The 'Research Network Quiet Traffic' – A global approach to reduce transportation noise

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Introduction

Mobility is a basic human need and an essential precondition for economic growth. But mobility on roads, on rails, and in the air is associated with noise. With more and more people feeling affected by and complaining about noise, traffic noise has become a severe environmental problem. While noise pollution comes from several sources, the dominant source is traffic. Around 20 percent of the Union's population or close on 80 million people suffer from transport noise levels considered to be unacceptable. An additional 170 million citizens are living in so-called "grey areas" where the noise levels are such to cause serious annoyance during the daytime. In Germany, located in the heart of Europe and with a high population density, more than 50% of the population feel affected, about 70% by road traffic noise, nearly 40% by air traffic noise, and 20% by rail traffic noise, according to a 2002 poll released by the German Federal Environmental Agency.

The noise pollution problem is being aggravated because of the growth of passenger and freight traffic; in the years to come the increase will be dramatic. According to projections released by the International Energy Agency in 2002, passenger and freight transportation in OECD Europe will increase by 40 and 64%, respectively, with road traffic having the largest share by far. Consequently, the already high level of noise pollution will also increase considerably, especially in, but not limited to, urban areas.

To maintain or even enhance "livability" in traffic noise affected areas without letting noise bottle-neck economical development, research directed at traffic noise abatement was and is being conducted in many projects and networks, sponsored and supported by national governments and by the EC.

Quiet Traffic – A global approach

To support the fight against traffic noise, and led by the German Aerospace Center/DLR which is also active in ground transportation research, about 70 partners from research institutions, industry and operators, and government agencies decided to join forces. In 1999 they established the national research network 'Quiet Traffic', aimed at the global reduction of noise emissions from road, rail, and air traffic. The Network tries to take into account the interdependencies between the many complex facets of transportation noise abatement and to exploit synergies by an integrated approach. The network provides an open scientific platform for communication, exchange of information, and cooperation in transparent and interdisciplinary R&D projects. By concentrating their research efforts, the partners hope to increase their output and optimize the use of resources. This is in contrast to most of the previous and ongoing research programs which take a discipline or traffic sector (road or rail or air) oriented approach as made evident, among other things, by the inventory provided by the CALM Network [1].

Network Structure

Five subject areas have been established within the network, Figure 1.

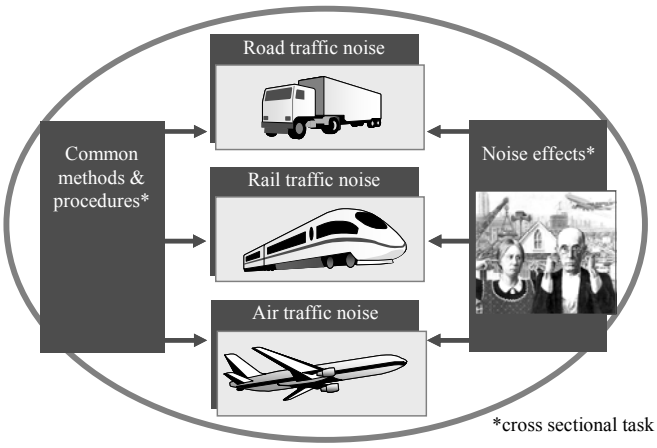

Figure 1: Research Areas in the Quiet Traffic Network

Three research areas deal with the major transportation sectors: road-, rail- and air traffic. To make best use of the available resources, activities concentrate on dominating noise sources with the intention to provide short to medium term solutions. Two further research areas include cross-sectional activities. One deals with methods and procedures common to all technical noise abatement efforts like noise source location and acoustic simulation methods, the other with the effects of noise. A program board formed by the coordinators of the five research groups and representatives from industry and operators provides the umbrella that ensures communication and the exchange of information between all participants in the network [2].

Effects of Noise

The inclusion of research on perception and physiological and psychosocial effects of noise on humans on an equal footing with the research on operational and technical noise abatement is a special feature of the Quiet Traffic network.

While basic research as well as research on possible long-term effects on health will not be considered, the noise-effects-research community will make scientific findings available to the other partners that allow for more effective and straight forward ways to control noise emissions and their negative effects. Based on these findings, engineers and scientists can change acoustic parameters to make noise less disturbing or harmful. Linking the temporal structure and the type of traffic noise to noise sensitivity that varies during the

day and during the night can provide inputs for drafting regulations and standards as well as for managing traffic flow to minimize noise emissions.

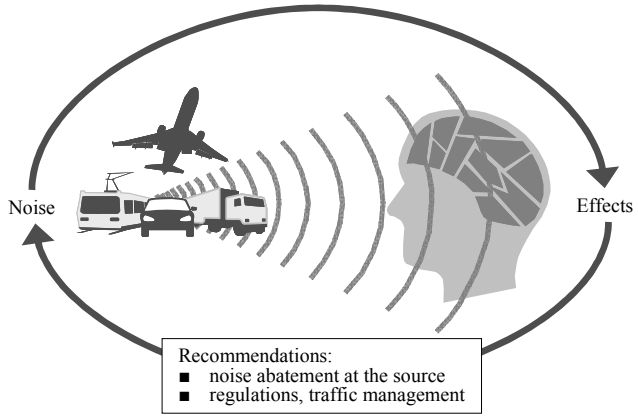

Figure 2: Interaction of research on noise abatement and effects of noise

Noise abatement at the source

During the last few decades technical progress has allowed to develop quieter vehicles and infrastructures, but these achievements have been "eaten up" because traffic has increased so much. The goal of the Quiet Traffic network is to contribute to reducing noise emissions even further. Figure 3 depicts the reduction potentials deemed achievable.

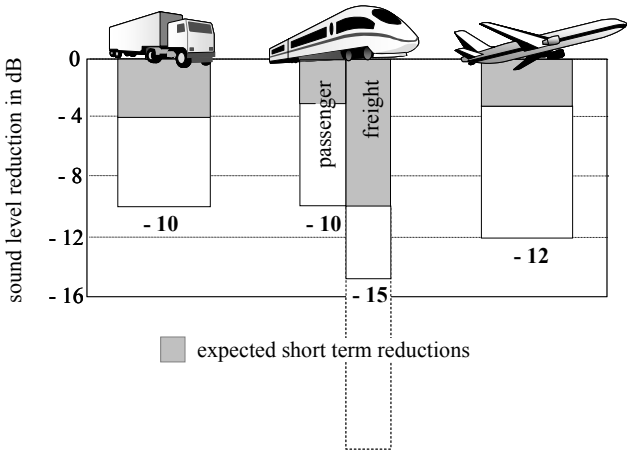

Figure 3: Noise reduction potentials

Low-noise road traffic

The major noise sources in road traffic are tire-road noise, propulsion noise and, at higher speeds, aerodynamic noise. Currenty the network partners concentrate on reducing tire-road noise which dominates at speeds above 40-50 km/h. Research topics are low-noise tires, sound absorbing surface materials (asphalt, concrete), tire-surface interaction and low-noise expansion joints at road-bridge transitions. Results made available early this year show that optimized tires on porous concrete are up to 4dB quieter than on mastic asphalt; however more research is required to increase the durability of porous concrete which is still inferior to that of mastic asphalt. A reduction of up to 2 dB was achieved with a foam clad and covered wheelhouses [3]. Efforts are underway in Quiet Traffic to include propulsion noise which plays a role especially in urban areas and at lower speeds.

Low-noise rail traffic

Current network projects deal with propulsion and brake noise prevailing at lower speeds. Research topics are acoustic quality control (vehicle acoustic prognosis and optimization), mitigation of noises caused by the ventilation systems of self-propelled rail vehicles, and heavy-duty disk-braking noise. Studies on rolling noise, caused by the interaction of wheels and tracks at medium speeds, include a rolling noise simulation tool and the verification of noise prediction, continuous anchoring, and optimized rail grinding. A project dealing with curve squeal is in the making.

Low-noise air traffic

Objectionable noise plaguing communities near airports comes from the engines and, during landing, increasingly from the airframe. The Quiet Traffic network takes a two-prong approach looking at operational and technical reduction potentials.

One project studies how operational procedures during take-off and approach/landing could be optimized—without any adverse effects on safety—such that the size of noise footprints on the ground is reduced.

Noise abatement at the source is the objective of projects dealing with engine and airframe noise. To reduce the (exhaust) jet noise, studies of the sound field behind the engine with improved acoustic cameras will lead to the development of quiet jet systems, including innovative serrated nozzles. To make the engine quieter, active and passive systems will be studied for suppression of disturbing discrete tones and broadband noise reduction. To reduce airframe noise, high lift devices and landing gears need to be modified to achieve short and medium term improvements with the help of simulation models and wind tunnel and flyover tests for data collection and model verification. Research will also address novel low-noise aircraft design concepts.

Acknowledgement

The research mentioned in this paper is supported by the German Ministry of Education and Research/BMBF with the exception of aircraft engine and airframe noise abatement which is supported by the Ministry of Economics and Labor/BMWA. BMBF has issued a brochure with status reports of the ongoing projects in 2003 [4].

References

[1] Reference to CALM Network - Community Noise Research Strategy Plan. URL: `http:// www.calm-network.com`

[2] Reference to "Forschungsverbund Leiser Verkehr" URL: `http://www.fv-leiserverkehr.de`

[3] Reichelt: Leiser Straßenverkehr. DFV-DLR-LV Symposium Berlin, Feb. 2004, in "Forschungsverbund Leiser Verkehr" URL: `http://www.fv-leiserverkehr.de`

[4] BMBF-Broschüre Leiser Verkehr - Lärmforschung im Forschungsprogramm Mobilität und Verkehr, Juni 2003