Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 3 [6] May 2014: 108-114

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804

ORIGINAL ARTICLE

Intelligent Transportation Systems (ITS) and Their Application in Urban Management (Case Study: Miandoab)

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ABSTRACT
Creation, control and utilization of intelligent transportation systems within the city seem to be essential in today's society. The goal of this study is to present intelligent transportation system (ITS), and its application in urban management. The methodology used in this study is a practical analytical and descriptive method. According to the findings, the results of the study indicate that ITS can be used in Miandoab, particularly in its central part, in seven areas including management system of main arteries, passenger transport systems, electronic payment, information management, safety and accident prevention, ITS and driver-assistant systems.
Keywords: *Intelligent Transport System (ITS), urban management, Miandoab*

Received 10.12.2013 Revised 04.03.2014 Accepted 19.04. 2014

INTRODUCTION

Due to population growth and the emergence of economies in developing countries, and the high economic growth in developed countries, the rapid development of technology makes cities more attractive and thereby increases the growth of urbanization. Therefore, people need to satisfy their residential needs. One of these requirements is the fast and optimal transport from one place to another within a city. Therefore, urban management is seriously challenged with adoption and better management of urban transport systems. Citizens have the right to own an automobile; thus, it is essential to manage the transportation system within the cities. A communication network system has its own capacity, traffic and level of service. Therefore, public transportation system is in priority over private transportation system, because the number of passengers transported by public system is more than by private system. In addition, public system occupies less road capacity and traffic. In fact, establishment of a managerial private and public transportation system within cities leads to a better urban management followed by citizen satisfaction.

The purpose of this study is to present the intelligent transport systems (ITS) and its application in urban management. The basic question is that how can ITS be used for the optimal management of urban traffic? How can ITS be along with urban management purposes?

ITS standards and its functional aspects lead to optimal performance of urban traffic management. In addition, ITS seems to be a powerful efficient tool to control transport system within a city.

METHODOLOGY

The methodology used for this study is a practical analytical and descriptive method. The studied area is Miandoab in south western Azerbaijan.

Theoretical Background

Urban public transportation routes were launched in 1828 in Paris, 1829 in London and 1837 in Berlin by horse-drawn wagons; in London (1830), 26 buses with steam propulsion were used. Public transport is one of the major sectors of transport and major element of transportation [1]. Car traffic dates back to 1860s in London when a traffic light was installed at an intersection near parliament for the safety of members of the parliament [2].

Public transport systems are often provided by the government or the public sector. This is due to various reasons including non-profitability of this sector. Therefore, private sector is not very interested in participation in development of public transportation systems. Hence, it can be concluded that the public transport system does not benefit the public sector. However, it is essential for growth and dynamism of the city [1].

There are different types of public transportation systems including railway systems, bus and taxi networks, which is more of a public and semi-public system. Railway network is divided into urban express trains, high-speed underground train (subway), ground and underground trams. Bus network is divided into buses, electric buses, minibuses and vans (ibid). Civic express train is responsible for connecting downtown and its surrounding towns in densely populated areas as the backbone of urban transport system. During recent years or in a near future, the other responsibility of the system is the connection between airports and national railway network. Express underground train (metro) is the most efficient public system in terms of speed and capacity. One of the main tasks of subway is to connect major roads within the city limits. These roads can be divided into several fine branches. The main disadvantage of subway is lack of flexibility. The ground tram is usually shared with other vehicles in space. Capacity of this system depends on the number of wagons used in tram. Ground tram is widely used throughout the world (ibid). Other public transport vehicles are bus and trolleybus. There is often no special road for both vehicles. Buses are more flexible than other vehicles; hence, buses are considered as the major transport system within metropolises. Minibuses, taxicabs and vans are more flexible than other public transport systems. They are free to choose the path and the initial investment in them is extremely low (ibid.). The new systems of transportation include the monorail train; some of their interesting features are their attractiveness and no interference with other motor vehicles. This type of system is usually more responsive in tourist cities due to their attractiveness. The disadvantages of this type of systems are their low capacity and high cost. Monorail hanging trains are similar to monorail trains, but faster. One advantage of this type of system is their safety, speed and low energy consumption as well as minimized environmental effects (ibid.).

Besides the private transport system, all public transport systems mentioned above may exist in a city. Under this circumstance, both complete planning and a control managerial system are required for different parts of public transport system. Usually, planning for public transport systems involves three processes including data gathering, patterns of travel and modelling. The models widely used in public transport systems typically are divided into four categories including travel production, travel distribution, travel allocation. The structure of these models and their definitions are out of the discussion in this article.

One of the most important systems is transportation system management (TSM). TSM has four modes. The first mode involves ways to reduce demand. The second mode involves ways to increase supply. The third mode involves procedures to reduce demand and supply. The fourth mode also involves ways to increase supply and reduce demand.

What is ITS? How it works in TSM?

In 1990's, scientists discovered that new possibilities and capacities are swallowed by consumers in a short term. Because of competition between road construction and production of comfortable affordable cars, development efforts have weakened and road safety have been frequently reduced. On the other hand, development of modern technologies provides opportunities for creating an uninterrupted connection (On-line) between decision makers, traffic management centres, vehicle and road traffic through sensors and electronic apparatus whereby an opportunity for intelligent, objective and coordinated management in order to promote productivity and increase efficiency. Thus, the modern concept of Intelligent Transportation Systems (ITS) was emerged in early 1990s [3]. ITS is a general term for combined application of communication technologies, control and information processing for transport systems. In fact, ITS includes all modes of transportation and all elements of transportation system such as vehicle, infrastructure, and the driver or user. The overall task of ITS is to improve decision making for transportation network controllers and other users, thus improving the overall application of transportation system. This definition encompasses a wide range of techniques and strategies that can be obtained by application of a technology or improvement of a set of transport technologies [4]. In fact, ITS is a rule and order which allows a series of new unconventional solutions to improve safety of the traffic and to satisfy transport requirements using new technologies for information processing, communications, control and electronic around the world [2]. Most new ITS technologies are primarily developed for roads with traffic lights control systems such as SCOOT[1] and SCOTS[2]. Now, ITS

[1] Split, Cycle, and Offset Optimisation

[2] Sydney Coordinated Adaptive Traffic System

includes all systems of transportation, including public transportation systems. Strategies such as fees in congested areas (cost pricing) can encourage drivers not to use cars; however, attractive comfortable public transport is also necessary simultaneously . U.S., Europe Union and its member states as well as Japan assigned funds for research and technology development as the basis for implementation of urban and inter-urban ITS. Currently, a new generation of ITS technologies has been emerged. In different parts of the world, countries have developed their specific ITS organizations in relation to the government sharing their experiences; thus, developing countries can take advantage of their experiences (ibid.). Now, many ITS applications are used alone, because it is often cheaper to use one short-term application; therefore, there would be no concerns about conflicts between the exchanged data, data exchange interfaces, communications and hardware requirements for integrating a comprehensive ITS system. However, the next step to take for ITS and its effectiveness is to consider integration of systems (ibid.). Introduction to ITS applications make it possible to clarify the definition. In fact, ITS involves a wide range of applications from advanced systems to control traffic, to control freeway congestion through interior entrances and accident alarm systems. ITS applications can be divided into two main groups, intelligent infrastructure and intelligent vehicles. These two groups are divided into other sub-groups in which ITS applications are clearly determined [2].

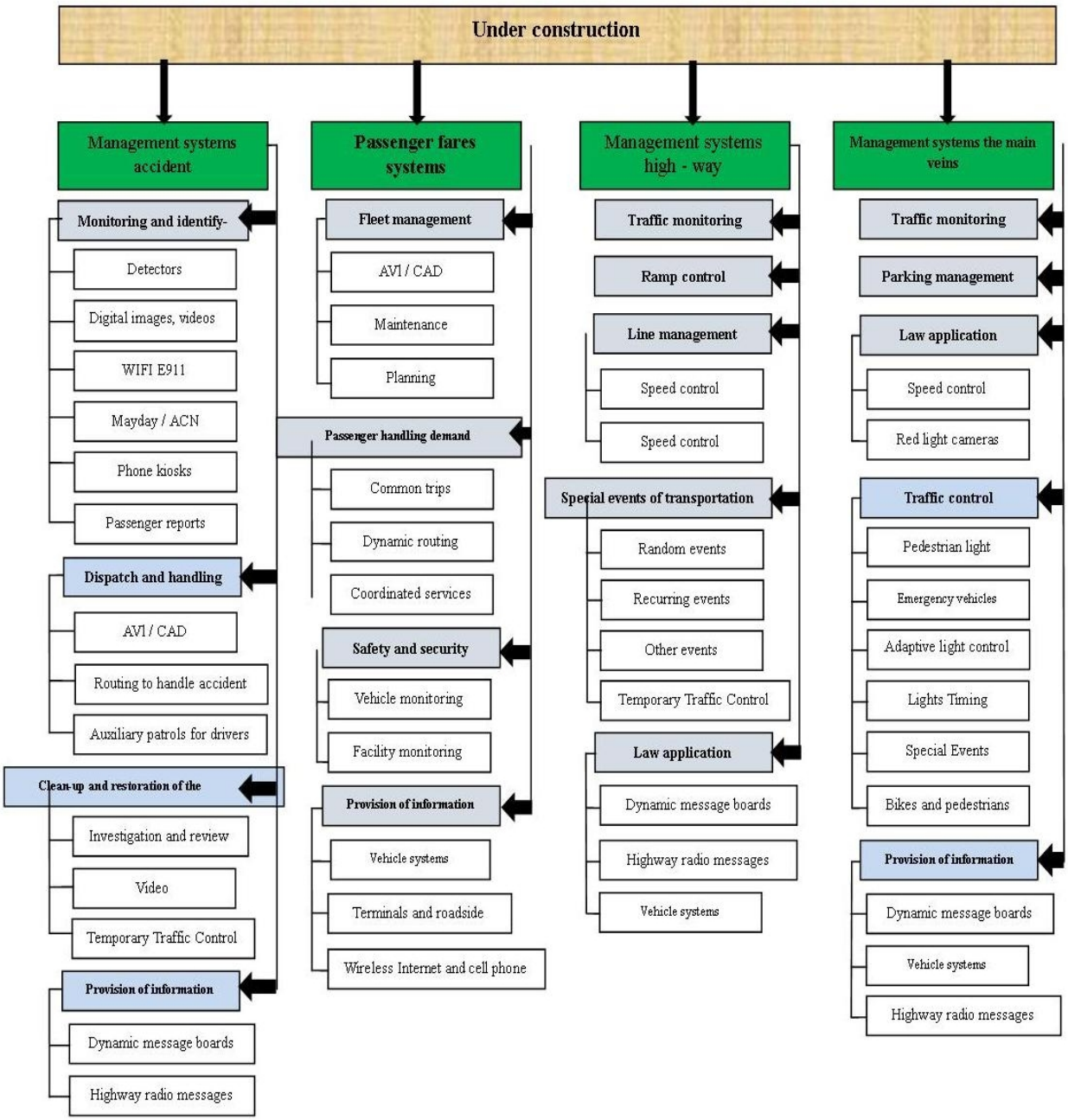

Figure 1: intelligent infrastructure ITS

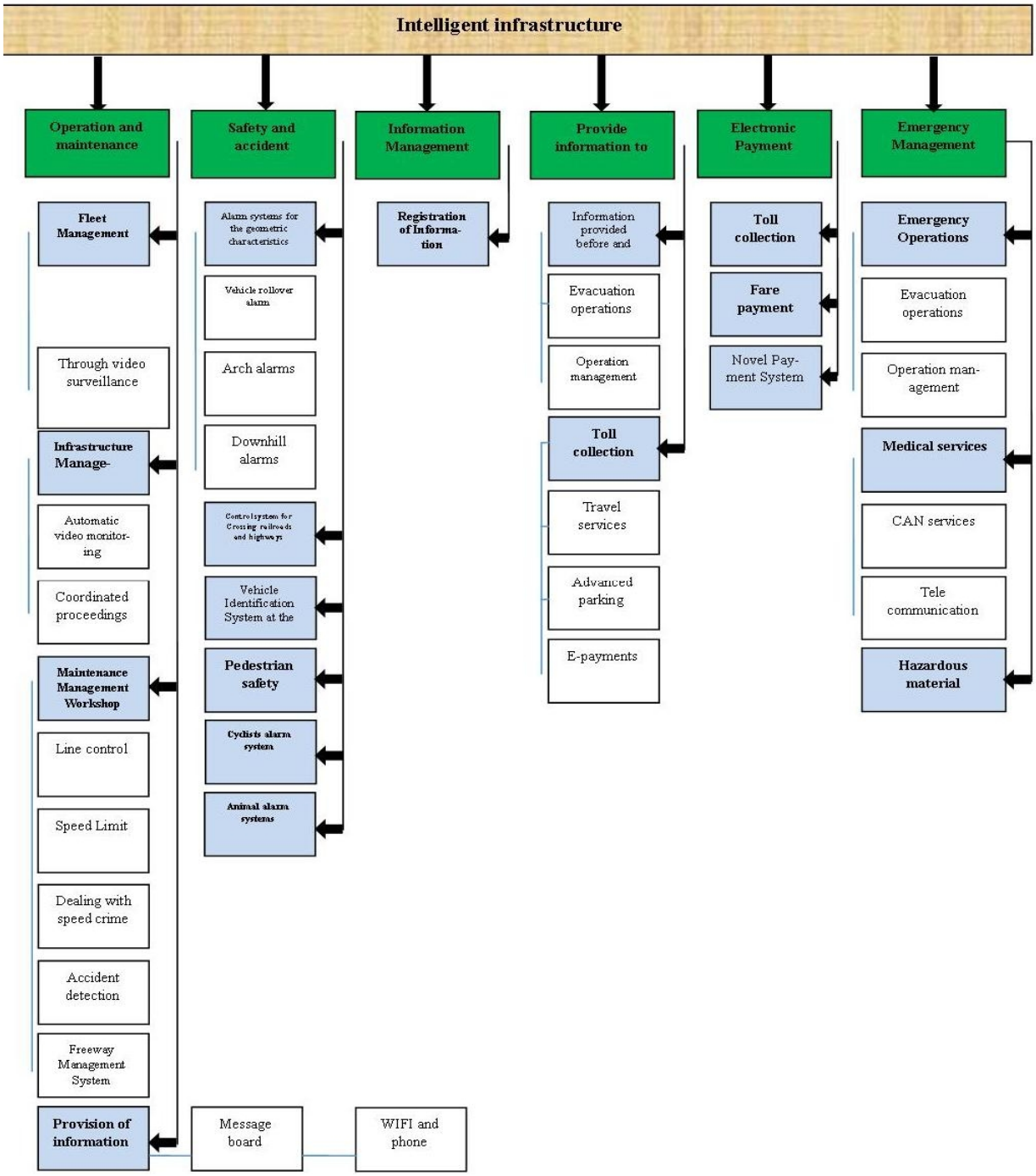

Figure 2: intelligent infrastructures of ITS

Architecture of ITS

ITS architecture defines the following:

- The performance required by ITS, such as collecting traffic information or demand for a road
- physical elements or subsystems underlying these activities (such as roadside or inside a vehicle)
- Information flows and data flows relating these activities and physical subsystems together in an integrated system (PIARC, 2004).

Architecture of the United States has been a stimulus for development of similar architectures as a replacement in Europe, Japan and some other countries. A country and region have to determine a set of user needs and requirements as a starting point for national or regional ITS architecture. However, the general approach taken for development of alternative architectures is quite similar, although some differences exist in the user services and terminology (ibid.).

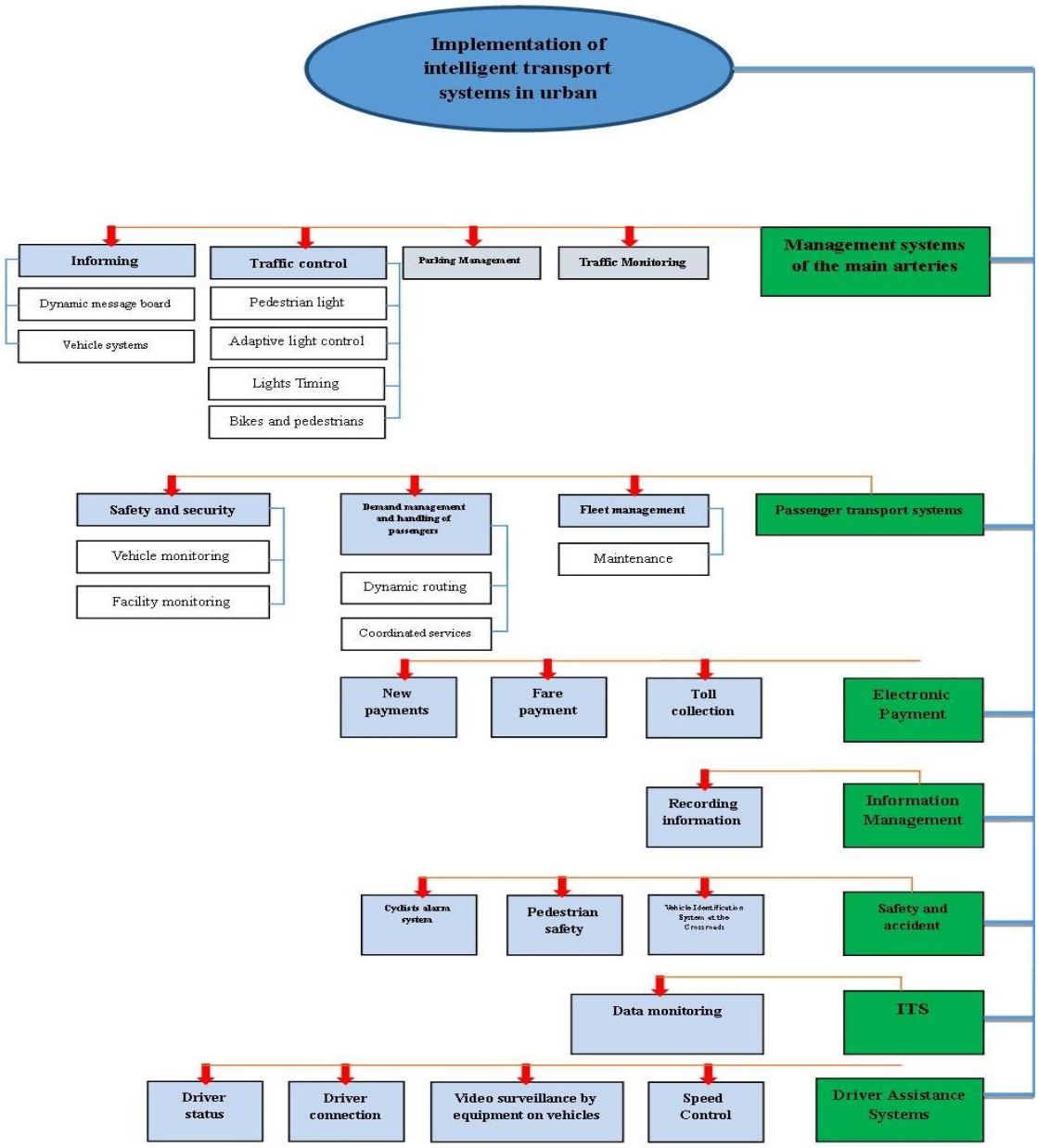

Figure 3: the model of ITS

Theoretical Framework

Generally, the model framework is divided into six groups including management system of main arteries, passenger transport systems, electronic payment, information management, safety and accident prevention, operation and maintenance, ITS and driver assistance systems. These groups are divided into the following sub-groups listed below.

Miandoab

Miandoab is located in an area of 1953 hectare in south Lake Urmia and southwest of West Azerbaijan Province, approximately linearly along the East-West. The city limits to Bokan, Malekan, Mahabad and Shahindezh; in fact, it is the connection between provinces of West Azerbaijan and East Azerbaijan. Area of the city is 2694k² in longitude of 46 degrees and 6 minutes to the east of the meridian time and within 36 degrees and 58 minutes to the north of the equator in the central plains ending to the lake at a height of 1314 meters above sea level [4].

RESULTS

Management system of the main arteries

Based on evaluation of Behran Traffic Consulting Engineers [5], traffic accidents in the first month of 2005 is as follows.

Traffic

Failure to meet the priority and the front seems to play a major role in rising accidents. To meet the priority and enhance the driver's vision, it is recommended to use global navigation technology (GNSS-CN) for satellite positioning, automatic vehicle tracking, and customs duties automatically based on the distance. A few of the technologies to reduce traffic is also described below.

- Artificial vision camera system, used for law enforcement and security
- Diagnosis and classification, used for traffic management, incident management, adaptability, safety and security
- Digital maps, as database of transportation networks saved in digital media (such as compact discs) using agreed terms of data and standardized location. Digital maps for ITS are considered as a main unit of service delivery.

Parking

Downtown streets of Miandoab include Imam St., Taleghani, Shohada, Shariati, 17 Shahrivar, Modares, Enghelab etc., with very little width from 8 to 11 meters. These streets are the focus of various absorbing lands and travel-generating routes ranging from administrative services with high travelling attractiveness during the day and especially at peak times of the morning and evening. At this time, a marginal parking is needed. There is no parking problem in the rest of the city. Only one floor-parking project in central part of the city, which is not yet approved, is considered in the agenda of the municipality as an upper priority project [5].

Traffic Control

UTC systems have been introduced to reduce congestion and traffic accidents. Computer traffic control has become common around the world; its domain has been extended from individual controllers for intersections to integrated systems covering urban networks all of which relying on traffic control and vehicle detection to set the duration of green light phase and time interval between the time periods of lights in adjacent intersections to react to changes in traffic flow. Urban traffic control system (UTC) has four characteristics:

- automatically collection of data about the speed and volume of traffic using devices such as road sensors, CCTV, automatic number plate recognition (ANPR) and Floating Vehicle Data (FVD)
- control of traffic lights based on this data
- Preparation of data for travel information services
- Automatic warning of accident for related organizations such as police, relevant departments (PIARC, 2004)

Dynamic message information

ATIS involves information of commercial and private road travels by various transport methods. Non-specified travel time and arrival time is a major problem for passengers and delivery companies. Intelligent travellers and fleet managers need very credible information to make informed decisions. According to available data, there is no evidence for citizens and passengers to use information needed to travel within the city. Therefore, it is recommended to use ATIS for dynamic informing to passengers.

Passenger transport systems

According to the approved service description of Interior Ministry, applicable and effective methods for organizing bus and minibus system were studied and reviewed considering financial constraints and possibilities on a horizon of five years or more and in accordance with budgets of development and improvement of bus transit system in Miandoab [5].

APTS applications are one of the methods for improving public transport, providing reliable, easily available and timely information to passengers. Automatic vehicle positioning system can provide synchronized information about departure time and arrival time as well as the route at the station, home or work, in the street, or other ways of transportation. This information can be provided by multiple media such as internet, information booths, text news, mobile phones, Pocket PCs and voice telephone services (ibid.).

Electronic payment

Given the status quo, no electronic payments occur in the city to use public transport. To this end, modern electronic payment systems provide major benefits to pay cash for road and transport authorities and passengers. Now, ETC/EFC system has evolved further in roads, bridges and tunnels across the world. Smart cards of advanced rental system (AFC) provide authorities of public transport with more flexible ticket sales, less administrative costs and better information management and marketing, while saving in time of passengers satisfied with a comfortable and safe travel, without cash payments. Electronic Payment System (EPS) also results in cross-functional capability and compatibility between systems and methods of transportation using an intelligent and unique tool (ibid).

Information Management

Unfortunately, information management of urban transport is being carried out traditionally in the municipality of Miandoab. To solve this problem, information management can record a series of transportation data, as described as follows.

DISCUSSION AND CONCLUSIONS

The results of this study show that urban management can use intelligent transportation system at least in seven areas including management system of main arteries, passenger transport systems, electronic payment, information management, safety and accident prevention, ITS and driver assistance systems to provide better services to citizens. In relation to management system of main arteries, particularly in downtown, digital maps and traffic control systems, or UTC can reduce traffic accidents. ATIS system can be used to provide suitable information such as bus arrival or red light repair. For passenger transport system, APTS system can be used to improve travels by public transportation system. It is recommended to use AFC, which is now available in most smart phones, in taxis and urban transport systems. However, AFC is recommended because of its inexpensiveness compared to other e-payment systems. For information management and optimal control of urban transportation system as well as integration of transportation infrastructures, the bus organization is recommended to work under supervision of the Miandoab municipality.

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