

# MORYNE

## D6.6 : *REPORT ON RECOMMENDATIONS*

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# 1 Introduction

## 1.1 Purpose of the document

This document proposes a set of recommendations for the future provided by the MORYNE consortium at the end of the project. It is based on the knowledge and the experience gained through the different activities, technical or not led during this project.

## 1.2 Document Status Sheet

Version	Date	Description
0.1	26/02/08	Table of content
1.0	18/03/08	Entries added. Version submitted to the Consortium for further inputs
1.1	21/04/08	Inputs from EKT, MART, GMV, TEM, MULT

Table 1: Document Status Sheet

# 2 Reference documents, abbreviations and definitions

## 2.1 Reference documents

[1] MORYNE Description of Work V5.0 – 24 Jul. 07

## 2.2 Abbreviations

CCTV	Closed Circuit Television
WiFi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
IP	Internet Protocol
UMTS	Universal Mobile Telecommunications System

## 2.3 Definitions

None

### 3 Recommendations for the future

In this section are provided technical and economic recommendations and guidelines for the future. It proposes a set of improvements to the deliverables and prototypes that the MORYNE project delivered at its end, and also a set of experiences learned by the Consortium members which is thought to be important to take note of to carry a similar project.

Recommendations are split in generic categories and sub-categories as follows:

Category	Sub-category
Industrial products	Traffic management system
	Video services
	Image processing and analysis
	Environment sensors
	Communication system
Knowledge	Fields of research
	Standards
Management	Project organisation
	Demo organisation

**Table 2 : Recommendations and guidelines for the future**

#### 3.1 Recommendations on industrial products

##### 3.1.1 Traffic management system

- A complete solution deployed over a big city with the concepts provided in MORYNE shall be compared to other car counting systems which already work in big cities. Comparison shall be done on technical and financial grounds.
- The traffic of cars in streets itself is already managed in cities, and a system like MORYNE has to offer other services than those related to traffic only. For instance, advertisement in bus, real-time information to passengers in buses, web, SMS, etc.
- It would be interesting to study the influence that information got through the MORYNE system (congestion levels, environmental alarms, etc.) has over the Public Transport Fleet performing of the daily services. Specially, it would be very interesting to study if the appearance of alarms cause delays in the services, and if those delays can be automatically quantified depending in the level of warning. This would be very useful for the dispatchers, and also, for the users, as they would receive much more accurate information in the User Information System (web, SMS, panels in Bus Stops, etc.).

##### 3.1.2 Video services

- The initial goal of MORYNE to enhance safety and efficiency of transport shall be enlarged to security aspects such as the bus indoor and outdoor surveillance. Emergency calls with associated video could be triggered by the bus driver (red button) or the control center. All Video Services associated with MORYNE communication platform can be adopted for videosurveillance applications.
- Coupling of bus video cameras with public safety video systems (CCTV) should be envisaged. Videos shot by buses could be used both in real time for surveillance, or later for legal aspects in case of physical assault, street unrest...

- Enhancement of Video Services are really dependant of progress to be done for hardware implementation of high end video content analysis algorithms. The challenge is to get powerful tools for robust automatic detection/analysis addressing various applications under the same onboard embedded platform: passengers surveillance, passengers counting, passengers tracking for flow analysis, passengers in hazardous situation, driver assistance ...
- Video Services have to emphasize high level Graphical User Interface addressing configuration, operation and maintenance for specific skill such as public transportation.

### 3.1.3 Image processing and analysis

- To exploit the estimated level of severity of events to prioritise the sequences to display in "images walls". Defining priorities in the videos to be displayed in a control room would help the operators be more efficient and more reactive. Thus, abnormal traffic situations are solved faster.
- To exploit extracted metadata for post-event analysis, search and retrieval. The metadata extracted from the MORYNE traffic scene analysis could be merged with the set of existing traffic sensors in order to enhance the mathematical models of the traffic situation in a city. The proposed algorithm provides traffic flow information which is formulated in a different way than the other existing traffic sensors. Taking into account the specificity of our new sensor in the traffic management mathematical models should improve both the knowledge of the current situation and should help enhance the traffic prediction. Alarms could also be generated when a new situation differs from the predictive models.
- Inter-bus collaboration for decision making. Correlating the detections and traffic flow classifications of several buses driving in the same area could help enhance the quality of the metadata produced by MORYNE. As an example, if one bus is following another one, the outputs of both algorithms should be compared and merged before being presented to the traffic management operators.
- To enhance the detection of bus lane violations. A license plate recognition algorithm could be incorporated in the MORYNE system. License plates have well defined image patterns that could be used to discriminate between vehicles and other objects the current version of the algorithm might detect.
- To extract more localised traffic information. The algorithm currently provides a classification of the traffic flow every 30 seconds. The traffic management centre receives the class for each period. The related colour is displayed on the map of the city between the positions of the bus at the beginning and the end of the classification sample period. Although the decisions have to be sent with a fixed frequency, it would be of interest to update the algorithm so that it provides an history of more localised data rather than just one value. Thus, the map which is displayed in the traffic management centre would contain smoother colour transitions and therefore an improved localisation of congestions and slow down compared to the current version.
- To extract other data from the video. Other data that could be useful for traffic management or public transport should be detected. An example is road works signals to known exactly where they are in the street, when they start and when they are finished. An algorithm could also detect other patterns like the red triangles signalling when there is an accident or breakdown vehicles. Finally, pattern matching algorithms could be used to check the infrastructure, e.g. presence of stop signals, etc.

### 3.1.4 Environment sensors

- Environmental data could be completed by pollution data from (CO, CO<sub>2</sub>, NO<sub>x</sub>) sensors. The idea is to have a pollution state map of the town with the data collected on the buses for environmental and health reasons.
- It will be interesting to use the humidity ceramic sensor composition developed in MORYNE project for hard condition atmosphere applications (temperature, high humidity, gaz).  
The applications could be:
  - health (respiratory machine)
  - automotive and aeronautic (Engines, exhaust pipes, fuel cells....)
- It will be useful to integrate a weather monitoring and forecast agencies. The objective is extend the ice and fog prevention for all the territory (not only in town) with the best forecast models. The Environmental sensors could be integrated on others vehicles such as cars and trucks.

### 3.1.5 Communication system

- The broadband communication network -based on WiFi in MORYNE, because no mobile WiMAX equipment was available – shall be based on WiMAX, to offer better services. A good engineering shall be made and a judicious frequency band shall be chosen so that the cost of the installation and exploitation be reasonable. From operator point of view, the WiMAX mobile technology needs to be more mature before launching a service over it. Furthermore, it is not clear now in several countries in EU which kind of organisations would be allowed to license the necessary frequencies.
- UMTS networks are public telecommunication networks which encounter congestion problems in case of high density of people (numerous homes and traffic jams). WiFi frequencies are commonly used by any computer, which degrades the available bandwidth for buses. We recommend to set private owned and operated networks to guarantee the quality of service of the access and of the transport of the information, especially in case the network is used when the bus driver and/or driver are in emergency situation. However, in this project, the technology used has been proven to be robust enough in order to avoid interferences. Furthermore, this technology has been used in the USA for emergency management (communication between police cars, ad-hoc). In any case, the WiFi mesh technology would be considered as a complementary technology for specific situations (as UMTS networks are already deployed and roll-out costs for WiFi mesh need to be included in ROI analysis).
- The telecommunication networks should be reused between several organisations (city transport, ambulance, police, fire brigades...) so that the public transport is not the only one to bear the brunt of the cost of installation and exploitation of the networks. A good resources allocation policy shall be associated to manage access conflicts between and within organisations. Another option would be that organisations willing to have this service would subcontract the broadband communications services through different tenders, either linked to traffic management system tenders or their general communications services tenders.
- The proposed architecture with vehicles communicating with an IP infrastructure should be completed by small ad-hoc networks built among buses, but also with cars, trucks... should standard and interoperable protocols be used between them. As mentioned before, the WiFi mesh technology used for the demonstrator purposes, can be used also in this ad-hoc manner.

## 3.2 Recommendations on knowledge

### 3.2.1 Fields of research

- In section 3.1.3, we have proposed some possible enhancements to the current traffic scene analysis solution. The associated fields of research include:
  - Pattern matching techniques
  - Data mining / data fusion for the optimisation of traffic management mathematical models and multi-sensor fusion.
  - Collaborative vehicles
  - Human Machine Interface for an improved traffic data screening experience.
  - Mobile video sensors: improvements of the current algorithm, detection of other events, etc.
- Video Content Analysis Algorithm with design oriented for hardware implementation
- Embedded processor with design oriented for Video Content Analysis Algorithm
- Use of the data environmental data for road de-icing procedure in order to :
  - have a quick intervention and better use of the personal resources
  - have economic and ecologic benefits because of the decreased amount of de-icing chemical (optimal use of the salt)
- Integration of a Public Transport Control Center with a CCTV System in a single interface.
- Development of a more powerful City Traffic Management Center, through the sharing of data with the Public Transport Control Center Database.
- Development of automatic information systems to the final users (pedestrians, private vehicle users, etc.) through the information received and displayed in the CTMC system. For instance, Environmental warning messages might be sent to information panels to alarm, the drivers that are entering a zone with this kind of alarm.
- In the case of communications for Communications solutions considered within the project, further research is necessary in order to:
  - Offer more signal stability in 802.11g frequency (this is offering a better service in the frequency offering more capacity).
  - Multi radio solutions to provide robust connectivity services within the bus and also communication between bus and infrastructure in more robust radio (such as 802.11a).
  - Interface for vehicular users through L2 Mobile APs (in the context of 802.11s still under development) instead of using Wifi Mesh clients such as the MAR, working at L3.
  - Interconnection with other broadband technologies such as Wimax or 3G, with wider coverage, as a backbone to smooth handover.
  - More stable Mobile WiMAX user equipment availability and extensive usability of the service in order to verify more accurately roaming capabilities.
  - High traffic Load and time extensive availability for measurement and analysis of results

### 3.2.2 Standards

- **CEN TC278** : CEN/TC 278 *Road Transport and Traffic Telematics* was established in 1991. Its scope was then defined as follows: "Standardisation in the field of telematics to be applied to road traffic and transport, including those elements that need technical harmonisation for intermodal operation in the case of other means of transport. It shall support:
  - vehicle, container, swap body and goods wagon identification;
  - communication between vehicles and road infrastructure;
  - communication between vehicles;
  - in-vehicle human machines interfacing as far as telematics is concerned;
  - traffic and parking management;
  - user fee collection;
  - public transport management;
  - user information."

The CEN Technical Committee (TC) 278 has been progressing the standardisation of Road Traffic and Transport Telematics (RTTT). The work comprises over 50 Work Items (WI) classed either as application specific, databases, interfaces or basic concepts. These work items are addressed by 14 Working Groups (WG):

<b>Working Group</b>
WG 1 Automatic fee collection and access control
WG 2 Freight and Fleet management systems
WG 3 Public transport
WG 4 Traffic and traveller information
WG 5 Traffic control
WG 6 Parking management
WG 7 Geographic databases
WG 8 Road data traffic/Elaboration, storage and distribution
WG 9 Dedicated short-range communication
WG 10: Man-machine interface
WG 11: Subsystem and intersystem interfaces
WG 12: Automatic vehicle and equipment identification
WG 13: Architecture and terminology
WG 14: After theft systems for stolen vehicles

It would suppose a great advance to the MORYNE project the standardisation of its protocols following the guidelines of the CEN TC278 standard, especially the ones regarding WG 3.

### **3.3 Recommendations on management**

#### **3.3.1 Project organisation**

- Language is always a barrier in this kind of multinational close cooperation and many philosophical and technical misunderstandings leading (1) to undiscovered problems and (2) to endless discussions would be avoided if English was mastered.
- There is no better way than meetings to discuss about different topics with more than two participants and to agree on solutions. There should be more meetings than one every three months, but budget and time miss.
- Conference calls lasting more than 1 hour are difficult to endure, because of the language, because of the uneven level and quality of the sound of the speakers. So they shall be limited to this duration, otherwise aspirin is needed.
- Conference calls involving more than 8 or 10 persons shall follow discipline rules such as giving one's name before speaking, especially at the beginning of the project when voices are not familiar.
- The system architecture related activities such as the design of the functional and physical architecture, the definition of the protocols, the overall engineering during the development and the close follow-up of the integration phase shall be done in close relationship with (1) the project manager and (2) the technical teams of the different partners.
- The project manager must be helped by a good technical architect who has an overall control of the technical activities, and who is helped by technical experts.

#### **3.3.2 Demo organisation**

- In-lab validation has its limits, especially because the simulation of the real-world for in-lab test may cost more than going in the fields. This was the case in MORYNE for the tests of the telecommunication network and the tests of the video processing algorithms. However, the tests of environmental sensors was easier in laboratory because many test situations can be obtained without waiting for months in case tests had to be performed outdoors.