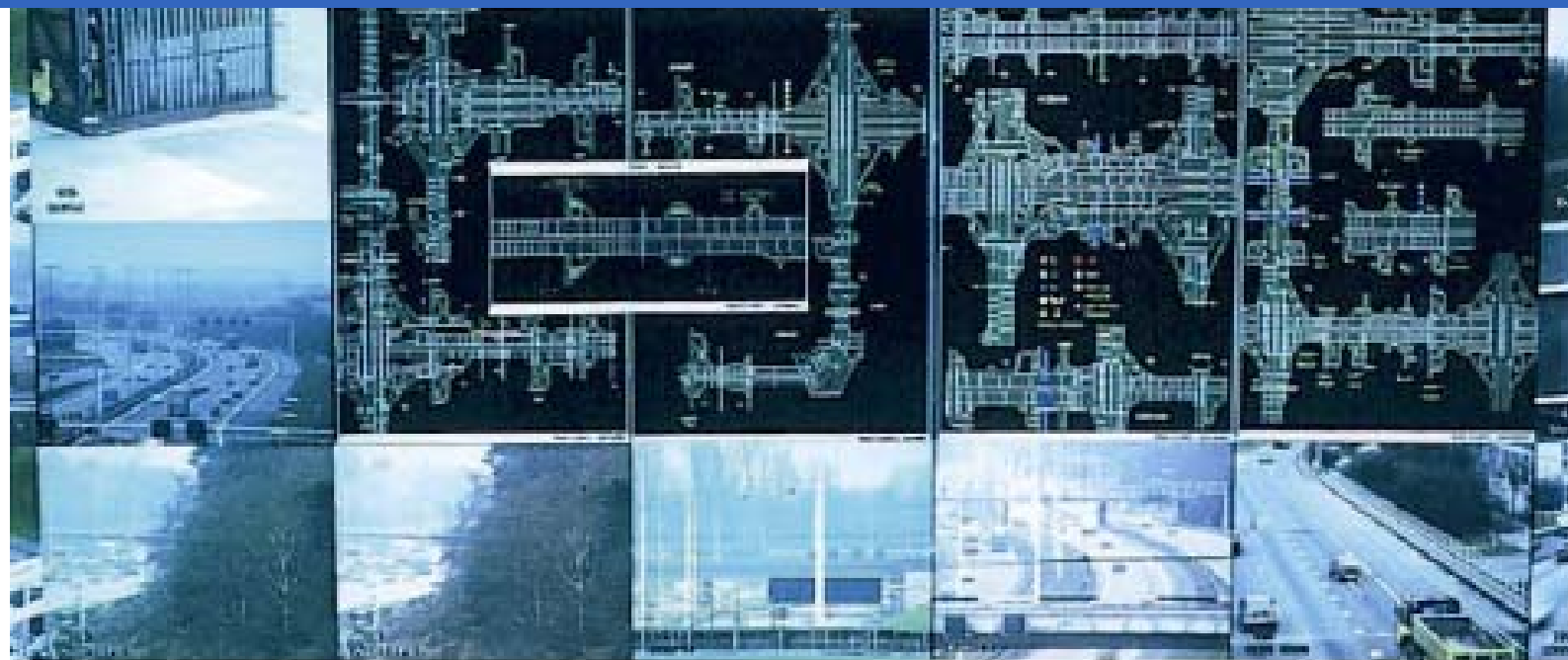




**Conférence Européenne  
des Directeurs des Routes**

**Conference of European  
Directors of Roads**

# *Network operations*



***April 2008***

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## Executive summary

CEDR tasked its project group 'Capacity and Service to Road Users' to come up with a definition of the term 'network operations' (NetOp) and, based on this definition, to develop new ideas that could be incorporated into the way the National Road Authorities (NRAs) work.

For the purposes of the following definition of the term 'NetOp', the provision of services to the customer/road user is considered to be the core task of NRAs.

***Network Operations is the delivering of user-oriented traffic management services to fulfil the need for the sustainable<sup>1</sup> movement of people and goods.***

<sup>1</sup> For the purposes of this definition, 'sustainable' is understood to mean 'safe, economical, and environmentally friendly'.

In order to make it easier for NRAs to use the term and to act on it, it was decided to limit the scope of the NetOp definition by putting it into context. Among other things, NetOp mainly:

- Harmonises/balances the demand for mobility and the supply of services to facilitate this demand. It includes all conditions that allow for the provision of NetOp services, such as a consistent network strategy, an efficient organisational structure, processes, programmes, capabilities, and an analysis of costs and benefits.
- Supports the efficient use of transport means and the existing infrastructure.
- Focuses not only on the improvement of traffic flows but also supports the protection of the environment and the improvement of road safety.
- Can be provided on a collective (public) or individual (private) basis by service providers with different objectives (e.g. by NRAs seeking to improve traffic flow performance or by broadcasters seeking to attract listeners).
- Combines traffic management, traffic information management, and asset management.

From the users' point of view, a distinction can be made between services provided directly to the (individual) users and those provided indirectly to the users within collective objective(s). A separate theme has been created for emergency services because these services have both a collective and an individual objective, resulting in a threefold subdivision:

- user-oriented services (travellers and goods),
- network management services, and
- emergency management services.

This subdivision supports interaction with other stakeholders. The involvement of more stakeholders—both public and private—in NetOp will change the current tasks, roles, and responsibilities of NRAs. These changes are already taking place and it is expected that NRAs will be positioned and acknowledged as one of the key mobility service providers.

In order to allow NRAs to organise services and make them available to road users, this report contains an inventory of essential aspects that influence either directly or indirectly the performance of NetOp or are a prerequisite to NetOp. These aspects can be summed up under the following headings: services, consistent network strategies, efficient organisation, processes, capabilities, programmes, and cost-benefit analysis.

The discussion about the aforementioned definition and its context was based on experience gained in practical cases at national level. As an important spin-off, this report presents some new ideas and makes recommendations for action that is urgently needed in order to allow NRAs to become better network operators.

It will be necessary to further elaborate on the following two actions:

- business models for the organisation of NetOp
- cooperation between public service providers and/or operators.

It is expected that the results of these activities will make a major contribution to the future position of NRAs in the multi-actor public/private arena within the space of one year.

In order to demonstrate the importance of taking action on NetOp, the ‘do nothing’ approach and the ‘NetOp’ approach were compared. Based on this comparison, the practical national cases discussed with NRA experts, and the results of the Executive Board workshop in Rome, the Governing Board adopted this report on **NetOp** presented by the project group ‘Capacity and Service to Road Users’.



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## 1 Definition of the issue (problem)

In 2004, CEDR's Governing Board endorsed the results of the report entitled 'Towards Network Operations – Big Shift' (see <http://www.cedr.eu/home/index.php?id=14>). However, it was felt that there was a need to elaborate on this issue, putting more emphasis on customer orientation and services. This report is the outcome of this work.

The group's objective in writing this report was to come up with a definition of the term 'NetOp' and to produce and exchange new ideas in view of incorporating these ideas into the way NRAs work.

### Background information

Several organisations are currently investigating how to shift their focus from the construction of new roads and maintenance of existing roads towards NetOp.

The first discussion focussed on what is meant by the term 'NetOp'.

The Federal Highway Administration in the USA initiated a National Dialog on Transportation Operations in an attempt to encourage discussions on operations issues, advocating a stronger focus on operating the nation's transportation system. The mission was 'to improve management and operation of the nation's existing transportation system so that its performance will exceed customer expectations'. The FHWA defines NetOp as follows:

*Network operations is 'the preservation of the available transport network capacity by managing operations on a day-to-day basis'.*

At its core, NetOp is the application of programmes, technology, and business processes that support the flow of vehicles, travellers, and goods on the existing transportation infrastructure. The FHWA supports activities that seek to improve day-to-day operations through asset management, application of traffic control devices, and real-time traveller information, and uses traffic analysis tools to better understand problems and possible solutions.

PIARC has published a handbook on road NetOp, initiated by the change in transport demand and the interest of the private sector in traffic services. The starting point for the discussion in PIARC was CEDR's 'Towards Network Operations – the Big Shift' report. PIARC defines NetOp as follows:

*Network operations is 'All traffic management and user support activities intended to permit, improve, or facilitate the use of an existing network, whatever its conditions of use'.*

Road NetOp concerns all activities directly related to the concept of service to the user of a road network (members of the public, freight transporters, and public transport operators) and to service improvement.

NetOp therefore differs from:

- *improvement* of the infrastructure, which consists of equipping it and adjusting its geometric and physical characteristics;

- *maintenance* of the infrastructure, which seeks to ensure the preservation, quality of use, and renewal of road assets;
- *traffic policing powers* that concern general or local rules of road use, whether permanent or temporary.

NetOp requires defined levels of services and associated quality indicators to quantify user satisfaction and the efficiency of the whole road system when considered as part of a global transport system. Effective NetOp requires continuous consultation between all those using and working on the road network, including the police, emergency and incident services, vehicle recovery organisations, other highway authorities, and road user representatives. Moreover, operation-related concerns must be taken into account from the design and development stage of the infrastructure.

National parliaments give public bodies their legitimacy by giving them a license to operate. The objective of these bodies—whether it be a national road administration and/or a ministry that is responsible for roads—is to provide citizens with a good road infrastructure that is well managed and therefore capable of meeting customer needs.

The present study starts with the FHWA and PIARC definitions and context as described above.

However, in line with the ‘license to operate’ outlined above, an alteration of the definition was necessary in order to take into account the importance of service provision to the customer/road user.



## 2 CEDR's definition of NetOp

NRAs are obliged to contribute to sustainable mobility by managing their networks.

The group addressed the NRAs' scope of work by evaluating their national approaches to NetOp. This approach, combined with others, provided input for what can be termed NetOp, and allowed for the development and exchange of new NetOp ideas.

The work done both by PIARC and FHWA in defining NetOp was carefully evaluated. These definitions were used as a starting point for CEDR's own definition. This was considered to be the best approach in the light of the lessons learned during case studies and the approaches adopted by some NRAs.

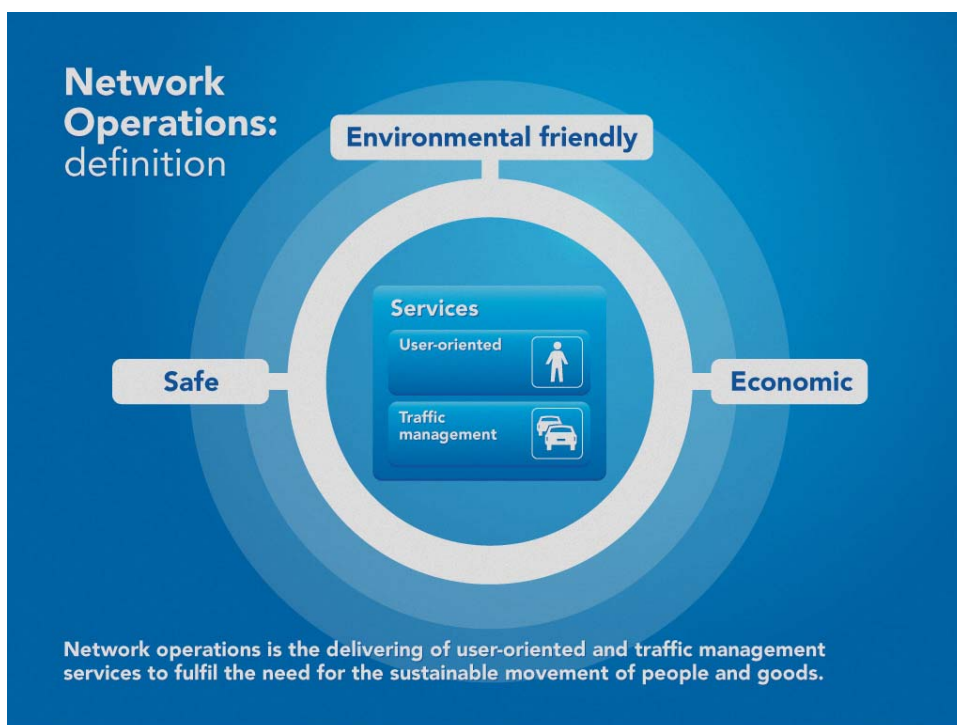
It can be concluded that NetOp is an important aspect of a comprehensive mobility arena in which people and goods can move freely and safely with the help and support of a customised infrastructure and user-friendly services. Mobility is a major prerequisite for economic growth and social development. A well-functioning system for the transport of people and goods and reliable accessibility are essential for the economy. Such a system can only be achieved by ensuring balance and harmony between the economy, space, traffic, and transport.

In order to improve NetOp, thereby helping NRAs to meet society's needs, it is necessary to define NetOp.

CEDR's definition of the term 'NetOp' reads as follows:

*Network operations is 'the delivering of user-oriented traffic management services to fulfil the need for the sustainable<sup>1</sup> movement of people and goods'.*

<sup>1</sup> For the purposes of this definition, 'sustainable' is understood to mean 'safe, economical, and environmentally friendly'.





### Putting NetOp in context

In order to make this definition applicable and to allow NRAs to take appropriate action, a broad context has been defined for NetOp. It is hoped that this context will help NRAs to fulfil their role as network operators:

- NetOp harmonises/balances the demand for mobility and the supply of services to facilitate this demand. It includes all conditions that allow for the provision of NetOp services, such as a consistent network strategy, an efficient organisational structure, processes, programmes, capabilities, and an analysis of costs and benefits. Although ITS is at present only a rather small NetOp tool, it certainly has significant growth potential.
- NetOp supports the efficient use of transport means and the existing infrastructure.
- NetOp services can be provided on a collective (public) or individual (private) basis by service providers with different objectives (e.g. by NRAs seeking to improve traffic flow performance or by broadcasters seeking to attract listeners).
- In principle, NetOp covers all roads, railroads, and waterways: CEDR, however, restricts itself to the strategic road network (urban, interurban), alternative road routes, and interfaces to the other modes.
- NetOp not only focuses on the improvement of traffic flows but also supports the protection of the environment and the improvement of road safety
- NetOp covers both long-term (>24 hrs) and short-term (<24hrs) activities and actions. Long-term and general operations/planning supports day-to-day traffic management and service provision to the road users.
- NetOp is the combination of traffic management, traffic information management, and asset management.
- Minor infrastructure changes that seek to improve function and traffic performance are considered part of NetOp; the planning and construction of new roads is not considered part of NetOp.
- The role, tasks, and responsibilities of NRAs in the field of NetOp depend on the position of each NRA in its national organisation and any (contractual) arrangements it may have with other stakeholders.
- The services provided by NetOp can differ in quality and/or availability depending on the function of the specific part of the transport network.

## **3 Elaboration of the proposed definition and aspects of the context**

As indicated in the definition, NetOp must be seen in its context. This chapter addresses in greater detail some of the important aspects of this context, including:

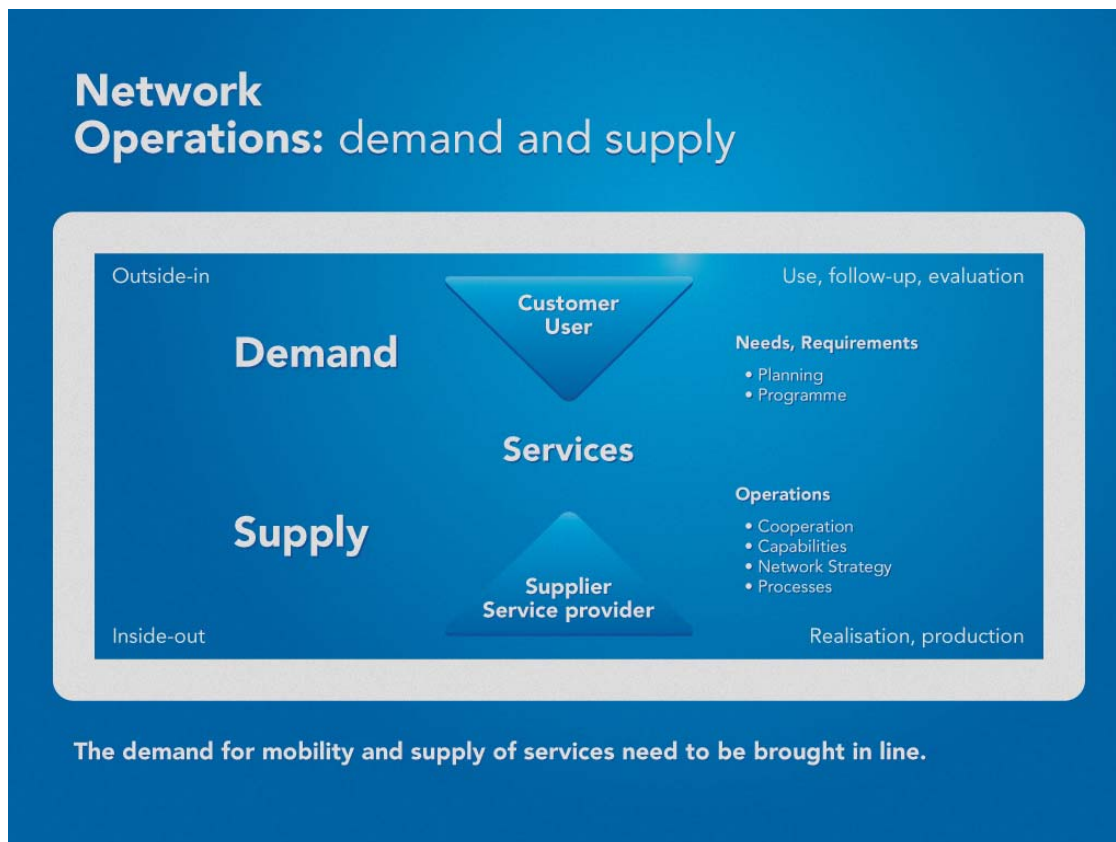
- 3.1 Balancing supply and demand,
- 3.2 Short- and long-term NetOp services,
- 3.3 Requirements for the provision of NetOp services, and
- 3.4 NRA roles, tasks, and responsibilities.

### 3.1 Network operations balances supply and demand

As described in the context above, NetOp harmonises the demand for mobility and the supply of services. NetOp is a set of services that are provided to road users in order to enable and facilitate the mobility of travellers and goods. NetOp is approached from the user's point of view and the position of the NRAs.

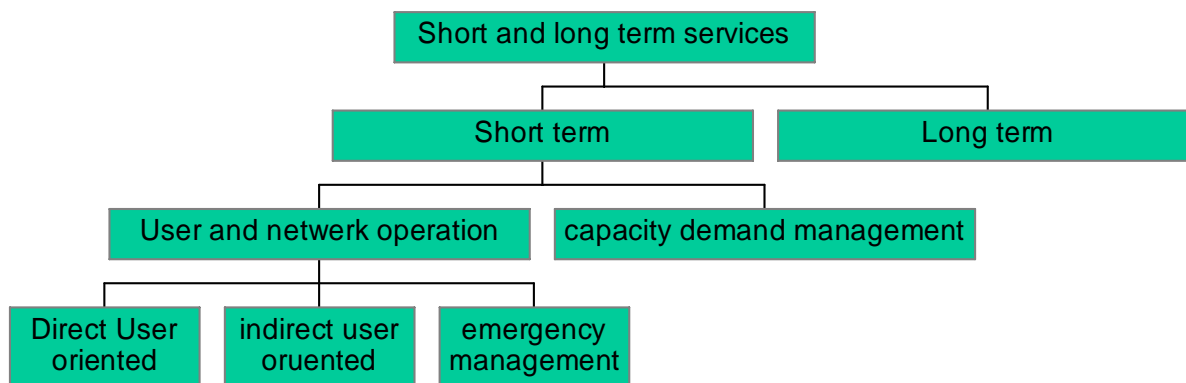
The demand for mobility and the supply of services needs to be brought into balance. Various different services can facilitate mobility. The provision of these services is built around operations in which processes, systems, organisation, capabilities, and (road) network strategies are closely linked.

NetOp services can focus on individual users or on specific groups of road users (e.g. road users on a specific route or heavy goods vehicles). Whether the individual user or specific groups of users are addressed often depends on the provider's objective, interest, and business. NRAs are responsible for collective efficiency, safety, and network management and therefore focus on all road users or specific group(s), while commercial operators see greater benefit in focussing on individual users/clients.



## 3.2 Short- and long-term NetOp services

Services provided to road users can be considered an opportunity for the network operator to manage road capacity demand. This management/operation can be separated into two different aspects, both of which are directly related to services and its organisation, namely short-term and long-term operation as shown in the figure below:



### 3.2.1 Short-term (day-to-day) operation

Short-term (day-to-day) operation consists of various groups of services that have been approached from different angles, namely:

- a) user and network operation services (from the users' point of view) and
- b) capacity demand management (frequently from the NRAs' point of view).

#### a) User and NetOp services (from the users' point of view)

This viewpoint approaches day-to-day NetOp from the users' point of view. A distinction is made between the services provided directly to the (individual) users and those provided indirectly to the users within the collective objective by means of network management. Although directly focused on the user, a separate theme has been created for incident management services because these services have both a collective and an individual objective. These themes are:

- i) user-oriented services (travellers and goods),
- ii) indirectly user-oriented services (collective objectives by means of network management services), and
- iii) emergency management services.

On this basis, a more detailed breakdown of the services is provided below.

#### i) Examples of user-oriented services (travellers and goods):

- real time traveller information (RTTI)
  - traveller information (en route and pre-trip)
  - traffic information, weather information, warning information, etc.
  - route advice and navigation
- speed alert
- public transport
- commercial vehicle operations
- extended environmental information

**ii) Examples of indirectly user-oriented services (collective objectives by means of network management services):**

- traffic management and control, e.g.
  - hard shoulder running, additional left lane, buffering
  - variable message sign (VMS), route guidance / rerouting
  - ramp metering and traffic controllers
  - lane closure
- traveller information (pre-trip)
- road pricing (pay for mobility)
- environmental conditions monitoring & management
- road safety management
- road works management
- small network improvements (to improve traffic flow performance)
- maintenance activities

**iii) Examples of emergency management services:**

- monitoring and incident response on dangerous goods transport
- incident notification, incident services and eCall
- incident vehicle management
- disaster management
- road weather management



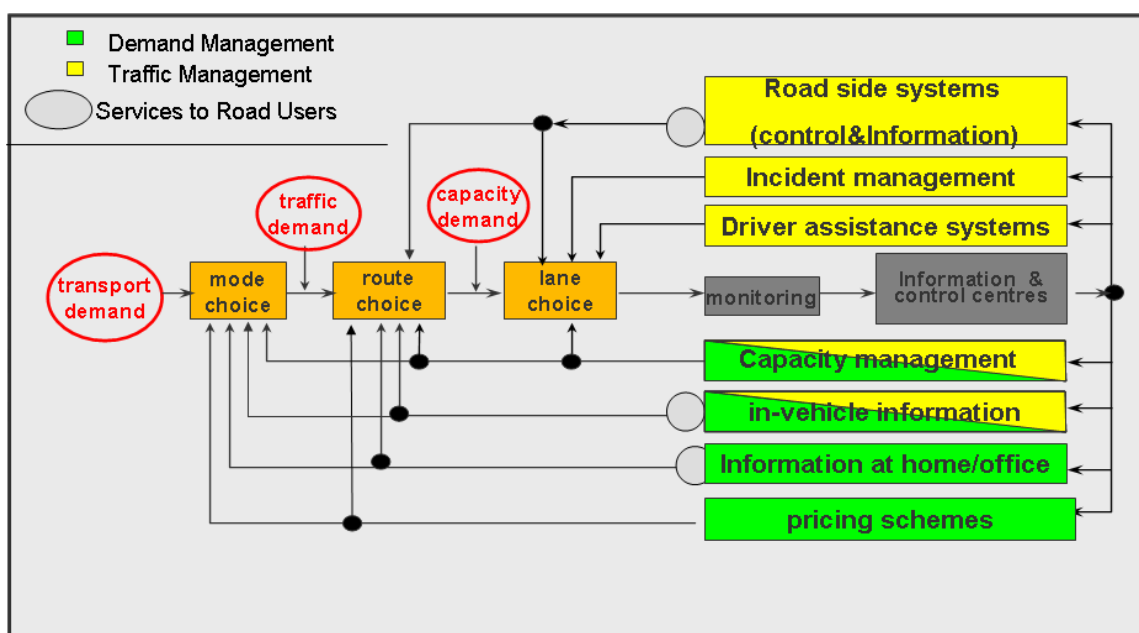
The day-to-day operation of the network is the actual service provided to the road users, management of traffic flows by harmonising the gap between supply shortage (due to lack of road capacity, road works, incidents) and demand (commuting, special events, etc.).

## b) Capacity demand management (frequently from the NRAs' point of view)

This viewpoint approaches day-to-day NetOp from the network operators' point of view. It is a complex process and has different influence levels. These levels include:

- Transport demand: this is the total transportation demand (users and goods) for the entire transport network, independently of the mode of transport. This demand can be influenced by mode choice.
- Traffic demand: this is the total transportation demand (users and goods) for the road network. This demand can be influenced by route choice.
- Capacity demand: this is the total transportation demand (users and goods) for a specific road. This demand can be influenced by, for example, lane choice.

From the NetOp point of view, a range of services are available for the management of demand at these three different levels. The different services have an (complex) influence on the different level or levels. This is illustrated in the diagram below, which shows the relationship between demand level and the influence of several services. These services can be provided by the network operator or (commercial) service providers.



*Diagram of transport demand management*

### 3.2.2 Long-term operation

Long-term (and general) operation involves the preparation, maintenance, and provision of support for the day-to-day operation of the network.

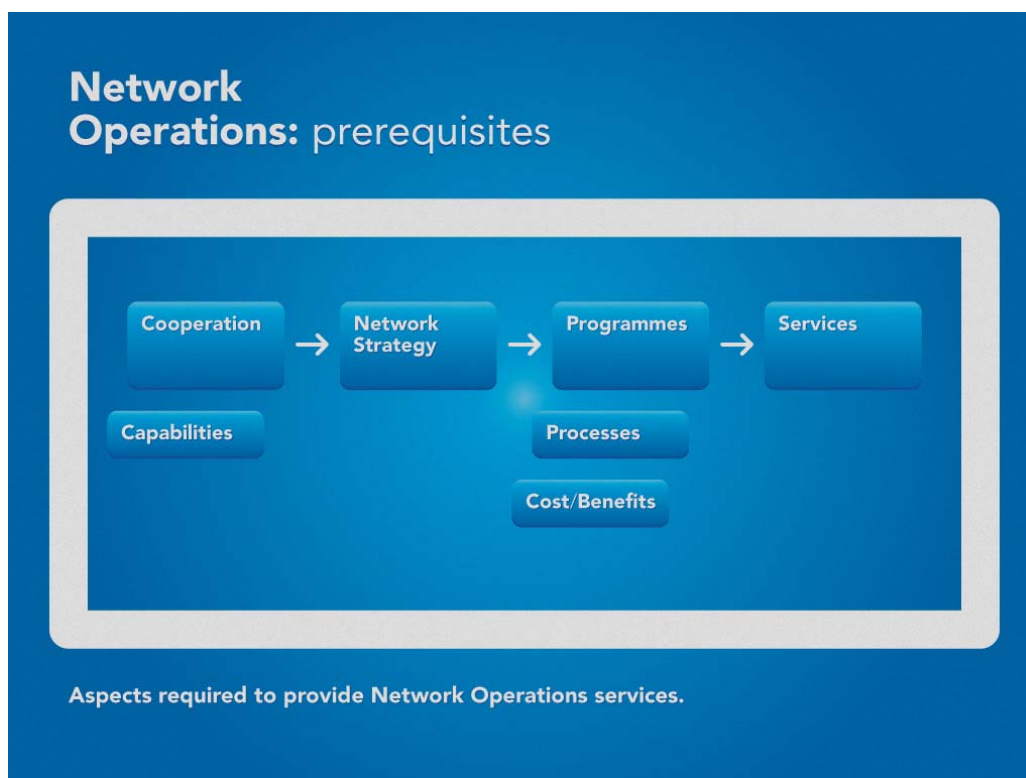
Long-term (and general) operation services cover:

- the monitoring of performance
  - evaluation of user needs
  - traffic performance measurements
- the planning of particular services, e.g.
  - road works
  - special events
  - (pro-active) asset management
  - mobility management

- the development of network management strategies
- research and the planning of new services
- road maintenance
- data warehouse and modelling/road planning
  - historic data management
  - transport forecasts
  - traffic analysis

### 3.3 Requirements for the provision of NetOp services

On the basis of discussions within the group and an analysis of national case studies relating to NetOp, a number of aspects that have a major influence on NetOp were identified. These aspects can be summed up as follows: services, consistent network strategies, efficient organisation, processes, capabilities, programmes, and costs/benefits.



#### ➤ **Services**

Services to road users are the most important aspect of NetOp. It is essential to pay attention to what the users want and need.

Services are the needs/requirements that must be met by service providers (including road authorities) in order to enable and facilitate the mobility of travellers and goods. These services can have collective or individual means and therefore be provided by service providers with different objectives.

➤ **Consistent network strategies**

Network operation requires an approach for the entire network that is based on consistent and jointly agreed strategies between national and regional road administrations. Measures (information and/or management) can have an unanticipated impact on parts of the (underlying) network. A co-ordinated or centralized approach is essential.

➤ **Efficient organisation**

An efficient organisational structure that involves all major players is of the utmost importance for the success of NetOp. Road user services and traffic management should be tackled jointly by road administrations and the police in conjunction with service providers and should, at a later stage, be supported by the automotive and telecommunications industries.

Working models for sustainable traffic management including traffic policy and co-operation should be developed. In order to achieve this, a win-win situation based on business models must be established, including the definition of relationships, roles, and responsibilities, and an open information exchange set out in an agreement or contract.

➤ **Processes**

NetOp requires well-structured processes in which consistent rules, scenarios, network strategies, provision of information, etc. are applied. These processes can and must be agreed by the players involved in the form of contracts that determine quality, flows, and the expected output/outcome (Service Level Agreements). Because of their position in the process chain, traffic information or management centres can often play a leading or guiding role in this regard.

➤ **Capabilities**

If NetOp is to be a success, the capabilities of all organizations and people involved must be channelled into the process. The availability of knowledge, experience, capacity, and momentum determine to a high degree the credibility of the measures and whether or not they are accepted by users and organisations involved in the process. NetOp capabilities must be developed, fostered, and maintained.

➤ **Programmes**

NetOp is a complex combination of projects, people, consensus, organisations, co-operation, interoperability of services, integration of systems, and financing. In this context, it is often very difficult to make rapid progress. Dedicated programmes with specific targets and stimuli to commit all relevant players can provide a boost.

➤ **Costs/benefits**

Costs and benefits are another important aspect of NetOp because they provide input for the NetOp strategy by identifying effective and efficient measures that should be applied. Until now, such costs and benefits have been difficult to estimate due to a lack of experience and quantitative measurements. This report recommends that, if possible, a framework and method for conducting a cost/benefit analysis of ITS, such as the one developed and used in Denmark, be applied. For example, although network operation measures such as fast clearing after incidents and strategic roadwork planning can dramatically reduce congestion, there is not, as yet, any evidence that such measures bring about an equivalent reduction in economic costs.

### 3.4 Role, task, and responsibilities of NRAs

As demonstrated in the previous chapters, many stakeholders are or will be involved in NetOp in the future. This depends on the services provided to the road users by:

- **Other public service providers**, and by
- **Private service providers**

#### 3.4.1 Other public service providers

##### a) **Other road authorities**

Road users are not interested in where the area of activity of one road administration ends and another begins. They want to have a seamless trip across the whole network. This requires harmonised service level agreements and close co-operation in the context of NetOp between all road authorities. Experience gained in case studies at national level discussed within the task group shows that a blueprint/framework for co-operation between road authorities could lead to progress in this regard.

##### b) **The police and emergency services (e.g. the fire brigade, ambulance services)**

In view of the increasing demand for transport, the complexity of NetOp, and the involvement of many stakeholders, all parties involved will in future tend to focus on their respective core business. This is also true of the public sector—the shift of tasks and responsibilities between the UK Highways Agency and the police being a case in point. Based on this case, the group briefly examined the European approach to co-operation between NRAs and the police. It concluded that, depending on the services/measures involved, there is limited consistency in the division of tasks and responsibilities between road administrations and the police across Europe. From the road users' point of view and also in the (future) context of NetOp, a more clear, consistent, pragmatic, and efficient division of tasks is recommended. The group briefly investigated the NRAs' preferences regarding the future division of tasks between NRAs and the police. Based on the results of this investigation and further discussion, it can be concluded that for specific services (such as incident management and traffic control), where co-operation between organisations (and in this case NRAs and the police) is required, it would be best for each organisation to focus on its core business.

#### 3.4.2 Private service providers

Whether the provider addresses the individual user or specific groups of road users (e.g. road users on a specific route or heavy goods vehicles) often depends on the provider's objective, interests, and (core) business. The NRAs, which are responsible for providing an efficient and safe network for all, focus on group(s) while commercial operators see more benefit in focussing on individual clients. The shift of roadside traffic information and management systems towards the vehicle is a trend that links both worlds. Although these differing interests could create tension, making use of cross competences could generate mutual benefits. Making use of the competences of other stakeholders creates a situation in which focus, competitive edge, core business, co-operation, and efficiency are key motors.



Jointly developed and agreed business models and cases are absolutely essential. One example is the provision of traffic information services that can be provided 'fee free', 'fee free for the basic service', or 'fully paid'. Criteria for all road user services should be harmonised and agreed across Europe. These criteria are related to strategies for road network management, safety, interoperability, information provision to road users, payment/tolling, enforcement, basic free-of-charge service definitions, quality/performance levels (e.g. for data/information), etc.

It is an acknowledged fact that NetOp-related tasks and responsibilities vary from NRA to NRA. Trends in mobility demand, 'user-oriented service provision' approaches, and the involvement of more stakeholders (both public and private), influence the roles, tasks, and responsibilities of the NRAs and others.

It is to be expected that NRAs will be positioned and acknowledged as one of the key mobility service providers.

This report strongly recommends that NRAs seek to create a synergy of NetOp approaches among all road authorities. A good division of labour between NRAs and the police, and the co-ordination of roles, tasks, and responsibilities between these two players are other essential factors.



## 4 Actions for the future deployment of NetOp by NRAs

The CEDR Executive Board prioritised the following two new actions:

- **business models for the organisation of NetOp**
- **co-operation between public service providers and/or operators**

These actions must provide an answer to the future position of the NRAs in the multi-actor public/private arena of NetOp.

### 4.1 Business models for the organisation of NetOp

There is a lack of a structured approach to NetOp, in terms of, for example, users, the roles and responsibilities of all future stakeholders, viability and feasibility of NetOp-services, and cost/benefits. Many stakeholders will be involved in NetOp in the future. These stakeholders will come from both public and private organisations and will all have their own objectives. This means that a clear vision and a clear definition of targets/objectives, tasks, roles, and responsibilities will be vital.

#### **Recommendations:**

It is recommended that business model(s) be developed for the organisation of NetOp and related services. Such models should provide a deeper insight into the complexity of (future) NetOp resulting in a blueprint that supports the vision and strategy of the objectives/targets to be achieved, the stakeholders (automotive and supplier industry, users and clients, competitors, financiers, other authorities), their tasks, roles and responsibilities, analysis of investment requirements, and quantitative or qualitative benefit for decision makers.

The business model should cover four domains:

Service	What is your service offering?
Organisation	What are the tasks, roles, responsibilities, and added value, and which stakeholders should participate?
Finance	What are possible cost and revenue models?
Technology	Which technical components do the service need?

### 4.2 Co-operation between public service providers and/or operators

The group recognised that there is still room for improvement in the co-operation between public service providers and/or operators such as road authorities, the police, traffic-officers, etc. Moreover, there is no single, harmonised approach to NetOp. The objective of NetOp is to provide a seamless service for road users. This requires seamless co-operation between road authorities.

### Recommendations:

- All road authorities should reach agreement on a consistent traffic policy framework, management strategies, and control scenarios.
- A good model for co-operation between authorities should be developed in order to support the traffic process and avoid misunderstandings and competition.
- A well-balanced approach to the targets to be achieved over the network should be adopted by all authorities (mobility, safety, and environment).
- The various authorities involved should define roles and responsibilities with respect to each service provided.
- A cost and investment sharing model should be developed.

## 5 A comparison of two possible approaches

The previous chapters describe an approach to NetOp that is based on the current and potential future situation in the mobility arena. This in turn is based on the experiences and views of NRA experts and the approach outlined by the FHWA and PIARC.

The approach outlined in this document (the 'NetOp' approach) is essentially unique because it focuses on the European context and brings together a variety of national issues. It defines a harmonised approach to user-oriented traffic management and the provision of traffic information services on an international, competitive, multi-actor market.

This approach is new from the NRAs point of view. It is difficult to compare it with other (operational) scenarios because such scenarios have not (yet) been developed. It can, therefore, only be compared with the current situation.

The current situation can be extended to the future and labelled the 'do nothing' approach.

An examination of both scenarios led to the following conclusions:

- **Mobility demand increases:** In the (near) future, NRAs will no longer be able to overcome this challenge using the isolated actions and measures currently being applied. The 'NetOp' approach is a co-operative, integrative approach that supports the sustainable movement of people and goods.  
If NRAs decide to 'do nothing', congestion will increase, safety will decrease, and the situation will have a negative affect on both the environment and economic development.
- The major trend is towards the shift from road network management and maintenance to service provision to road users. In view of this fact, NRAs are advised to react to this trend by acting as service providers. User-oriented services are right at the heart of the 'NetOp' approach.  
The 'do nothing' approach would not put the road user at the centre of NRA activities.
- Current and expected future mobility demand necessitates the balanced use of the total (road) network. Road users are not interested in where the area of activity of one road administration ends and another begins. The 'NetOp' approach would ensure more balanced co-operation in the field of traffic information and management service provision at network level, and offer consistent services in terms of policy, safety, and quality levels. The current individual actions of each (public) authority are an obstacle to a harmonised and efficient approach for the total road network.  
The 'do nothing' approach would not provide a solution to this situation.

- The fact that the involvement of the private industry in the mobility arena is increasing means that more and more stakeholders are offering (commercial) services to the road user. This will have a huge influence on the tasks, role, and responsibilities of the NRAs. Adopting the 'NetOp' approach would mean that acknowledged key mobility service providers would share tasks and responsibilities.  
The 'do nothing' approach would ultimately result in a situation where the NRAs become irrelevant and cannot claim to be a mobility service provider. This would hamper any attempts by NRAs to increase safety.
- The development of in-car technologies offers new opportunities in the field of safety, efficiency, environmental protection, and economic improvement. It will also shift the provision of services from the roadside to the car (in-car systems). As responsible NetOp authorities, NRAs should guide these developments, ultimately serving their objectives.  
The 'do nothing' approach could lead to unwanted and uncontrollable situations on the road network (e.g. HGVs travelling through small villages);
- The NetOp definition and context could and should be used to set (strategic) targets for research and development project;  
The 'do nothing' approach would keep the efficiency and impact of various projects at a low level.

## 6 Conclusions

Based on the above comparison of the 'do nothing' and 'NetOp' approaches, the practical national cases discussed with NRA experts, and the results of the Executive Board workshop in Rome, the Governing Board adopted this report on **NetOp** presented by the project group 'Capacity and Service to Road Users'.



Ref: CEDR report 2009 TDOperation2009 / Network Operations



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