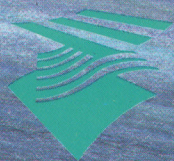
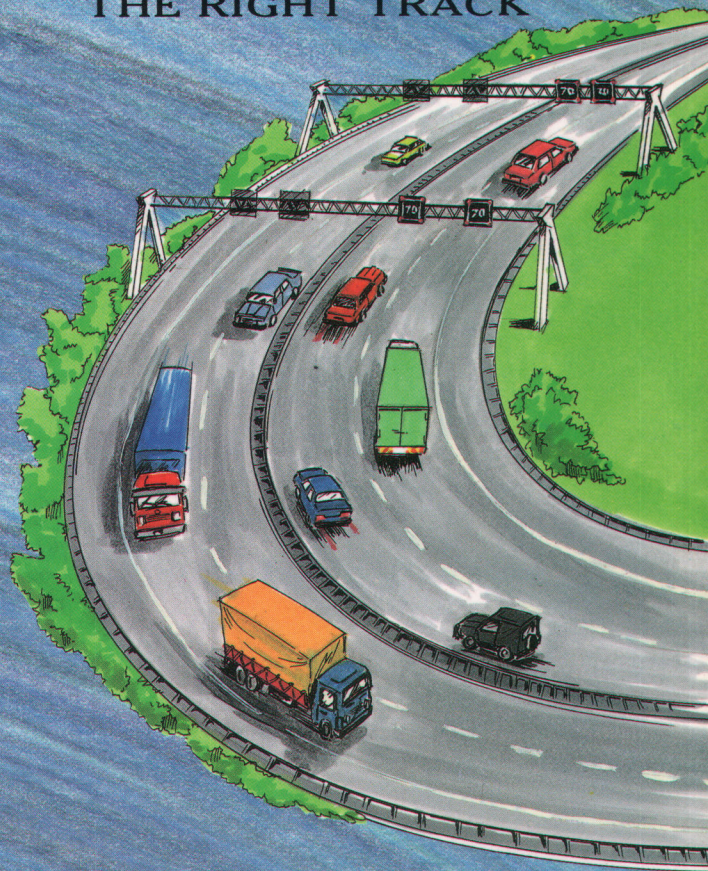


MOTORWAY SIGNALLING

NEW INCENTIVES
PUT TRAFFIC ON
THE RIGHT TRACK



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TRANSPORT RESEARCH CENTRE (AVV)*

The Transport Research centre (AVV) of the Department of Public Works and Water Management is developing ways of steering traffic in the Netherlands in the right direction. This is taking place within the framework of the AVV's services to the general management and the regional managements of the Department of Public Works and Water Management. One of their methods is the motorway signalling system.

The system signals and analyses changes in the traffic flow. Drivers are warned of these changes by means of maximum speeds displayed on matrix-signs. The system is also used when roadworks are under way. Arrows and crosses shown on the same signs indicate clearly to drivers the lanes which may not be used.

Since the successful implementation of the motorway signalling system in 1981, other routes have been equipped with the system. Approximately 200 kilometres of motorway are now covered. In all probability this will increase to 500 kilometres.



REASONS FOR A MOTORWAY SIGNALLING SYSTEM

Between 1986 and 1990 traffic on motorways increased by 25%. Unless something is done, by the year 2010 traffic will have increased by 70% and the damage, both financial and social, resulting from congestion will have quadrupled.

The consequences of increased traffic can be seen every day: TRAFFIC JAMS!

- A direct effect of traffic jams is an increasing chance of secondary accidents.
- A side-effect of a heavy burden on the principal road network is that it is impossible to carry out road repairs during the day.

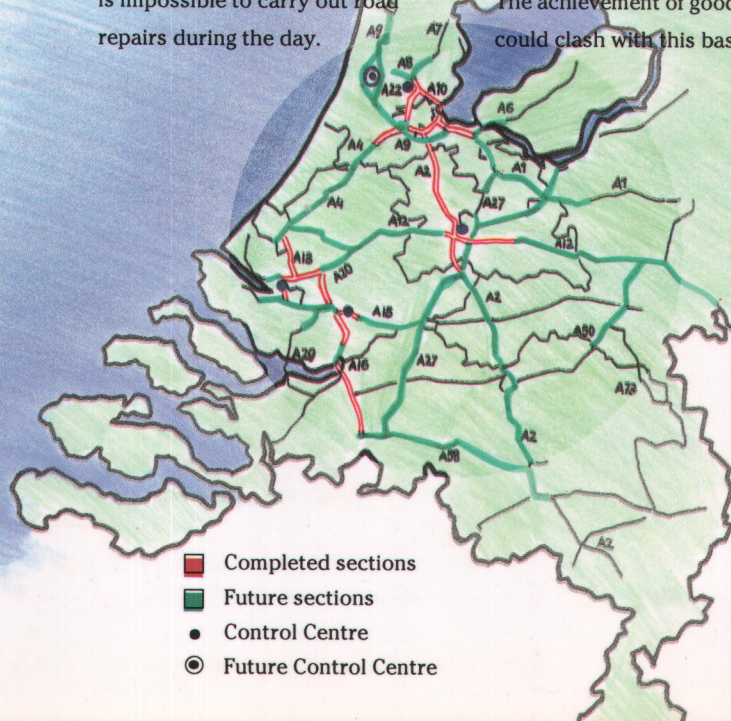
Consequently the Second Master Plan for traffic and transportation emphasizes the threat which this represents to the accessibility and competitive position of the Western Holland conurbation (Amsterdam-Rotterdam). The quality and costs of transportation are at stake and therefore also the attractiveness of the Netherlands as a place of business. A Primary consideration of the policy which must be adopted is an enduring society: solutions to today's traffic and transportation problems must not shift the associated environmental problems to future generations. The achievement of good accessibility could clash with this basic principle.

In reality an attempt must be made to find a balance among the environment, accessibility and safety. A creative solution must be found: 'Solutions which facilitate economic growth, within the context of an enduring society.'

The essential points of the traffic and transportation policy are therefore:

- Congestion on the principal road network must be prevented,
- in the year 2000 there must be a 25% reduction in the total number of traffic accidents vis-à-vis the 1985 total and
- signs must be positioned above the lanes on busy motorways, so that they can be closed for road repairs to be carried out in safety.

One of the ways the essential points are being achieved in the Netherlands is through a number of dynamic traffic management instruments. The motorway signalling system is perhaps the most important instrument and this contributes considerably to the Key Policy Points which have been established for the traffic and transportation policy.



- Completed sections
- Future sections
- Control Centre
- Future Control Centre

which can be used in all locations. Extensions and changes can be made easily, because the separate system parts are put together via software.

RELIABLE

In constructing the system a great deal of attention was paid to operational safety and reliability. The design of the motorway signalling system makes use of the principle of 'graceful degradation'. This means that if one part should break down, then the function of this part is taken over as much as possible by another part, thus avoiding the occurrence of dangerous situations.

FUNCTIONS

INCIDENT DETECTION

This fully-automatic mechanism, known as Automatic Incident Detection (AID), displays the maximum speeds of 70 or 50 (depending on the traffic situation) on the signs, in the event of a disruption in the traffic flow. If the traffic situation involves a decrease in speed, then these maximum speeds are accompanied by flashing lights.

motorists to drive more slowly, because this is most advantageous for the traffic flow in the current traffic situation. Smoothing automatically displays the maximum speeds of 90 or 70, depending upon the traffic situation, without additional flashing lights.



MONITORING

The motorway signalling system has an extensive monitoring system and diagnostic facilities. For example all lamps of all matrices are monitored continuously. The operator is alerted instantly if a lamp becomes faulty, and failures are detected immediately by the system and reported to the operator.

FOG WARNING

Visibility sensors have been placed along the side of the road to assist in giving fog warnings. If a sensor detects fog, the signals are brought into operation by the outstations, to display the maximum speeds of 80 or 60 in conjunction with the warning sign "fog". Flashing lights around these warning signs alert drivers that they should expect fog down the road.

MAXIMUM SPEED

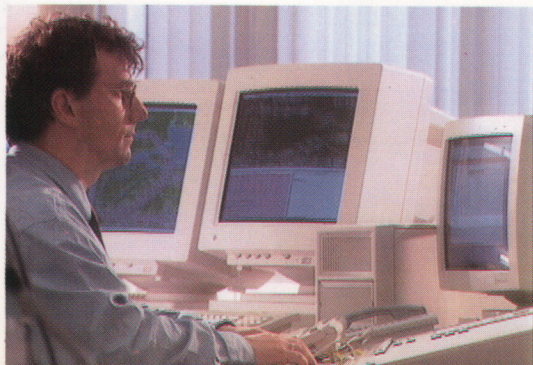
If the road is slippery, or in cases of strong winds or other environmental influences the operator can give the order to display a maximum speed. In this case too, the necessary images are calculated and displayed by the system in order to prevent operational errors.

OPTIONAL SIGNS

The operator can control optional signs which give drivers extra information about the current traffic situation.

SMOOTHING

Smoothing is a form of traffic control in which a maximum speed, adapted to the speed of the traffic, is shown along a longer section of road. It is only used in situations where there is the risk of the formation of shock waves or traffic jams. Smoothing is aimed at exhorting





LANE CLOSURES

In the event of an accident or during maintenance the operator can instruct one or more lanes to be closed for traffic. The system subsequently calculates whether congestion can be anticipated. Such a prognosis can also be made in advance for planning road-work activities. The images needed on the signs to indicate a lane closure are calculated by the system and sent to the road in well defined stages. This eliminates the chance of illogical or conflicting signs.

TRAFFIC DATA

The speed and flow measured by the induction loops are passed on every minute to the central computer so that an overview of the current traffic behaviour is always available. In the interest of further research, a research system has been included which is independent of the operational central computer. This research system can collect, via its own cable network, the information from a number of induction loops for further processing.

EMERGENCY TUNNEL CLOSING

The signalling system offers the possibility in cases of emergency to

close a tunnel completely and extremely quickly. When this command is given the red traffic lights are switched on, the maximum speeds of 70 and 50 are displayed on the signs, a lead-in is displayed on optional signs and then the barriers are dropped.

BRIDGE INTERVENTION

The bridge intervention function allows the opening of a bridge to be guided by the signalling system. The operator switches on the red bridge lights and the system will display the lead-in maximum speeds of 70 and 50 on the signs and the associated optional signs. Any possible traffic jams resulting from a bridge opening will naturally be monitored by the AID mechanism.

ONCOMING TRAFFIC ON THE SAME CARRIAGEWAY

The oncoming traffic function within the motorway signalling system enables traffic to go through the other tube of the tunnel, in the event of a tunnel closure. Drivers in both directions see red crosses on the signs above the lanes designated for oncoming traffic. The AID mechanism remains functional throughout the situation. When setting up an oncoming traffic situation, the tunnel is closed with barriers and a movable crash barrier.



AUTOMATIC ROUTE INFORMATION

The automatic route information system uses information from the signalling system in order to determine the traffic situation. If impediments to the flow of traffic on a network are



found, then the automatic route information system displays the necessary route information to drivers.

TIDAL FLOW

Tidal flow enables a lane to be made available for one of both directions. This could mean that in the morning rush hour the lane can be available for traffic heading towards the city and in the evening in the opposite direction. The motorway signalling system effects this traffic control, by displaying a red cross to traffic from the other direction. The alternating car-pool lane on the A1 is an example of the use of tidal flow.

THE SIGNALLING SYSTEM

The speed and flow of passing vehicles are measured by means of induction loops placed at regular intervals along each traffic lane.

Various programs analyse this information to show when a disruption in the traffic flow has arisen on a stretch of road. As soon as the programs have established a disruption, automatic measures come into effect to warn drivers. These consist of variable speed limits, shown on matrix signs above the lanes.

In addition to the automatic programs, the signs can also be controlled manually by an operator in order to display specific traffic measures. The system assists the operator in implementing these measures.

STRUCTURE

Detector stations are located along the road in order to collect traffic data from the induction loops in the road and send them on to outstations.

The standard function of an outstation is to pre-process and send traffic data to the central computer. In addition, outstations switch legends on signs and optional signs, either independently or when instructed to do so by the central computer. Outstations also continually monitor the hardware and the correctness of the legends which have been switched.

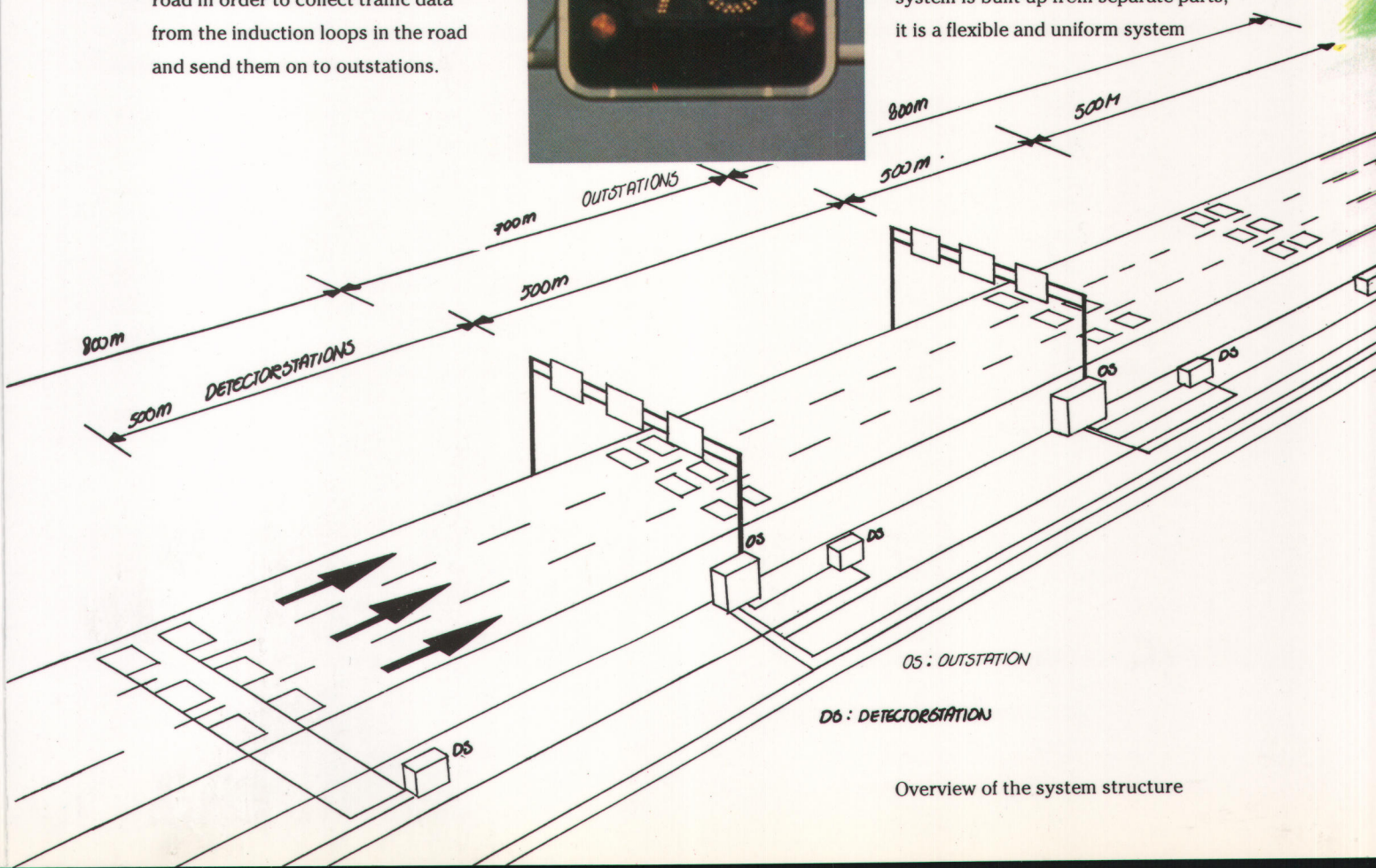
The outstations are linked to the central computer via a specialized communication network. The central computer is responsible for communicating with the outstations, processing the traffic data, calculating the right images and sending back an instruction to the outstations, for displaying the right legends on the signs.

The central computer is also connected to a number of user-terminals. At a user-terminal the traffic and system data are shown as clearly as possible on a graphic colour screen. This user-terminal allows an operator to run, maintain and monitor the entire system.

Where specific traffic systems are required by the presence of a particular structure, such as a barrier at a tunnel, these are also displayed on the same graphic screen. In this way an operator has, on one single screen, all the necessary information and an unambiguous representation of all the systems necessary for controlling the traffic flow.

CHARACTERISTICS FLEXIBLE

Because the motorway signalling system is built up from separate parts, it is a flexible and uniform system



Overview of the system structure

ADVANTAGES

GENERAL

Evaluation

Independent evaluative research has shown that a majority of motorists rate the signalling system positively.

Operation

The motorway signalling system is extremely flexible to extend and the system has very little "down time".

Central Control

The system allows traffic control systems for motorways, bridges and tunnels to be carried out by one central control system.

TRAFFIC SAFETY

The motorway signalling system has a positive effect regarding traffic safety:

- An approximately 50% reduction in the number of secondary accidents,
- extremely good accident prevention in poor visibility situations (fog) and
- accident prevention through increased flow during congestion and lane closures (fewer shock waves).

ACCESSIBILITY

The current signalling system does not work miracles in the area of accessibility, but does have a positive effect:

- More stable traffic during congestion,
- increased flow during lane closures and
- a general increase in the flow with 5%, and 15% less travel time loss.

ROAD MAINTENANCE

The conclusions concerning road maintenance for the current signalling system are as follows:

- Considerable cost-savings per lane closure,
- improvement of the feeling of safety of the road workers and
- less number of police assistance.

COSTS

The costs of the motorway signalling system are between 1 and 1.5 million guilders per kilometre of motorway, depending upon the lay-out and the complexity of the road.

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