

COOPERATIVE SYSTEMS ROLL-OUT IN AUSTRIA AND MIDDLE-GERMANY: RESULTING IMPACTS ON ENVIRONMENT - FIRST CALCULATIONS

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ABSTRACT

This paper frames two large-scale regional initiatives on cooperative systems (infrastructure-to-car) within the currently emerging European context – large-scale FOTs. Purpose is to present and share early results and field test designs from regional initiatives at a European ITS conference for the purpose of cross-fertilization, convergence and harmonization of approaches. In Austria the driving element for now setting-up a large-scale cooperative services field test by means of national climate funds has been the newly emerging opportunity to directly communicate with car drivers in contexts when public transport offers an attractive alternative. Rather soon while setting-up the field test it became clear that cooperative services (“EASYWAY set”) have not only a significant potential in terms of increasing efficiency but also in terms of effectively coping with severe weather conditions. MOSAIQUE has been Germany’s flagship cooperative systems activity within what is known as Middle-Germany (with some 14MEuro budget spent). Regional governments’ driving rationale has been to better prepare for handling traffic-related challenges as a main cause for facing bottlenecks in meeting ambitious German quality of

life-related as well as environmental and climate targets and agendas. For some mid-size towns the target is to reduce the number of days with critically high particulate matter levels by 5 or 10 – something that should be feasible by means of co-operative systems. We present first impact calculations, discuss emerging convergence and differentiation between Austria and Germany and generate an outlook into a European dimension.

EMERGING SITUATION FOR CO-OPERATIVE SYSTEMS'

ENVIRONMENT IMPACT IN MIDDLE-GERMANY

In Middle-Germany climate and energy efficiency in the context of co-operative services has been driven by three threads:

- (1) MOSAIQUE – one of the two large-scale German ITS research projects into future traffic management approaches at Halle/Leipzig.
- (2) German society repeatedly watching on TV during prime time the unanticipated consequences of millions of drivers trying to escape from severe winter conditions on German highways by means of Google's routing services (in January 2010, in December 2010).
- (3) Strict and very ambitious targets in terms of legal CO₂ emissions and air pollution in Germany.

In MOSAIQUE (Halle/Leipzig) the guiding study question was: What can be gained from intelligent traffic management? Where MOSAIQUE's approach differs from Google's free-rider approach is (1) in delivering dynamic infrastructure-related traffic information into the cockpit as well as (2) using information from participating drivers to improve the overall picture and traffic status information as input for improved traffic management. Purpose is not just to individually outsmart traffic jams but generate routing information that is in line with environmental targets – however, without establishing heavily restricted traffic areas. As a consequence of this new form of traffic management and route guidance traffic jams, necessary stops and resulting acceleration and deceleration should be significantly reduced. An outstanding feature in the MOSAIQUE approach – especially for Halle/Saxony Anhalt – has been the joint optimization for public transport and individual mobility – both integrating real-time traffic information.

Weimar/Thüringen has been rather ambitious when it comes to reducing air pollution by means of intelligent traffic management. For Weimar an additional focus is on intelligent traffic management for some of those days when particulate matter levels is anticipated to be

beyond target values. A third element in monitoring traffic status is NOX (average per year).

EMERGING SITUATION FOR CO-OPERATIVE SYSTEMS'

ENVIRONMENT IMPACT IN AUSTRIA

In Austria a large-scale field operational test on co-operative systems started in 2011 - funded by the Austrian climate and energy funds (KliEn). In this national funding programme co-operative systems were picked because they offer the missing link towards those mobility consumers who do not yet use public transport to its full potential.

The FOT "Testfeld Telematik" was selected because it nicely integrates all results from preparatory projects (transport capacity, information layer, maps, routing information) and provides the strongest leverage for climate policy. Users in the Vienna metropolitan area can now plan and adapt individual trips "on the fly" – all based on real-time traffic information and infrastructure bottlenecks. The multitude of on-board units and smartphone apps significantly contribute to a more conscious form of ecomobility.

From a historical perspective this large-scale FOT builds on four strong elements in Austrian co-operative services.

- (1) A strong telematics industry cluster whose members were the backbone of EC's three integrated projects on I2C co-operative services.
- (2) ASFiNAG – the national motorway operator – has played a leadership role in European telematics and especially co-operative systems agenda for more than a decade. Marko Jandrisits from ASFiNAG – the Austrian FOT's project coordinator – has also chaired the working group on co-operative services in EASYWAY.
- (3) A study team from TU Vienna investigated the potential reduction from using co-operative services during the COOPERS demonstration test (Innsbruck, Brennerautobahn, EC's IP on I2C co-operative services).
- (4) Finally all favorable preconditions in Austria have profited from the opportunity window that ITS World Congress 2012 will take place in Vienna, Austria. The key ambition is to successfully demonstrate that co-operative services (fully compliant with EASYWAY's shortlist) are highly accepted when presented in a state-of-the-art user interface into the cockpit.

FIRST CALCULATION FOR AUSTRIAN CO-OPERATIVE SYSTEMS FOT'S ENVIRONMENT IMPACT

A study commissioned in COOPERS revealed that providing I2C co-operative services into the cockpit reduces CO2 by three per cent on average with reductions up to nine per cent at sections where ghost driver warnings are displayed (2). Results from a simulator study in Linköping VTI (1) point towards similar results in the long run. It is anticipated that drivers experiencing the superior validity of accurate real-time location based recommendations and warnings will come rather close to these nine per cent. A first grasp of what can be expected from introducing this type of co-operative services in the southern part of the Vienna region is shown in table 1. The overall design was successfully used in the Hamburg area by Plank-Wiedenbeck et al (2010) when estimating impacts for the entire Hamburg metropolitan area. Particulate matters and NOX have not been at the focus of this calculation. Figures presented are actual traffic figures for the Austrian FOT.

The 5 MEURO Austrian FOT will soon be evaluated by means of an independent study team – where environmental impacts will be assessed on the traffic system level.

Table 1 shows the status quo of cars on the corridor A23/A04/S01 (covering all incoming traffic from the south and the east of the Vienna metropolitan region) - totaling 328.000 cars per day. The rest of the table illustrates CO2 quantities involved, when using standard figures how in Germany CO2 emissions for cars are calculated. Three key elements in our first approximation are:

- (1) Currently traffic jams do not impact 55 per cent of cars on this corridor.
- (2) There is significant idle capacity in terms of park & ride facilities in the south of Vienna.
- (3) Public transport has sufficient capacity to quickly transport additional people from these park & ride facilities.

Szenario: derzeitiges Istsituation (Wien A04, A23, S01)							
Einfallstrasse Wien	Zählstelle km						
A04	11,693	Schwechat	Kfz		95.069		
A04	11,693	Schwechat	Kfz > 3,5t		10.405		
A04	11,693	Schwechat	Kfz <= 3,5t		84.664		
A23	9,068	St.Marx	Kfz		198.124		
A23	9,068	St.Marx	Kfz > 3,5t		14.008		
A23	9,068	St.Marx	Kfz <= 3,5t		184.116		
S01	6,16	Rustenfeld	Kfz		72.091		
S01	6,16	Rustenfeld	Kfz > 3,5t		12.404		
S01	6,16	Rustenfeld	Kfz <= 3,5t		59.687		
Kfz ins Zielgebiet gesamt	328.467	Kfz/d					
Lkw-Anteil	11%	%					
Lkw	36.817	Kfz/d					
Pkw- Verkehr ins Zielgebiet alt	291.650	Kfz/d					
Langfristige Verlagerung ÖPNV	-	%					
Pkw-Verkehr ins Zielgebiet neu	291.650	Kfz/d					
Kriterium	nicht von Stau betroffen	von Stau betroffen				Gesamt	
		zusätzliche P+R-Nutzer		Direktfahrer			
Anteil	55%						
			- %	100 %			%
Verkehr ins Zielgebiet	160.408	Kfz/d	- Kfz/d	131.243	Kfz/d	291.650	Kfz/d
durchschnittliche Fahrtlänge	35	km	12 km	35	km	35	km
Anzahl Fahrten	2	Fahrten / Tag	2 Fahrten / Tag	2	Fahrten / Tag	2	Fahrten / Tag
durchschnittlicher Verbrauch	7,0	l/100 km	7,0 l/100 km	8,4	l/100 km	7,6	l/100 km
Anteil Dieselfahrzeuge	23	%	23 %	23	%	23	%
CO2-Emission Dieselfahrzeuge	2,7	kg CO2 / l	2,7 kg CO2 / l	2,7	kg CO2 / l	2,7	kg CO2 / l
CO2-Emission Benzinfahrzeuge	2,3	kg CO2 / l	2,3 kg CO2 / l	2,3	kg CO2 / l	2,3	kg CO2 / l
CO2-Emission Flottenmix Pkw	2,4	kg CO2 / l	2,4 kg CO2 / l	2,4	kg CO2 / l	2,4	kg CO2 / l
Kraftstoffverbrauch	785.997	l	- l	771.706	l	1.557.703	l
CO2-Verbrauch Pkw / Tag	1.880	Tonnen	- Tonnen	1.846	Tonnen	3.726	Tonnen
Lkw	20.249	Kfz/d		16.568	Kfz/d	36.817	Kfz/d
durchschnittliche Fahrtlänge	42	km		42	km	42	km
Anzahl Fahrten	2	Fahrten / Tag		2	Fahrten / Tag	2	Fahrten / Tag
durchschnittlicher Verbrauch	12,5	l/100 km		15,0	l/100 km	13,6	l/100 km
Anteil Dieselfahrzeuge	100	%		100	%	100	%
CO2-Emission Dieselfahrzeuge	2,7	kg CO2 / l		2,7	kg CO2 / l	2,7	kg CO2 / l
Kraftstoffverbrauch	212.618	l		208.752	l	421.371	l
CO2-Verbrauch Lkw / Tag	574	Tonnen		564	Tonnen	1.138	Tonnen
CO2-Verbrauch / Tag	2.454	Tonnen	- Tonnen	2.410	Tonnen	4.864	Tonnen
CO2-Verbrauch / Jahr	716.619	Tonnen	- Tonnen	703.589	Tonnen	1.420.208	Tonnen

Table 1: Status quo at corridor A04/A23/S01 Vienna/“Testfeld Telematik”

However in the impact scenario for Vienna (see table 2) we used rather conservative estimates as compared to Hamburg. For the “Testfeld Telematik” we used the rather low figure of 1 per cent car drivers switching to park & ride facilities. In the long run 1 per cent are anticipated to permanently switch to public transport. Improved real-time traffic information in the “Testfeld Telematik” is estimated to increase the number of cars not impacted by traffic jams

or traffic jam-related deceleration and acceleration from 55 to 60 per cent. From these two input variations we calculate a reduction of CO₂ emissions in the order of 27 tons CO₂ per year or roughly some 2 per cent (from 1.420208 million tons CO₂/year down to 1.393010 million tons/year – last line column to the right).

Within the political discourse and in preparatory studies significantly higher figures have been communicated – e.g. 6 to 30 per cent are said to be ready for modal shift. We need to add 3 to 9 per cent from the TU Vienna study (2) to our conservative estimate of 2 per cent. Overall co-operative services in Vienna could reduce CO₂ emissions by some 5 plus per cent – even from a rather conservative point of view. In this model any increase of traffic jams – either from increases in traffic, from construction work, severe weather conditions or imposed legal restrictions – would probably make modal shift more attractive - thus reducing CO₂ emissions.

Szenario: Auswirkungen des Feldtests (Wien A04, A23, S01)								
Kfz ins Zielgebiet gesamt	328.467	Kfz/d						
Lkw-Anteil	11%	%						
Lkw	36.817	Kfz/d						
Pkw- Verkehr ins Zielgebiet alt	291.650	Kfz/d						
Langfristige Verlagerung ÖPNV	1	%						
Pkw-Verkehr ins Zielgebiet neu	288.734	Kfz/d						
Kriterium	nicht von Stau betroffen		von Stau betroffen				Gesamt	
			zusätzliche P+R-Nutzer		Direktfahrer			
Anteil	60%							
			1	%	99	%		%
Verkehr ins Zielgebiet	173.240	Kfz/d	1.155	Kfz/d	114.338	Kfz/d	288.734	Kfz/d
durchschnittliche Fahrtlänge	35	km	12	km	35	km	35	km
Anzahl Fahrten	2	Fahrten / Tag	2	Fahrten / Tag	2	Fahrten / Tag	2	Fahrten / Tag
durchschnittlicher Verbrauch	7,0	l/100 km	7,0	l/100 km	8,4	l/100 km	7,6	l/100 km
Anteil Dieselfahrzeuge	23	%	23	%	23	%	23	%
CO2-Emission Dieselfahrzeuge	2,7	kg CO2 / l	2,7	kg CO2 / l	2,7	kg CO2 / l	2,7	kg CO2 / l
CO2-Emission Benzinfahrzeuge	2,3	kg CO2 / l	2,3	kg CO2 / l	2,3	kg CO2 / l	2,3	kg CO2 / l
CO2-Emission Flottenmix Pkw	2,4	kg CO2 / l	2,4	kg CO2 / l	2,4	kg CO2 / l	2,4	kg CO2 / l
Kraftstoffverbrauch	848.876	l	1.940	l	672.310	l	1.523.127	l
CO2-Verbrauch Pkw / Tag	2.031	Tonnen	5	Tonnen	1.608	Tonnen	3.643	Tonnen
Lkw	22.090	Kfz/d			14.727	Kfz/d	36.817	Kfz/d
durchschnittliche Fahrtlänge	42	km			42	km	42	km
Anzahl Fahrten	2	Fahrten / Tag			2	Fahrten / Tag	2	Fahrten / Tag
durchschnittlicher Verbrauch	12,5	l/100 km			15,0	l/100 km	13,5	l/100 km
Anteil Dieselfahrzeuge	100	%			100	%	100	%
CO2-Emission Dieselfahrzeuge	2,7	kg CO2 / l			2,7	kg CO2 / l	2,7	kg CO2 / l
Kraftstoffverbrauch	231.947	l			185.558	l	417.505	l
CO2-Verbrauch Lkw / Tag	626	Tonnen			501	Tonnen	1.127	Tonnen
CO2-Verbrauch / Tag	2.657	Tonnen	5	Tonnen	2.109	Tonnen	4.771	Tonnen
CO2-Verbrauch / Jahr	775.777	Tonnen	1.355	Tonnen	615.878	Tonnen	1.393.010	Tonnen

Table 2: CO2 impact from co-operative services at the corridor A04/A23/S01 (conservative scenario)

FIRST IMPACT CALCULATIONS FOR MIDDLE GERMANY

For demonstrating the guiding rationale for Middle German mid-size towns (100,000 to 500,000 inhabitants) we here present elements from preparatory work on Erfurt/Thüringen. In Erfurt significant efficiency gains have been due to improved traffic infrastructure and public transport. Environmental impact assessment from this type of investment can be measured ex-post – however rather in the long run.

However, all success has not been sufficient. On a significant number of days per year particulate matter levels are critically above thresholds. Figure 1 shows results from the

measurement installation Erfurt-Bergstraße: on 326 days the particulate matter level was sufficiently below the threshold of 50 micrograms per square meter (324 measurements and 2 special cases). The high level on 39 days is beyond the legal limit of 35 days per year. As a consequence penalties will have to be paid by the municipality for the years to come.

Improved traffic management by means of co-operative services therefore faces the short-term bottom-line target of reducing critical particulate matter levels on at least 4 days per year. 4 days amounts to some 1 per cent of a year, however typically under challenging climate-related conditions. Such a reduction of 1 per cent per year will have its immediate financial benefit for the municipality.

In more technical terms the purpose is to significantly reduce stops, frequent acceleration and deceleration from traffic lights and dense traffic. Three significant constraints contribute to this bottleneck-approach:

- (1) Shifting traffic to other areas of Erfurt is considered inappropriate.
- (2) Individual traffic can never be prioritised towards public transport.
- (3) Mobility in its role for economic prosperity and quality of life cannot possibly be restricted.

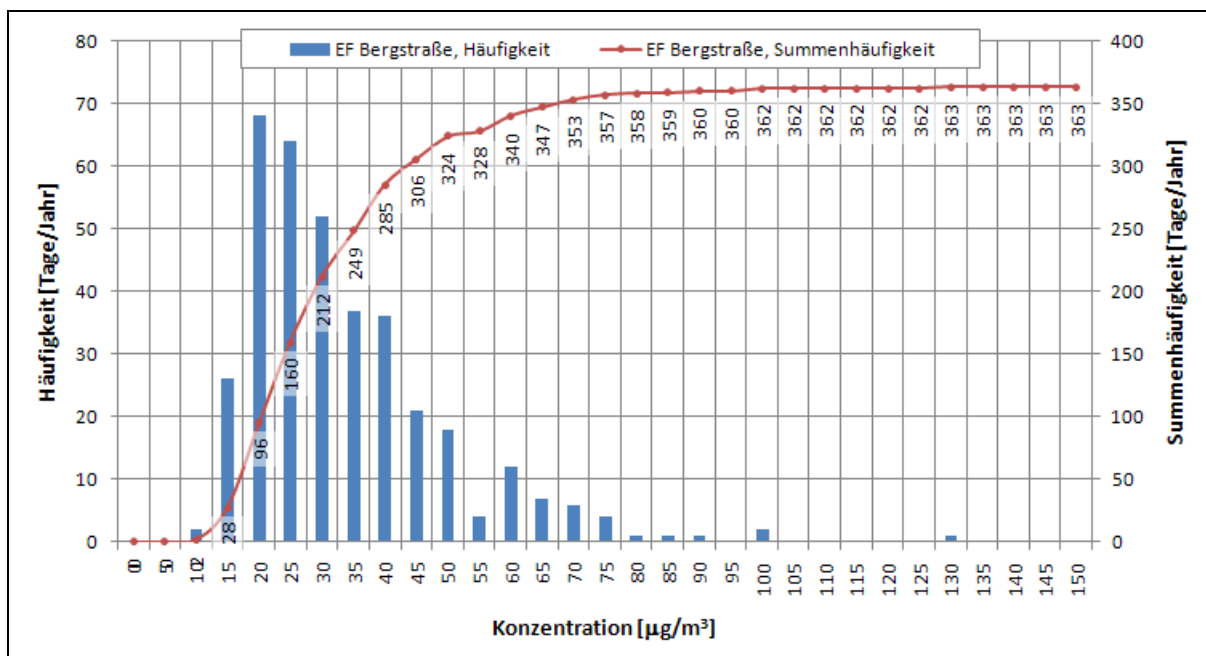


Figure 1: particulate matter level (PM10-Konzentrationen) at Erfurt-Bergstraße in 2009
[Daten: TLUG]

DISCUSSION OF EMERGING CONVERGENCE

In Middle-Germany a cluster of innovative co-operative services emerges without the official umbrella of an FOT-joint research project. The climate focus has come in step by step. A significant element has been key individuals in Saxony, Saxony-Anhalt and Thüringen. Key individuals from Halle were also actively involved in EC's leading infrastructure-to-car co-operative services integrated project. These key individuals have also designed early calculations for the potential reduction in the Hamburg area and for Thüringen and are currently on a team that will perform an accompanying measurement study to the Austrian climate and energy field operational test on co-operative systems.

Key individuals from Austria's FOT "Testfeld Telematik" have successfully established regular informal exchange on an international scale and shared measurement approaches. Austria has been at the forefront of promoting EASYWAY-compliant use cases and infrastructure-to-car co-operative services. This can be seen as a small country proactively adhering to yet emerging European standards in order to protect its leading highway road operator's investment. A second strong element has been sufficient critical mass in terms of a single research institution's 15 year track record of involvement in designing and studying acceptance and user issues for commercially relevant European ITS solutions.

OUTLOOK INTO A EUROPEAN DIMENSION

From a European dimension we here have two pioneering groups. The Austrian "Testfeld Telematik" follows a service quality-oriented road map while rolling-out co-operative services. The climate aspect comes in mainly from using the unique communication channel to car drivers – in situations when mobility behaviour change offers immediate advantages. In Middle-Germany the climate-related rationale rather leads to a soft form of interventions; - soft as compared to static bans for individual car traffic. Both approaches capitalize on results and lessons learnt in EC's infrastructure-to-car flag ship project COOPERS. Climate-related improvement presented in our paper might be less than expected in ambitious political agendas. However, co-operative systems demonstrate how elegantly intelligent infrastructure-to-car investment can be used to successfully cope with societal challenges and bottlenecks. It is anticipated that extreme weather conditions will become more frequent – another opportunity window for marketing co-operative services. The authors are looking forward to joining forces with other European pioneers in the field of infrastructure-to-car co-operative services and to discussing and forging on our measurement approaches and early results in Lyon.

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