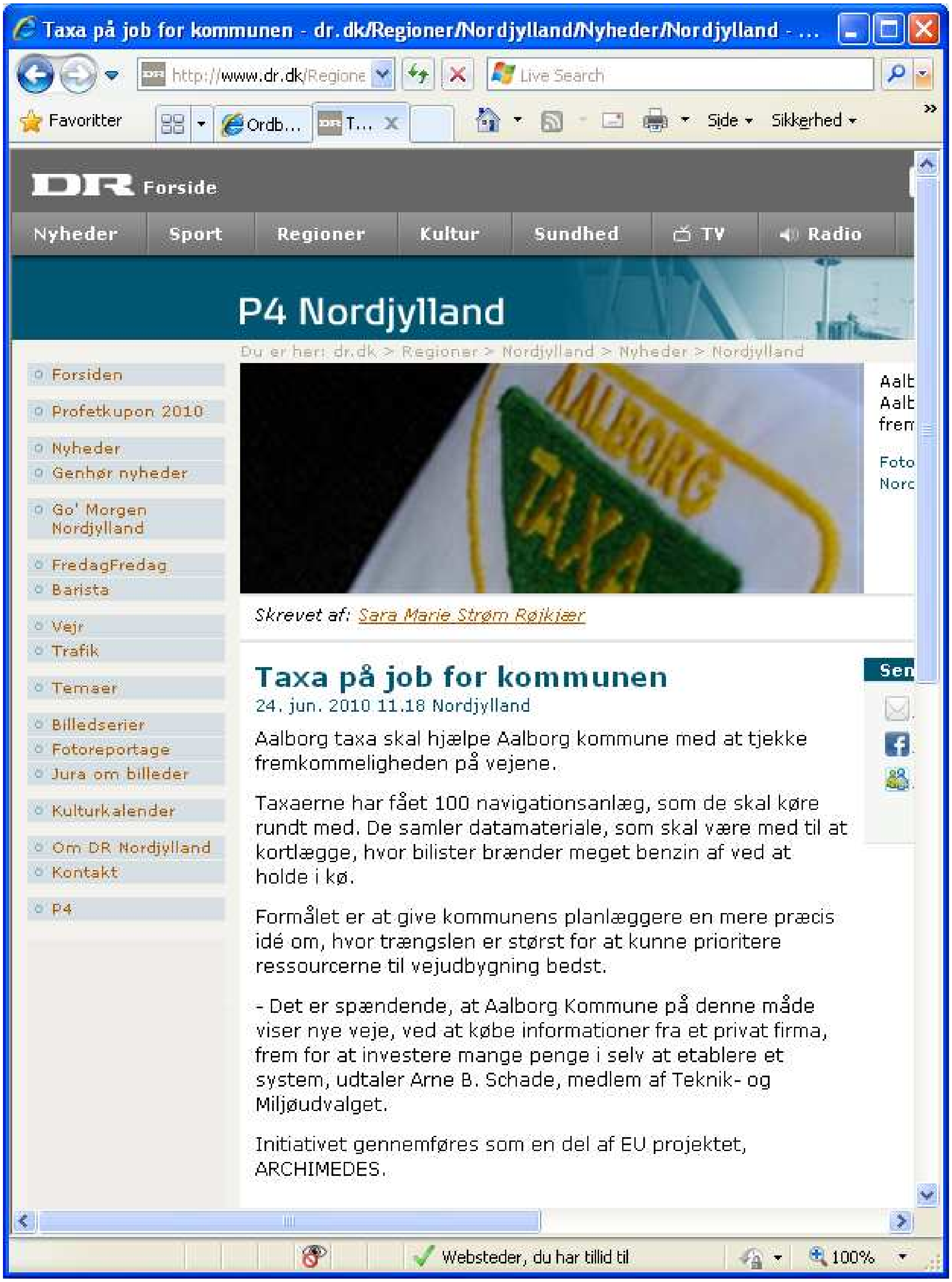


Figure 23 National radio site. 'Taxis working for the municipality'

The congestion monitoring project was presented at a conference for ITS experts in Finland, and a paper has been submitted to the ITS Europe conference in 2011.

Before starting to implement the SPOT system an advertisement was put in the newspaper to brief the public on the project and to prepare them on the possible inconveniences the implementation work could cause them.

The project was presented in two articles in the regional newspaper. The articles focused on the effect the system would have on easing the rising problem with fast accessibility for cars on the new harbour front.

Fredag 13. august 2010 NORDJYSKE Stiftstidende

Aalborg 3

Mursky i Nr. Tranders Kirkecenter

NR. TRANDERS: Onsdag aften er der fri entre, når Eugene Mursky giver koncert i Nr. Tranders Kirkecenter.

Eugene Mursky er født i Uzbekistan i det tidlige USSR, og startede på undervisning i klaver som 6 årig på en ungdoms-musikskole. Som 8 årig blev han optaget på en musikskole for meget talentfulde børn og kom som 12 årig til Moskva for at studere hos professor Lev Naumov.

I 1994 vandt han "verdensmesterskabet" i klaverkonkurrencer og har spillet med Londons, Sveriges og Singapores symfoniorkestre.

Hjælp på vej til kø-ramte

TRAFIK: Mere grønt lys på Østre Alle skal lokke bilisterne uden om Aalborgs midtby

Af Lars Termansen
lars.termansen@nordjyske.dk

AALBORG: Nu er der hjælp på vej til bilister, som er trætte af holde i kø på Nyhavnsgade i Aalborg.

Som NORDJYSKE Medier de seneste dage har dokumenteret er der problemer med opstuvning af trafikken i Nyhavnsgade.

Især i krydset ved Rendsburggade ind til midtbyens butikker og parkeringshuse er der ventetid.

En del af forklaringen er, at mange bilister stadig bruger den genåbnede Nyhavnsgade til at krydse gennem Aalborg.

Kommunen vil forsøge at få flere bilister til at køre uden om køen og vælge ringvejsforbindelsen på Østre Alle.

Lokkemidlet er mere grønt lys. Det skal et nyt signalstyringsanlæg sørge for. Det tages i brug i slutningen af 2010.

I dag byder Østre Alle på flere stop med lyskryds, men det ny intelligente styringssystem skal få trafikken i lyskrydsene til at glide bedre.

På strækningen fra Nyhavnsgade til Sønderbro er der i alt otte signalregulerede kryds, og de skal nu bygges om, så der går besked fra lyskryds til lyskryds om den tilstrømmende trafik.

Informationerne skal bruges til at skrue op og ned for intervallerne med grønt lys - i fagsprog også kaldet omløbstiden.

På bundlinjen skulle det gerne give mere grønt lys og færre stop for bilerne på Østre Alle.

- Når der er mindre kø på Østre Alle, bliver det en fordel at vælge den strækning frem for Nyhavnsgade, som jo ikke længere er tænkt som en gennemkørende vej på tværs af Aalborg, siger ingeniør Niels Ulrich Clausen, Aalborg Kommunes trafik og veje.

Han tilføjer, at der ikke bliver mere kapacitet på den i forvejen firsporede Østre Alle, men at kapaciteten udnyttes bedre. Dog må fodgængere og krydsende biler fremover være indstillet på at skulle vente længere for rødt lys.

På nuværende tidspunkt bliver der fræset riller i asfalten i de kryds, der støder op til Østre Alle. Senere skal der lægges spoler ned i vejbelægningen, som registrerer bilernes ankomst.

LYSKRYDS PÅ ØSTRE ALLE

FAKTA

SÅ MEGET TRAFIK ER DER

- Årsdøgntrafikken er knap 20.000 biler på Østre Alle, mens Nyhavnsgade er belastet af 11.000-12.000 biler i døgnet.
- Det nye styringsanlæg bliver kun installeret på den østlige del af Østre Alle, og det skyldes hensyn til økonomi og vurdering af behov.
- Trafikbelastningen er stærkest på strækningen fra Nyhavnsgade til Sønderbro. 10.700 biler i de fire timer på døgnet med spidsbelastning - om morgenen og eftermiddagen.
- Trafikken er mindre på strækningen fra Sønderbro til Hobrovej/Vesterbro. Her passerer 8.500 biler i de fire mest trafikerede timer i døgnet.

TRAFIKKEN PÅ Østerbro skal glide lettere fra Limfjordstunnelen til Sønderbro. Arkivfoto: Per Kolind

Få gader gør stor forskel

Af Lars Termansen
lars.termansen@nordjyske.dk

AALBORG: Trafik har samme egenskab som vand. Det løber den vej, der er nemmest.

Men er der nu så stor fordel ved at bruge Nyhavnsgade til at krydse gennem Aalborg?

Korttjenesten Google Maps er ikke i tvivl.

Hvis man sætter start til krydset Nyhavnsgade/Østre Alle i øst og slutpunkt til krydset Strandvejen/Dannebrogsgade i Aalborgs vestlige del, er vejen ind igennem Aalborgs midtby hurtigst.

Vejen er 2,1 kilometer og køretiden målt til 5 minutter. Ringvejsforbindelsen via Østre Alle mellem de to samme punkter er angivet til 5,2 km og køretiden til cirka 10 minutter.

Her er der altså klar hurtigst at skyde genvej gennem midtbyen. Hvis der altså ikke lige er kø.

Men rykker man ruten bare nogle få gader, sker der drastiske ændringer.

Ved start fra krydset Nyhavnsgade/Østre Alle til krydset Hasserisgade/Kong Christians Alle er ringvejsruten via Østre Alle og Kong Christians Alle udmålt til 4,3 km. Køretiden er cirka 7 minutter.

Samme tur ind gennem byen via Nyhavnsgade, Slotspladsen, Ved Stranden, Vesterbro og Hasserisgade er 3,5 km.

Og køretiden er det samme - cirka 7 minutter.

Figure 24 Two articles on the SPOT system. 'Help coming up to queue-affected' and 'A few streets makes a big difference'

During the implementation period signs were erected informing road users, that the SPOT system was being tested :

Figure 25 'New signal controlling system is being tested'

4.3 Problems Identified

One of the main challenges in this task has been the rapidly changing technology which made the detailed project description obsolete even before the project was really initiated. New possibilities arose and solutions that were supposed to be necessary at design time showed up to be out of date before implementation. Therefore, it was necessary to develop new ways to reach the objectives from the DoW. By being willing to find new alternative solutions, and to use new technological possibilities, this proved to be possible.

Use of data implies that analysis on raw data shows different levels of congestion than analysis done on aggregated data. It has not been possible to indentify the reason for this. Even though aggregated data is collected over 3 years, and the raw data in the analyses is from the latest year, this should not influence the result. This implies that there could be some kind of systematic bias in the data.

4.4 Future Plans

The congestion monitoring system is based on data from 2009. At the end of February, data from 2010 will be added, and analyses of time trends will be carried out.

New 2010 analyses will replace the 2009 analyses on the traffic information website.

If new 2010 data show changes in the traffic situation, this information will be used as part of the basis for planning and resource allocation and road users will be informed by news releases, to give them the opportunities to change their traffic habits to suit these new conditions.

A paper has been accepted at the 2011 ITS Europe Conference and the project will be presented there.

In the coming year road users will be presented with more precise travel times each time they download map updates from TomTom. As a part of the evaluation, taxi drivers involved in the study will be interviewed to see, if they have changed choice of route on the basis of this information.

The SPOT system is implemented now, and by the 21st February 2011 a Site Acceptance Test will be carried out. After that a period will follow where the system is optimised, by fine tuning the settings. After-measurements of driving times will be collected to evaluate the effect of the adaptive system.

The measures will be evaluated in accordance with the measure evaluation plan within ARCHIMEDES.