COMMERCIAL VEHICLE FLEET MANAGEMENT SYSTEM

Duration of the project: July, 2001 – June, 2003

Homepage of the project: pl. <http://daedalus.scl.sztaki.hu/nkfp/>

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Keywords: fleet management; intelligent supervision systems; control and communication systems; logistics and navigation systems; server architectures; vehicle dynamics; transport automation.

1. General description of the system

The main objectives of the project are the elaboration of the theory and methods of intelligent supervision, control and communication systems installed on vehicles, and an associated information service system for fleet management. The development of the information service as part of the fleet management system that collects, analyses and evaluates data sent by
individual vehicles extends the utility of the installed vehicle systems and represents a significant added value to its application.

This system integrates the capabilities of recent mobile telecommunication and the sensory and data measurement systems on the vehicle into a unified framework and has the feature of maintaining a permanent communication among the data acquisition and control modules allocated on the vehicles of transportation companies. It can also supervise and control the transportation processes, assist the driver in decision making, support the co-ordination of transport activities, and provides an information database for all participants possessing the particular unit on the vehicle. The main tasks in cargo transport systems are to monitor the technical conditions of the vehicle and schedule the maintenances, the fast and safe delivery of the cargo, to increase the driving safety of vehicles, to decrease the load of the vehicle by specifying the most suitable routes and by the dynamic modification of the routes planned, and to increase the efficiency of all activities related to the transportation.

The system to be developed will be coordinated among three main parties as it is illustrated in Figure 1. One of them is the vehicle whose states of motion and cargo, road or traffic information can be downloaded either off-line, either on-line, depending on the later use of the data. The second is the fleet management center that evaluates these data, communicates them to the owner and, if necessary, based on the confirmative action of the vehicle owners, supervises the vehicle control systems. The third party includes the users (fleet or vehicle owners) who are interested in having the information provided locally on-line about certain traffic situations or road conditions.

![Figure 1: Illustration of the intelligent supervision, control and communication system](image)

2. Realization of the fleet management system

2.1 The control and communication unit installed on vehicles

The on-board vehicle unit has been developed by using two methods. Firstly, a commercial measurement and mobile data communication unit has been adapted to the vehicle in order to collect and process the available signals and send the results to the fleet management center.
by using various communication technologies. Secondly, the vehicle unit with an up-to-date architecture has also been developed in order to test new ideas and functions which require research and development, and which can be used as a basis for new vehicle products.

The fundamental functions of the mobile unit installed on vehicle are data acquisition from on-board sensors, gathering, pre-processing, and storing these data, sending information to the fleet management center, and carrying out commands from the center. All of the sensors and the on-board units are connected to a local network, thus the course features become accessible. A microprocessor-based unit carries out the processing of the measured data. Pre-processing means extracting and compressing important information from the sensor data. The unit is also responsible for sending information to the center by mobile communication. The vehicle unit consists of three layers:

- All the signals of the on-board sensors are accessible through an interface of the local network.
- The vehicle unit ensures connection between the communication subsystem and the local network. The tasks of the central unit are as follows: it collects sensor data, after pre-processing it sends them to the communication subsystem; it receives the commands of the fleet management center or of the driver, and forwards them to the local network; it carries out black-box functions; displays the course features and instructions of the fleet management center for the driver. These functions are reconfigurable, changeable from the fleet management center as well.
- The communication system is in connection with the fleet management center.

The new architecture has been developed in an embedded board computer system that can serve as a basis for experiments and tests for intelligent vehicle control tasks, in which flexibility, convenient re-configurability have got a great significance. This computer system has been realized by a compact, low consumption, robust embedded industrial computer with an embedded operational system (Embedded Windows NT/XP/CE, QNX, Linux). The vehicle unit also includes a smart sensor system which communicates on standard interfaces, inertial sensors, GPS, camera, and local/wide range wireless digital communication possibilities, e.g. Bluetooth, WLAN, GSM SMS, GPRS.

The new functions that have been implemented in the vehicle unit include environment mapping for the prevention of unintended lane departures to avoid obstacles; high precision positioning and navigation; system modeling to identify unknown or uncertain parameters; control functions to solve the tracking and stability problem; increasing reliability by fault tolerant control, fault detection and diagnostics; and the basic functions of the unmanned operation (IUV: Intelligent Unmanned Vehicles).

### 2.2 The fleet management server

The fleet management center as a processing-evaluating computer has a two-way connection with all of the vehicles and their owners. It receives the packages of data from vehicles, processes them and sends the requested information to the firms and, if necessary, sends information back to the vehicles. The server is in contact with other organizations (e.g. meteorological institutes, road maintenance companies) to which it provides useful information. Other subscribers, e.g. passenger transport firms, cannot send data to the server,
since they do not have any communication unit on their vehicle, but they can request management services. Several communication accessibilities have been implemented in the server center: a communication interface to guarantee stable and continuous contact with vehicles; a company communication interface to provide access to the incoming detailed information for the management; contact with other subscribers to get information from the environment, and a public access displayed on an Internet-site. By applying this modern architecture, the fleet management center has been developed in such a way that it guarantees the communication and management functions available in the vehicle industry and it provides a possibility to modify the existing functions or add new functions to the server functions.

The user connects to the fleet management center through a general web browser running under an arbitrary operating system. Every user action and request is received by the web server, which is a Java middleware web container. This component constructs a dynamic HTML page with the responses of the center using the information in the database and/or activating the appropriate functional server tasks. The information about the vehicles (position, velocity, etc.) and the environment (roads, traffic, etc.) is provided by the vehicle on-board units and is sent to the center on-line in SMS or GPRS message format or off-line from the depot via the Internet. The properties of the server architecture are as following:

- The security of the stored and exchanged information is guaranteed by the strict rules of the safety management of the database handler and Java environment.
- As a result of the database-centered architecture, the servers can be developed independently on arbitrary platforms by different groups and the updated modules can be inserted into the system without interrupting the operation. In the case of increasing demands, the modules of the center can be easily multiplied.
- Every user has an individual web interface, which contains the services the user needs or has subscribed to.

2.3 Services provided by the fleet management system

It is more profitable for the operators and fleet owners to use only the services that are absolutely necessary for them, therefore, they are given the possibility to choose various software packages for solving various problems. Moreover, there is no need for buying their own central server system, since by connecting to the central server at the headquarters, all services will be available. According to the above, six packages will be designed: basic, safety, diagnostics, financial, consignment-safety and administration packages.