MORYNE

D2.1 : 'SYSTEM ARCHITECTURE AND TECHNICAL SPECIFICATIONS'

PUBLIC VERSION

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Abbreviations

CS	Communication Server
CTMC	City Traffic Management Centre (VMZ)
EDGE	Enhanced Data for GSM Evolution
GPRS	General Packet Radio Service
GPS	Global Positioning System
IP	Internet Protocol
LAN	Local Area Network
MS	MORYNE Server
MVS	Mobile Video Server
OBU	On Board Unit
PAL	Phase Alternating Line - Video frame resolution of 720 columns and 576 lines
PCMCIA	Personal Computer Memory Card International Association
PTCC	Public Transport Control Centre
PTMC	Public Traffic Management Centre
PMR	Professional Mobile Radio
TMS	Traffic Management System
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
VS	Video System
WiFi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access

1 Introduction

1.1 Scope of the project

The MORYNE project is aiming to enhance the efficiency and the safety of the transport, while making it more environmental friendly, by improving the traffic management in urban and sub–urban areas. The use of mobile sensors evaluating the traffic status with a camera, measuring the temperature and the humidity rate offers a solution more dynamic than the sensors already used, installed at fixed locations. But the mobility concept requires a mobile support and a communication link between the sensors and the traffic management centres. The Traffic Management System (TMS) proposed by the MORYNE project uses the public transport vehicles as mobile support of the sensors which communicate with the traffic management centres through a radio–based communication network and a ground infrastructure. Sensor data are processed on–board in real–time and generated information is sent to the Public Traffic Management Centre (PTMC).

The Public Traffic Management Centre processes these data and generates decisions that are broadcasted to public transport vehicles, to fixed points (like message panels at bus stations) and to a City Traffic Management Centre (CTMC), like a request for a police intervention for example. The PTMC makes the collected information available to a CTMC to provide it with an up–to–date picture of the traffic situation. The CTMC derives traffic management decisions always going through the PTMC before being sent to appropriate distributed Traffic Control Devices (e.g. Variable Message Sign panels) and to vehicle drivers (via PDA, Internet, message broadcasting…). These interactions require a strong cooperation between Public and City Traffic Management Centres.

1.2 Purpose of the document

The purpose of the document is to define the system architecture. It presents the system's main functional blocks and its subsystems.
This present document is the **public** version of D2.1 (and hence shortened/subsumed).

2 System Architecture

2.1 Overview

The MORYNE system uses sensors installed on public transport vehicles to improve the traffic management in urban and sub–urban areas. The data of the video and environmental sensors are real–time processed on–board before transmission to the Traffic Management Centres. The MORYNE system requires therefore three main segments, namely the Board segment, the Communication system and the Ground segment. Each of these segments includes sub–systems, as displayed in Figure 1.

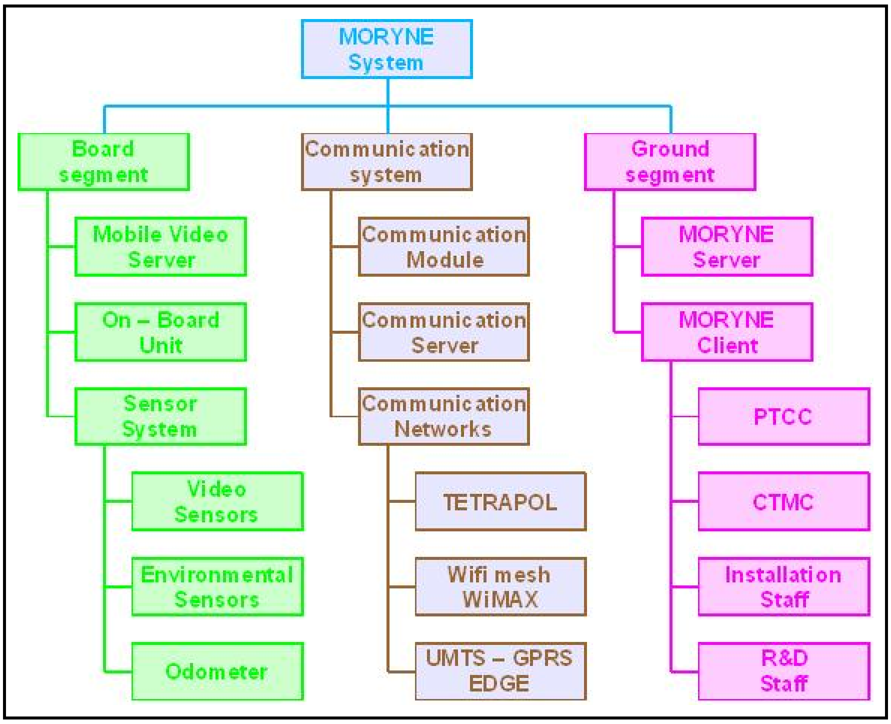

Figure 1 – MORYNE system arborescence

2.2 Board segment

As displayed in Figure 1, the Board segment consists of three sub–systems. The Sensor System catches physical data, processed by the Mobile Video Server and the On–Board Unit, also in charge of the access to the Communication System. The architecture overview of this segment and the data flows are depicted in Figure 2. Each sub–system is introduced below.

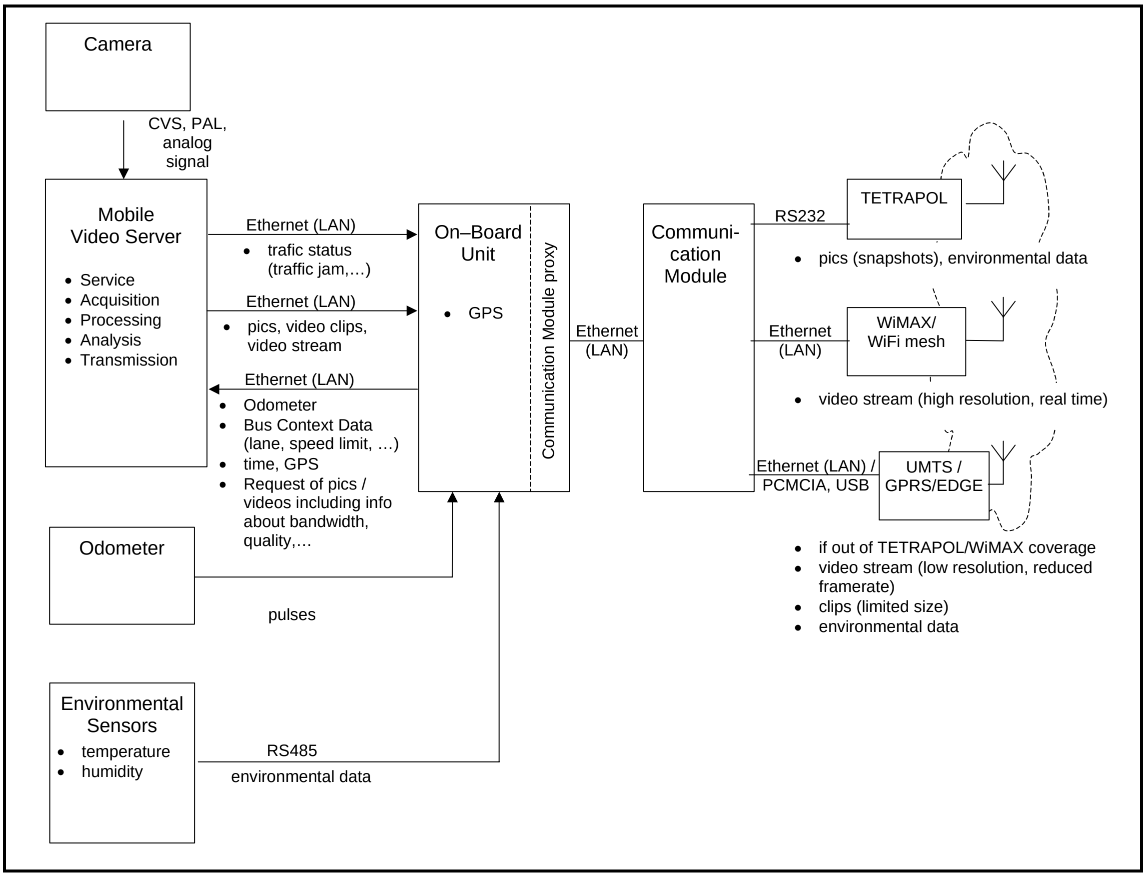

Figure 2 – Architecture overview of the Board segment

The environmental sensors, the video sensors and the odometer make the Sensor system.

- Environmental sensors perform measurement of humidity and temperature. A further process of these data can detect ice or fog and make warnings available for the final users in the Public Traffic Management Centre.
- The odometer is intended to provide information with pulses about the distance travelled by the vehicle. This information is correlated with the GPS information, in particular for the video analysis.
- The video sensor, e.g. a video camera (at least 2), provides the Mobile Video Server with a video flow. The video quality must be sufficient to allow the process of image analysis algorithm and the video compression for recording and wireless transmission purposes.

The Mobile Video Server (MVS) processes the video signal issued from the camera to first convert it into a standard digital video signal. This signal is then analysed to detect events on traffic conditions and update the traffic status. The digital video signal is also compressed to make easy the recording on the hard disk and to demand less bandwidth on the radio network during the transmission to the ground on user request. The MVS must keep to specific constraints due to a harsh embedded environment. These constraints are related to temperature, electromagnetic, shock and vibration topics. Besides these environment constraints, the MVS definition must take into account the low power consumption and the small size for mounting.

The On-Board Unit (OBU) connects several units inside the bus, like the Mobile Video Server, the environmental sensors and the communication module (using the communication module proxy). The OBU also connects a GPS sub–system installed inside of it. The OBU processes the received information and communicates with the control centre through the communication module. The On-Board Unit dispatches data flows like GPS data, video data, and sensor data. It sends periodic information to the Control Centre about position, speed, status of working of the different subsystems. It will also send pictures, video clips and video streaming under requests coming in from the Ground segment via the communication module.

2.3 Communication system

Various radio systems - PMR (TETRAPOL), UMTS/GPRS/EDGE and WiMAX/WiFi - are used in the framework of the MORYNE project. But the local sensing and processing unit in the vehicle should be independent of the radio system used for transmission; it should not be bothered with controlling the radio modems and managing the radio transmission itself. The same applies for the Public Traffic Management System. It is therefore necessary to have a common interface integrating the different radio systems used, managing them intelligently and providing high level transmission services.

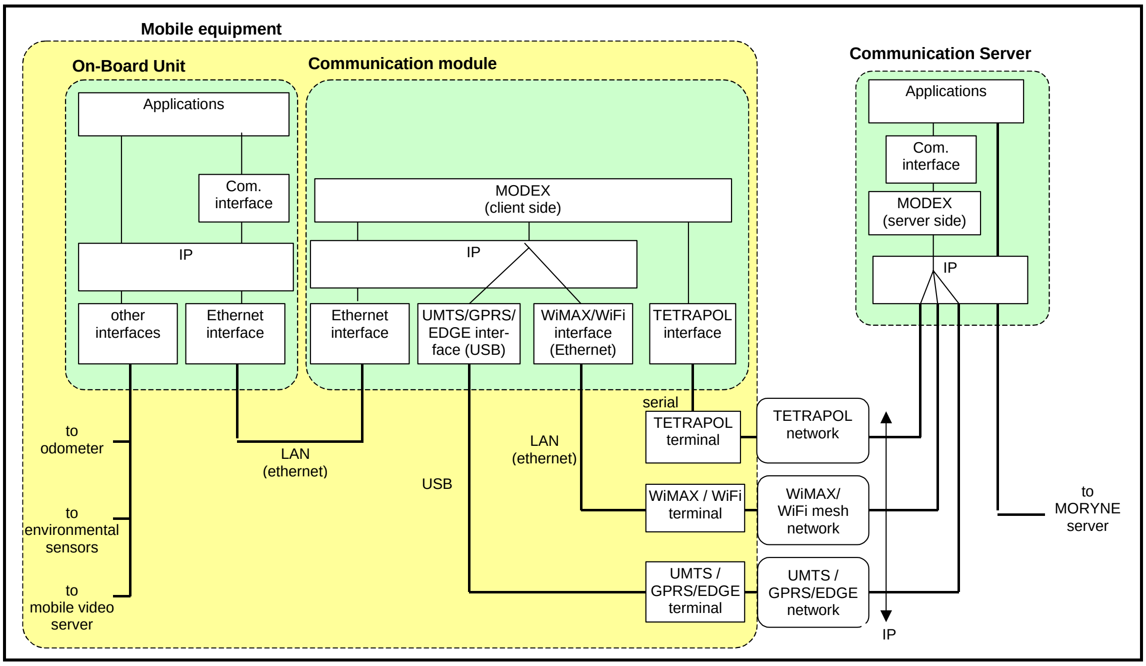

Figure 3 – Architecture overview of the Communication System

The Communication Module is the interface allowing the OBU (and therefore the vehicle) to access the data transmission services provided by the various communication systems. All data (processed or not) pass through the OBU, which converts them into a telegram structure suitable to be sent or just be handed through already processed data. The Communication Module needs information about priorities, timestamps to cancel transmission due to loss of communication, size, availability of radio communication and a radio preference list. It integrates also the different radio systems (TETRAPOL, UMTS/GPRS/EDGE, WiMAX/WiFi), provides a single interface to all of them and manages radio resources. It performs intelligent routing via the best medium and service. In case of an emergency or lots of data, more than one communication system should be used. It is designed in an open architecture allowing extension to future needs and radio systems.

The Communication Server is the interface for the MORYNE server to access the data transmission services provided by the various communication systems. Installed in a standard PC with a great connectivity, it allows the connection to several kinds of communication networks (TETRAPOL, UMTS/GPRS/EDGE, WiMAX/WiFi, Internet and PTCC Intranet). The Communication Server on the Ground segment is the counterpart of the

Communication Module on the Board segment. The Communication Server provides the interface allowing the Public Traffic Management Centre to access the radio systems and does smart routing via the best medium and service. It integrates the different radio systems on the Ground segment, provides a single interface to the different radio systems / network systems and their services, manages radio resources and integrates all different data incoming via internet/intranet. It is designed in an open architecture based on standard technology allowing extension to future needs and radio systems.

Three types of radio–based communication networks are used depending on the type of data to be transmitted:

- TETRAPOL
- WiFi mesh / WiMAX
- UMTS/GPRS/EDGE.

2.4 Ground segment

As displayed in Figure 1, the Ground segment is composed of the MORYNE Server and the MORYNE clients. The architecture overview of this segment and the data flows are depicted in Figure 4.

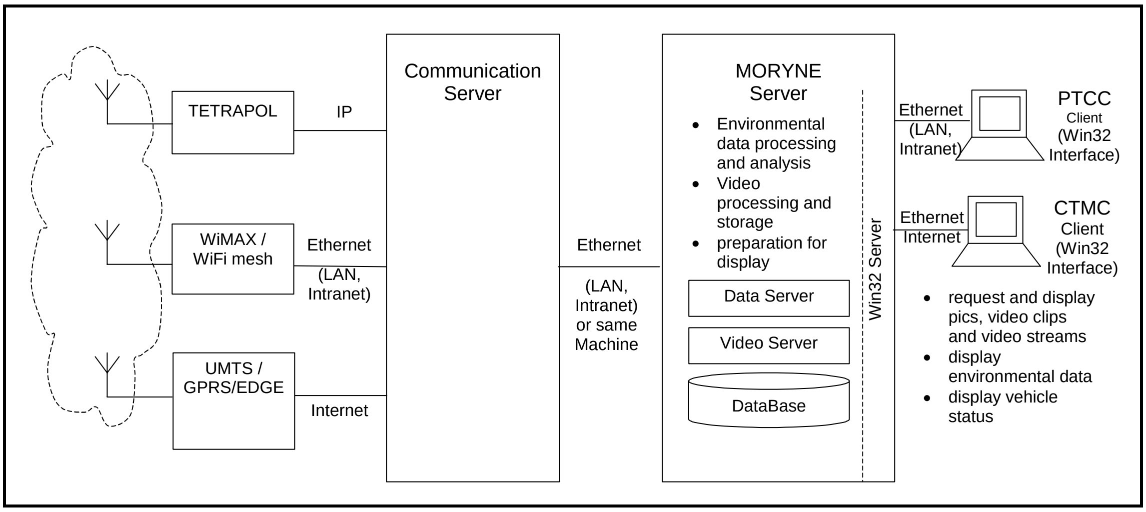

Figure 4 – Architecture overview of the Ground segment

The MORYNE Server receives information, files, etc from the mobile units (buses) through the Communication Server. It processes all the information received (in particular storage in the system Data Base), or forwards it to its final user (i.e. MORYNE Client) or intermediate module (i.e. Ground Video Server). The role of the MORYNE Server (MS) is to allow users located in the PTCC and the CTMC to access video and environmental data issued from the bus, as same as other information from the bus subsystem. The MS stores information received from the Mobile Equipment in its database, so the Video Server and the Clients can use it when they consider it appropriate. Stored video information is formatted according to the MPEG standard before being forwarded to the clients installed on the users machines.

PTCC and CTMC Clients are Win32 Interfaces that communicates to the MORYNE Server and the main Data Base. A proprietary protocol will be used to exchange data between the Server and the Client. The supervision allows on–line the localisation of the vehicle (position and speed for example), the environmental conditions (humidity and temperature) and the visualisation of the alarms generated inside the vehicle (fog and traffic jam for example). The control allows the user to request a picture, a video clip or a live video issued from a specified vehicle. The user can access to the events saved in a log per vehicle and time range.

