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Working Party on Transport Statistics
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agenda item 6(a))

GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN TRANSPORT STATISTICS

Report of the UN/ECE Workshop on GIS in Transport

(15-16 November 1999, Geneva)

NOTE: *The first UN/ECE Workshop on GIS in Transport was held from 15 to 16 November 1999 at the Palais des Nations in Geneva. The Workshop preceded the fiftieth session of the UN/ECE Working Party on Transport Statistics (WP.6) (17-19 November 1999) and was part of the celebration of its fiftieth anniversary session which was devoted to the theme of Indicators for Sustainable Transport. An evening reception was hosted by the software company Environmental Systems Research Institute (ESRI), who also presented literature and technical materials for the Workshop. The present Report has been prepared in English only, and contains in the Annexes, the Agenda for the Workshop and the List of Participants. Outlines of some presentations given during the Workshop will be made available as Informal Documents during the session of WP.6.*

BACKGROUND AND MANDATE

1. At its forty-ninth session, the Working Party was informed about the results of the Project on the Automation and Geographic Application of the 1995 E-Road Census, in which road traffic data and infrastructure parameters from 30 ECE member countries were produced in a Geographic Information System (GIS). The Working Party expressed its appreciation for

this work and asked the secretariat to explore the possibility of organizing a Workshop on GIS in Transport, the objective of which was to further explore the use of GIS technology for transport planning and road management, and to have an exchange of experiences among member countries and experts in the field (TRANS/WP.6/135, paras. 22-26).

2. The Workshop was chaired by Mr. Erik Grib (Denmark). Participants from the following ECE member countries were present: Canada, Croatia, Czech Republic, Denmark, Ireland, Italy, Latvia, Netherlands, Poland, Romania, Slovenia, Switzerland and The former Yugoslav Republic of Macedonia. Representatives were also present from the following international and intergovernmental organizations: Eurostat, the International Automobile Federation/International Association of Tourism (FIA/AIT), Touring Club Suisse (TCS), the International Union of Railways (UIC), the United Nations Environment Programme (UNEP/GRID) and the United Nations High Commission for Refugees (UNHCR). Representatives from the private sector were present as follows: Institute of Territorial Studies (IET), Topomat, S.A., Rosenthaler et Partenaires/INSER, S.A. and Environmental Systems Research Institute (ESRI) of Redlands, California (please refer to the List of Participants in annex 2).

OPENING OF THE WORKSHOP

3. The Workshop was opened by the UN/ECE secretariat (Mr. José Capel Ferrer, Director of the Transport Division and Ms. Brinda Wachs Shimizu, Economic Affairs Officer and Secretary to WP.6) and the Chairman (Mr. Erik Grib, Denmark). They cited the importance of GIS technology, considered increasingly important in various domains of transport technology from traffic management to transport planning, and a key component of Intelligent Transport Systems. They underlined that GIS technology allowed the integration of common database operations such as querying and database analysis with the visualization and cartographic representation of geographic information. In the field of transport, GIS allowed moreover not only the creation of maps, but the ability to model different scenarios in a geographic context, such as real-time information on traffic, weather and congestion, identification of new infrastructure, location of accidents, environmental consequences of transport and emergency response.

4. The Chairman called on the member countries present to assess the state of the art in GIS in their respective administrations. The representative of Latvia said that they were just beginning to use GIS in the Ministry of Transport. In Italy, GIS was being used in ANAS with national data on transport. In Israel, both the Statistical Office (CBS) and the Transport Ministry were making use of this technology, which was also the case in the Czech Republic. In Romania, the National Road Administration was using GIS both for managing traffic data and cadastre. Switzerland was using GIS in its Statistical Office in Neuchâtel through its Spatial Data Section.

GIS in Transport: Software Alternatives by ESRI, ***Mr. Ernest Ott, Transportation Industry Manager, Environmental Systems Research Institute (ESRI), Redlands, California***

5. Mr. Ott described the current user of GIS technology in the transport sector (GIS-T): over 10,000 technicians and academics who deal with transport statistics and planning

including road management in the United States alone, where he offered to introduce participants to GIS-T contacts. He said that GIS was used in automated data collection techniques for **assessing road maintenance** and management, and cited GPS (**Global Positioning System**) satellites that could take 3-D pictures of road and railway networks. He also cited **edge-mapping technology** in **land-use planning**. Moreover, he noted the importance of integrating GIS with GPS, as well as **voice recognition systems** to identify new infrastructure and requirements for maintenance, such as potholes, damage to bridges or roads and signal problems. Voice recognition allowed quick recorded messages of precise locations to dispatch repairmen. He also cited **Traffic Signal Controls**, **Ramp Metering** and other traffic maintenance systems that could be linked with GIS. **Linear Referencing** allowed the user to tie location from the field to a relational database to show, for example, pavement conditions on roads or track conditions on railways.

6. He pointed out, moreover, that transport infrastructure had its own life-cycle, including design, planning and construction, noting that GIS technology could be used in each phase. For airports, GIS was used to control hazardous materials, hydrology and modelling of noise emissions from the airport in outlying areas, including monitoring the patterns of complaints from noise, all in a GIS database.

7. He also cited examples where ESRI products were used in environmental impact reports to assess the **impact of transport on sensitive areas,** based on the information on **endangered species**, **proximity to water treatment** etc. and to create a weighted average cost model showing the relative environmental costs to determine the least environmentally costly development.

8. He also described the use of **dynamic segmentation** to link graphic and non-graphic information and cited recent trends in the integration and interoperability of transport systems, highlighting the possibility to link construction, engineering and planning information across modes to mapping information using GIS. He noted, moreover, the opportunity to integrate **computer-aided drafting** (CAD) techniques and GIS using ESRI's Spatial Data Engine (SDI) and cited the importance of using GIS in the **integration of transportation and land-use planning** to improve data integrity.

9. Finally, he gave the example of Korea, where **real-time satellite information** was used to depict weather conditions (snow, emergency floods, etc.) and traffic conditions.

Using the National Geographic Base in Transport Applications: the Canadian experience, ***Mr. Tim Davis, Director of the Geography Division, Statistics Canada***

10. Mr. Davis explained that Statistics Canada has been involved in Spatial Data Infrastructure for many years: he said they had a **street network file** covering all major streets in urban areas in Canada -- an **integrated database of spatial and geographic information**, enabling the user to delineate transportation-based geographic units and enhance journey-to-work analysis and map it on street files. He said also there was a system of geo-coding for emergency preparedness, but that emergency response has not really benefited from GIS. On the other hand, GIS was effective for **transportation network analysis** showing the relative industrial activity vs. existing transport infrastructure (for

planning purposes). He also noted the use of GIS for real estate applications, GIS to calculate **gas taxes for trucking** and the use of GIS for **just-in-time** delivery.

The GIS application of the UN/ECE E-Road Census: A Tool for Transport Analysis and Planning, ***Mr. Francesc Carbonell, Institut d'Estudis Territorials, Barcelona***

11. Mr. Carbonell explained the background of the UN/ECE Project on the Geographic Application of the 1995 E-Road Census, a GIS application of a long-standing data collection exercise by the United Nations to obtain traffic and infrastructure information on the AGR Network. He said that now that the statistical report and maps of the 1995 Census had been completed, as well as the electronic version on CD-ROM, the next phase was the Internet Application. He said the Internet Application of the Project would be an important step to develop in-depth analysis, both for ECE member Governments, as well as for transport planners and researchers. While the original database was constructed on the basis of tables set forth in the Recommendations to Governments, the future census should be developed into a relational database.

12. He noted, moreover, the difficulties in preparing the 1995 Census GIS due to inconsistencies in the data coming from member countries. He added that one of the benefits of GIS was that it was incremental, thus always allowing for additional fields of information. He demonstrated the Census GIS, pointing out, in particular, the percentage of heavy traffic in Switzerland as less than that of neighbouring countries, due to a strong transport policy in the Alpine region.

13. He underlined the fact that GIS allowed for different ways of reading traffic maps, such as a snap-shot of population and economic activity indicated by traffic volumes. As for traffic volumes, he noted the difference between Central European countries (averaging 50,000 vehicles per day) vs. outlying countries (10,000-15,000 vehicles per day) through a given counting point (on main E-roads). While admittedly it was difficult to determine the causality of the trends seen at different points on the maps, one could at least see the differences in population density as a partial explanation for the difference in traffic volumes. Effects of direct tolls too could explain traffic movements, and were shown on the maps. (*Please note that a summary of the IET presentation was presented as an Appendix to this Report as Informal document no. 4 to the Working Party on Transport Statistics.*)

First Panel Discussion:
Software and Internet Alternatives for GIS(T)

14. The panel members (see Agenda for names of panel members) noted that various experiments were currently taking place using Internet, including, but not limited to, the use of ESRI products like Internet Map Server (IMS). However, the consensus was that the Internet Application of many uses of GIS(T) were not yet ripe, and that it was still difficult to conceive of spatial information on the Internet in a useable format.

15. Mr. Ott of ESRI said that he saw two patterns in recent Internet Applications: people using Intranet and browser tools to expand spatial data available to a given organization, and

the increasing ability to expand services to citizens or customers through spatial services never offered before.

16. Mr. Couderq of Topomat said most of the solutions he had seen in Geneva involved the diffusion of data to a wider public through the Internet by use of Internet Map Server. This required all data to be stored on a single server and only applied to raster data, not to vector data. He pointed out that existing applications allowed the public to cite, for every Swiss canton, roads, schools, parking and other spatial information -- all stored on one server using Oracle and Spatial Database Engine from ESRI.

17. Mr. Henchoz of Touring Club Suisse said that the Internet was an interesting tool to provide information to users, but that the real problem was with data consultation and data quality. The Internet was interesting, moreover, for pre-trip information: e.g., to receive information on a planned trip between Geneva and Dublin. Thanks to Global Positioning Systems (GPS) and other on-board information systems (mobile data transfer), users could increasingly obtain important information in their cars, although there was often a problem with the speed and the quality of data. In future, he said, we would see many more on-board maps provided through the Internet.

18. Mr. Ott pointed out the importance of considering the user in developing Internet applications, by reducing to a minimum both functions and choices (buttons), and by keeping the selection possibilities down to simple tools such as zooming and panning. He urged information systems developers to take account of responses and demand of users, if necessary, through needs assessment interviews, and to customize the programs based on actual need.

19. Mr. Davis of Statistics Canada reiterated the importance of keeping mapping cites as simple as possible, pointing out that the beauty of Internet is that it was interactive, so it could allow for the collection of data (such as street files), not only the dissemination of data. Mr. Tardieu of NEA said he saw a huge future for the Internet in building up a GIS database on a European scale, but one important question would be the confidentiality of data.

Potential Uses of GEOSTAT for Transport and Environment Policy in Switzerland: Protection of Endangered Forestry and Noise Abatement, ***Mr. Rainer Humbel, Swiss Federal Statistical Office, Bern***

20. Mr. Humbel described the GEOSTAT system for Transport and Environment in Switzerland, saying that GEOSTAT was a service centre for the entire Swiss administration. He gave one example of how GIS can be used locally: maps showing existing dentists in Neuchâtel, based on population statistics. He also cited the example of GIS allowing for an indication of where pollution levels are highest, based on altitude and traffic. By identifying the slope of forests, moreover, one could also identify risks from avalanches. In the case of Railways, GIS could help identify the benefits and costs along a particular line in terms of noise reduction.

Use of GIS in Railway Transport Statistics, ***Mr. Michael Varga, International Union of Railways (UIC), Paris***

21. Mr. Varga presented the UIC's Rail Infrastructure GIS Database, which was developed using MapInfo. He said the objective of the database was to develop a European master plan for Railways, since many different railway standards are used across Europe. The UIC's GIS database included all lines from the AGC, AGTC, EU-TEN and 10 Helsinki Corridors (9 of which are road/rail, and 1 of which is in inland waterways on the Danube), and included railway infrastructure information available for each line (e.g., length, gauge, tracks, signalling, ERTMS [interoperable signalling system], design speed, length of tunnels, number of trains, electrification of lines and journey times). He said the access to the information was limited to members of UIC, but that the UIC was open to possible cooperative arrangements. (Please note that a summary of the UIC presentation is presented as an Appendix to this Report as Informal document no. 5 to the Working Party on Transport Statistics.)

The use of transport modelling and GIS to exploit EU regional transport statistics, ***Statistical Office of the European Communities (Eurostat), presented by Mrs. Caroline Heylan, Geographic Information Management (GIM), Luxembourg***

22. Ms. Heylan described the GISCO system of the European Commission which, using statistical data on the transport of goods by road, as well as socio-economic data, added a regional dimension to EC policy analysis. While the GISCO system did not contain much attribute information, it did have origin-destination information at the national and international levels in a GIS context. Also included in GISCO was information on traffic densities and the European road network. Using modelling and GIS, the system allowed for an analysis of the regional transport and trends on certain corridors.

The GRID Network, and Global/Regional GIS Databases for Transport-related Studies, ***Dr. Hy Dao, GRID / United Nations Environment Program, University of Geneva***

23. Mr. Dao described the GIS activities of UNEP/GRID, and cited in particular the work done on the relationship between transport data and environmental data, as well as the overlay of natural hazards with transport infrastructure. He said UNEP had developed a GIS application for Asia using transport data to distribute population, as well as work on an accessibility index calculated based on the transport network. (*Please note that a summary of this presentation was distributed as Informal document 7 during the Working Party on Transport Statistics.*)

Intelligent Transport Systems and GIS, ***Mr. Tom Royston, Head of Traffic Mobility and Intelligent Transport Systems (ITS), Federation Internationale de L'Automobile (FIA/AIT), Geneva***

24. Mr. Royston said that GIS was important to FIA members in the wider context of Intelligent Transport Systems (ITS). He said that the definition of ITS was the use of information and telecommunications technology to increase efficiency of transport as a key to sustainable mobility in the 21st century. Governments (transport planners) cared about ITS because of transport and the environment; not the construction of new roads -- but improvements in the efficiency of existing transport networks. Citizens cared about ITS

because of the level of services provided and their safety and security while travelling. Drivers wanted improved breakdown services, emergency response services.

25. He said there were a number of organizations responsible for collecting real-time data on traffic, including Inforoute, Roadwatch and Traffic Master, as well as National and Regional Traffic Control Centres. He said the data came from infrastructure-based sensors, floating car data, police reports and club members. He noted, however, that the lack of real-time dynamic traffic information would increasingly see traffic information brought to portable phones. In the future, he said we would see cellular phones fitted with global positioning systems and Internet-based navigation.

26. The representative of Romania said that it had started a pilot study on E-roads between Bucharest and Brussels and installed a system with 15 intelligent system stations, 12 portable message stations and a coordinating centre network system. With 60 posts along the national route, this system established the optimal route for traffic by road and determined the class of vehicles. (*Please note that a summary of the AIT/FIA presentation was presented as an Appendix to this Report as Informal document no. 7 to the Working Party on Transport Statistics.*)

Internet Alternatives for GIS(T), ***Messrs. Stéphane Couderq & Christophe Suter, Topomat, S.A., Geneva***

27. Mr. Couderq said that his company had published geographic information for the Canton of Vaud using Internet Map Server (IMS) and Spatial Data Engine of ESRI. The program was made up of a main map on which it was possible to navigate and show smaller synoptic maps. Each request to the map was sent to the IMS server of the State of Geneva, which generated the image response. Through this GIS system the user could obtain information on land parcels, subsidized housing, handicapped parking, etc. The system had a link with the office of Transport and Traffic in Geneva, which is also inputting its own datasets. He said Geneva was the most advanced of all the cantons of Switzerland because it had the most clear policy of open data access, while the other cantons were more reluctant to provide access to the public. This application was a result of a charter between partners to exchange data between different administrations (transport, housing, environment), allowing a dynamic assemblage of data in a GIS context.

Diffusion of Traffic Information on the Internet, ***Mr. John Michel Henchoz, Touring Club Suisse (TCS), Geneva***

28. Mr. Henchoz said that there was a big difference in perception of what constituted traffic information on the Internet and how it should be dealt with. In 1998, there were major problems in providing traffic information due to a lack of systems to manage and store information, the lack of clear standards for traffic reporting and the lack of automatic data input. A logical solution was GIS. Now TCS interfaces with the police to provide quality information about travel and transport to its members. Moreover, TCS has developed a system that combines Internet and mobile communications to personalize and customize real-time traffic information, which requires a well developed GIS framework.

Second Panel Discussion:
Intelligent Transport Systems and the Future of GIS(T)

29. The panel members (see annex 2 for members of panel) discussed the future of ITS and GIS(T), underlining that ITS needed to be considered as Information Technology services and better linked to end-user needs. As one example, they cited the development of intelligent speed adaptation (in residential areas) to compel drivers to control speeds through on-board GPS that knew the speed limit and knew when to slow the car down.

30. The panel noted that integrated modelling GIS was becoming an expanded field: models to predict how new factors change the spatial environment, which was also important in planning. Moreover, the interface between GIS emissions modelling and GIS flow data could be very important in the future of GIS(T).

31. Mr. Bouchardy of UNHCR said there was an interagency team to address emergency issues and humanitarian affairs, made up of representatives from FAO, OCHA, WHO and UNHCR. One objective was to share information about GIS and satellite imaging. He said the question of data quality was always important, as was the standardization of information. In emergency situations and conflict situations, transport information was essential: e.g., the existence and capacity of roads, bridges and tunnels.

STRADA: GIS database on Road Infrastructure, ***Mr. Claude Marschal, Rosenthaler + Partenaires / INSER S.A., Le Mont-sur-Lausanne***

32. Mr. Marschal introduced the STRADA project, saying it involved a dynamic segmentation of the Swiss road network for cartographic representation and a calculation for each object in a GIS road database. For each type of data, a separate shape file was created, making up a digitized network for navigation, road maintenance and traffic counts. (*Please note that a summary of the STRADA presentation is presented as an Appendix to this Report as Informal document no. 3 to the Working Party on Transport Statistics.*)

Use of RATIF-GIS in Road Transport Information, ***Dr. Chris Querée, Director, MVA, on behalf of Western European Road Directors (WERD)***

33. Mr. Querée described the use of RADEF, the Western European Road Directors' (WERD) system to provide access to a core database of European Highway Information. He said that the system consists of an application which sits in front of a database for each road administration and was a useful tool for cross-referencing, including accident information. He said that the challenge for RADEF was to target various issues confronted by WERD and search for strategies using GIS-based solutions.

Conclusions and Recommendations

34. The Chairman summed up some of the broader conclusions from the Workshop as follows: GIS is a mature instrument, but not consistently used. Licensing and cost prohibit a more general use of data. Many organizations used GIS, but many with overlapping applications. The need for good meta-data and meta-data standards came up repeatedly as an

important theme. Some software products like ESRI now included the capacity for data description and meta-data, since it was increasingly important to know at what precision data was captured and the variability of data. The importance of intersectoral analysis, also a priority area for the ECE, was cited as a logical avenue to exploit the use of GIS. Two important sectors to be explored in a follow-up Workshop could be the interface between urban transport and land-use planning, with GIS as the tool linking data in both sectors with the aim of comprehensive planning for sustainable urban development.

Annex 1

The first UN/ECE Workshop on GIS in Transport
15-16 November 1999, Palais des Nations, Geneva

FINAL AGENDA

Monday, 15 November 1999

9:30 **Registration, Palais des Nations,** ***Room H-3, Third Floor***

10:00 **Opening remarks,** ***José Capel Ferrer, Director of Transport Division, United Nations Economic Commission for Europe***

10:15 **Introduction of speakers & panelists,** ***Brinda Wachs Shimizu, UN/ECE & Erik Grib, Senior Statistician, Statistics Denmark***

10:30 **"GIS in Transport: Software Alternatives by ESRI"**
Ernest Ott, Transportation Industry Manager, Environmental Systems Research Institute (ESRI), Redlands, California

11:00 **Coffee Break** *(personalized demonstrations and self-practice)*

11:30 **"Using the National Geographic Base in Transport Applications: the Canadian experience"**
Tim Davis, Director of the Geography Division, Statistics Canada

12:00 **"The GIS application of the UN/ECE E-Road Census: A Tool for Transport Analysis and Planning"**
Francesc Carbonell, Institut d'Estudis Territorials, Barcelona

12:30 Lunch Break

14:30 First Panel Discussion:
Software and Internet Alternatives for GIS(T)

15:00 **"Potential Uses of GEOSTAT for Transport and Environment Policy in Switzerland: Protection of Endangered Forestry and Noise Abatement"**
Rainer Humbel, Swiss Federal Statistical Office, Bern

15:30 **"Use of GIS in Railway Transport Statistics"**
Michael Varga, International Union of Railways (UIC), Paris

16:00 **Coffee Break (***personalized demonstrations and self-practice***)**

16:30 **"The use of transport modelling and GIS to exploit EU regional transport statistics"**
Statistical Office of the European Communities (Eurostat), presented by Caroline Heylan, Geographic Information Management (GIM), Luxembourg

17:00 **"The GRID Network, and Global/Regional GIS Databases for Transport-related Studies"**
Dr. Hy Dao, GRID / United Nations Environment Program, University of Geneva

18:00-19:00 Evening Reception ***(8th Floor Restaurant, Palais des Nations)***

Tuesday, 16 November 1999

10:00 **Synthesis of first day, discussion and questions**

10:30 **"Intelligent Transport Systems and GIS"**
Tom Royston, Head of Traffic Mobility and Intelligent Transport Systems (ITS), Federation Internationale de L'Automobile , Geneva

11:00 **Coffee Break (***personalized demonstrations and self-practice***)**

11:30 **"Internet Alternatives for GIS(T)"**
Stéphane Couderq & Christophe Suter, Topomat, S.A., Geneva

12:00 **"Diffusion of Traffic Information on the Internet"**
John Michel Henchoz, Touring Club Suisse, Geneva

12:30 Lunch Break

14:30 Second Panel Discussion:
Intelligent Transport Systems and the Future of GIS(T)

15:30 **"STRADA: GIS database on Road Infrastructure"**
Claude Marschal, Rosenthaler + Partenaires / INSER S.A., Le Mont-sur-Lausanne

16:00 ***Use of RATIF-GIS in Road Transport Information*, Dr. Chris Querée, Director, MVA, on behalf of Western European Road Directors (WERD)**

16:30 Conclusions and Recommendations

17:00 Close of Workshop

PANEL DISCUSSIONS

Monday, 15 November 1999

14:30 First Panel Discussion:
Software and Internet Alternatives for GIS(T)

Panelists:

E. Ott, ESRI
S. Couderq / C. Suter, Topomat, SA
R. Muggli, GIS Consultant
J.M. Henchoz, Touring Club Suisse

Tuesday, 16 November 1999

14:30 Second Panel Discussion:
Intelligent Transport Systems and the Future of GIS(T)

Panelists:

T. Royston, FIA/AIT
C. Marschal, Rosenthaler + Partenaires / INSER, SA
E. Ott, ESRI
J-Y. Bouchardy, UNHCR

Annex 2

The first UN/ECE Workshop on GIS in Transport

LIST OF PARTICIPANTS

Chairman: Mr. Erik GRIB (Denmark)

CANADA
Mr. Tim DAVIS
Director, Geography Division
Statistics Canada
3C7 Jean Talon Building
Tunneys Pasture
Ottawa, Ontario K1A 0T6
Tel: (1-613) 951 9710 / Fax: (1-613) 951 0569 / e-mail: davitim@statcan.ca

CROATIA
Mrs. Edita KNEZIC OMERZO
Statistician, Central Bureau of Statistics
POB 671
Ilica 3
Zagreb
Tel: (385-01) 4806 111 / Fax: (385-01) 4817 666 /e-mail: omerzoe@dzs.hr

CZECH REPUBLIC
Mrs. Olga KASTLOVA,
Ministerial Counsellor, Ministry of Transport and Communications
Nabrezi Ludvika Svobody 12
110 15 Prague 1
Tel: (420-2) 514 31 439/ Fax: (420-2) 248 12 293 / e-mail: kastlova@mdcr.cz

Mr. Milan BRICH
Head of Department, Transport Research Centre - Division Praha
Sokolovska 82, 180 00 Praha 8
Tel: (420-2) 2481 7383,7386,7387 /Fax: (420-2) 2481 8391/ e-mail: mbrich@cdvgis.cz

DENMARK
Mr. Erik GRIB
Senior Statistician, Statistics Denmark
Sejrogade 11, 2100 Copenhagen OE
Tel: (45-39) 17 30 25 / Fax: (45-39 17 34 25 / e-mail: eeg@dst.dk

ISRAEL
Mr. Shahar KATZ
Head, GIS, Central Bureau of Statistics
66 Kanfei Nesharim St., Jerusalem
Tel: (972-2) 659 2158 / Fax: (972-2) 659 2173 / e-mail: shahar@cbs.gov.il

ITALY
Mr. Sandro LA MONICA
Engineer, ANAS Italian National Road Authority
Via della Stazione di Cesano 311
00064 Cesano (Rome)
Tel. (3906) 30434043 / Fax (3906) 3038585 / e-mail: anas_cesano@rmnet.it

LATVIA
Mrs. Inta ROZENSTEINE
Deputy Head of Division, Ministry of Transport
Gogola iela 3
Riga LV 1743
Tel: (37-1) 702 8344 / Fax: (37-1) 721 7180 / e-mail: intaro@sam.gov.lv

NETHERLANDS
Mr. Philippe TARDIEU
Project Manager, NEA
Polakweg 13
2288 GG Rijswijk
Tel: (31-70) 3988 369 /Fax: (31-70) 395 4186 / e-mail: pta@nea.nl

POLAND
Mrs. Malgorzata DYTMAN
Deputy Director, Central Statistical Office
Niepodleglosci Ave. 208
00925 Warsaw
Tel: (48-22) 608 3473 / Fax: (48-22) 608 3882 / e-mail: m.dytman@stat.gov.pl

Mr. Boguslaw BARCIKOWSKI
Transport Statistics Expert, Central Statistical Office
Niepodleglosci Ave. 208
00925 Warsaw
Tel: (48-22) 608 3201 / Fax: (48-22) 608 3882 / e-mail: b.barcikowski@stat.gov.pl

ROMANIA
M. Florea DASCALU
Chef de Service, Administration Nationale des Routes
Bdul. Dinicu Golescu Nr. 38
Secteur 1
Bucharest 1
Tel: (40-1) 638 4325 / Fax: (40-1) 312 0984 / e-mail: admin.and@mx.and.logicnet.ro

M. Mircea Gheorghe NICOLAU
Conseiller, Administration Nationale des Routes, CESTRIN
Rue Soveja No. 115
Secteur 1, Bucharest 1
Tel: (40-1) 312 82 05 / Fax: (40-1) 312 82 05 / e-mail: admin.and@mx.and.logicnet.ro

SLOVENIA
Mr. Misko VIDMAR
Assistant Director, Statistical Office
Vozarski pot 12
1000 Ljubljana
Tel: (386-61) 125 88 39 / Fax: (386-61) 216 932 / e-mail: miso.vidmar@gov.si

Mrs. Slavica CERNE
Adviser to the Director, Statistical Office
Vozarski pot 12
1000 Ljubljana
Tel: (386-61) 125 88 38 / Fax: (386-61) 216 932 / e-mail: slavica.cerne@gov.si

SWITZERLAND
Mr. Rainer HUMBEL
Section Head, Federal Statistical Office
Espace de l=Europe 10
2010 Neuchâtel, Switzerland
Tel: (41-32) 713 66 91 / Fax: (41-32) 713 65 60 / e-mail: rainer.humbel@bfs.admin.ch

Mr. Pierre CAILLE
Head of Transport Section, Federal Statistical Office
Espace de l=Europe 10
2010 Neuchâtel, Switzerland
Tel: (41-32) 713 68 91 / Fax: (41-32) 713 69 81 / e-mail: pierre.caille@bfs.admin.ch

Mr. François-Xavier DE ROSSI
Collaborateur scientifique, Office fédéral de la statistique
Espace de l=Europe 10
2010 Neuchâtel, Switzerland
Tel: (41-32) 713 60 97/Fax: (41-32) 713 69 81/e-mail: francois-xavier.derossi@bfs.admin.ch

Mrs. Gerda SUTER
Adjointe scientifique
Office fédéral de la statistique
Espace de l=Europe 10
2010 Neuchâtel, Switzerland
Tel: (41-32) 713 66 55 / Fax: (41-32) 713 69 81 / e-mail: gerda.suter@bfs.admin.ch

THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA
Mrs. Verka PANOVA-GROZDANOSKA
Director's Advisor, Statistical Office
Dame Gruev 4
91000 Skopje
Tel: (389-91) 137 190 / Fax: (389-91) 111 336 / e-mail: verkap@stat.gov.mk

***

EUROSTAT
Ms. Caroline HEYLEN
Consultant, Geographic Information Management SA
Ribaucourt Straat 139
1080 Sint Jans Molenbeek
Luxembourg
Tel: (35-2) 42 20 43 / Fax: (35-2) 42 20 44 / e-mail: caro@gim.lu

FEDERATION INTERNATIONALE DE L'AUTOMOBILE (FIA/AIT)
Mr. Tom ROYSTON
Head of Traffic and ITS
Blandonnet, 2
1215 Cointrin, Geneva
Switzerland
Tel: (41-22) 544 45 15 / Fax: (41-22) 544 45 50 / e-mail: troyston@aitgva.ch

TOURING CLUB SUISSE
M. Jean-Michel HENCHOZ
Engineer
ch. de Blandonnet 4
CP 820
1214 Vernier/Genève
Switzerland
Tel: (41-22) 417 29 63 / Fax: (41-22) 417 2020 /e-mail: jhenchoz@tcs.ch

UNION INTERNATIONAL DES CHEMINS DE FER (UIC)
Mr. Michael VARGA
Infrastructure
16, rue Jean Rey
75015 Paris
France
Tel: (33-1) 4449 2063 / Fax: (33-1) 4449 2069 / e-mail: varga@uic.asso.fr

Mr. Alain JEHAN
Chargé de mission statistique
16, rue Jean Rey
75015 Paris
France
Tel: (33-1) 4449 2281 / Fax: (33-1) 4449 2289 / e-mail: jehan@uic.asso.fr

WESTERN EUROPEAN ROAD DIRECTORS (WERD)
Dr. Chris QUEREE
Director, MVA
Victoria Way
Woking GU21 1DD
United Kingdom
Tel: (44-1483) 728 051 / Fax: (44-1483) 755 207 / e-mail: cqueree@mva.co.uk

UN/ECE/TEM
Mr. Petr POSPISIL
Project Manager, Trans-European North-South Motorway
l0 Goledzinowska St.
03 302 Warsaw
Poland
Tel: (48-22) 614 5397, 5399 / Fax: (48-22) 614 5401 / e-mail: untem@promail.pl

Mr. Petr POSPISIL
Student, Prague University of Economics
Horackova 926
14000 Prague
Czech Republic
Tel: (420-2) 414 000 23 / e-mail: xposp09@vse.cz

UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP)/
GLOBAL RESOURCE INFORMATION DATABASE (GRID)
Dr. Hy DAO
GIS Analyst, Geneva Executive Center (GEC)
15, chemin des Anémones
1219 Châtelaine, Geneva
Switzerland
Tel: (41-22) 917 8225 / Fax: (41-22) 917 8029 / e-mail: hy.dao@grid.unep.ch

UNITED NATIONS HIGH COMMISSIONER FOR REFUGEES (UNHCR)
Mr. Jean-Yves BOUCHARDY
Senior Information Officer (Environment)
Division of Operational Support
Case postale 2500
1211 Geneva 2 Dépôt
Switzerland
Tel: (41-22) 739 7963 / Fax: (41-22) 739 73 28
e-mail: bouchard@unhcr.ch

Mr. Einar BJORGO
Associate Information Officer (Geographical Data)
Division of Operational Support
Mapping Unit
Case postale 2500
1211 Geneva 2 Dépôt
Switzerland
Tel: (41-22) 739 85 50 / Fax: (41-22) 739 73 28 / e-mail: bjorgo@unhcr.ch

Private Sector

ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE (ESRI)

Mr. Ernest OTT
Transportation Industry Manager
380 New York Street
Redlands, CA 92373
USA
Tel: (1-909) 793 2853 x1984 / Fax: (1-909) 307 3039 / e-mail: eott@esri.com

Mr. Emanuele GENNAI
Manager for Switzerland
4 rue Cavour
1211 Genève 8
Switzerland
Tel: (41-22) 940 08 00 / Fax: (41-22) 940 08 01 / e-mail: e.gennai@esri-suisse.ch

INSTITUT D=ESTUDIS TERRITORIALS (IET)

Mr. Francesc CARBONELL
Consultant
Institut D=Estudis Territorials
Wellington 19
08018 Barcelona
Spain
Tel: (34-93) 485 11 93 / Fax: (34-93) 485 03 59 / e-mail: ptmb@fcr.es
francesc.carbonell@upcnet.upc.es

TOPOMAT, S.A.

Mr. Stéphane COUDERQ
Directeur technique
ch. Sus-la-Meule 6
1297 Founex VD
Suisse
Tel: (41-22) 776 07 50 / Fax: (41-22) 776 07 59 / e-mail: scouderq@topomat.ch

Mr. Christophe SUTER
Developer
ch. Sus-la-Meule 6
1297 Founex VD
Suisse
Tel: (41-22) 776 07 50 / Fax: (41-22) 776 07 59 / e-mail: csuter@topomat.ch

Mr. R. MUGGLI
GIS Consultant
14 Avenue de Luserna
1203 Geneva
Switzerland
Tel: (41-22) 344 22 47

ROSENTHALER & PARTENAIRES / INSER S.A.
Mr. Claude MARSCHAL
Feldrebenweg 16
4132 Muttenz
Switzerland
Tel: (41-61) 467 9700 / Fax: (41-61) 467 97 05 / e-mail: cm@rpag.ch

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ECE Secretariat

Mr. José CAPEL FERRER
Director
Transport Division
UN Economic Commission for Europe
8-14 ave. de la Paix
1211 Geneva 10
Tel: (41-22) 917 2400 / Fax: (41-22) 917 0039 / e-mail: jose.capel.ferrer@unece.org

Mrs. Brinda Wachs SHIMIZU
Economic Affairs Officer
Transport Division
UN Economic Commission for Europe
8-14 ave. de la Paix
1211 Geneva 10
Tel: (41-22) 917 2452 / Fax: (41-22) 917 0039 / e-mail: brinda.shimizu@unece.org

M. Bernard PERROLLAZ
Statistical Assistant
Transport Division
UN Economic Commission for Europe
8-14 ave. de la Paix
1211 Geneva 10
Tel: (41-22) 917 2972 / Fax: (41-22) 917 0039 / e-mail: bernard.perrollaz@unece.org

Mrs. Gina FAURE
Secretary
Transport Division
UN Economic Commission for Europe
8-14 ave. de la Paix
1211 Geneva 10
Tel: (41-22) 917 2152 / Fax: (41-22) 917 0039 / e-mail: gina.faure@unece.org

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