FUTURISTIC SMART TRANSPORTATION

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KEY WORDS: GIS (Geographic Information System), GPS (Global positioning satellites), CO2 (Carbon dioxide), GNSS (The Global Navigation Satellite System), DOD (U.S. Department of Defence), SVs (Space vehicles), PPS **(**Precise Positioning Service), SPS (Standard Positioning Service), TMC (Traffic Message Channel).

ABSTRACT:

Cities around the world are being wrecked by the ever-increasing burden of traffic. A significant part of the problem is the enduring popularity of the private car, as it is an attractive and convenient option to the mass, which turned a blind eye to the environmental and public health impact. Public transport has always seemed the second place to private. Local-scale networks at many large cities are facing now a near death end of traffic integrations. While horrible accidents, delays, vehicles overpopulated, oversized highways and bridges that mostly destroy the urban pattern of cities, demolishing the skylines with endless circles of network-lines. This may turn the human being into a desperate robot, spending three quarters of his life-time trying to be transferred from one place to another.

This research aims to explore new GIS measures being tried in some developed communities. Case studies around the world are being examined. Illustrating the intelligent transport system being used by some governments, to help in solving the transport networks problem impact. Technological techniques are associated with GIS system, to perform more advanced and fast transport analysis. The results of the research are these new forms of analysis that are enabled by GIS and such vast new transport supplies of data as; GPS and Radar system. Finding transport solutions by many methods that form decision-support systems enlisting GIS to search automatically across thousands and millions of options. Surely working with these scientific methods will reduce pollution in our environment, avoid traffic, decrease accidents and facilitate mobility.

INTRODUCTION

Unfortunately, the future arrival with the millennium have not as science fiction fans imagined for the transport revolution (see photo1). No signs for personal helicopters or airborne cars. Just private and public transport integrated in abstract urban environment. The hope is that some parties achieved some quiet streets to walk through and delight transport to use.

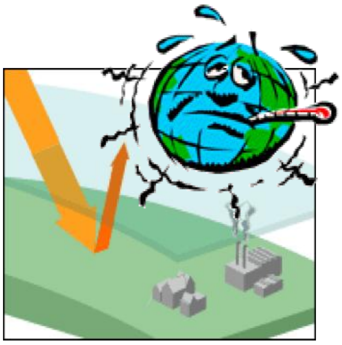
(Photo1): Film Metropolis, directed by Fritz Lang, 1926.

But in big cities the most important factor that affects the environment is number of cars per head population. For example in Europe the population density of 334 people per square mile, owns 116 million cars. While in USA the density is 78 people per square mile, owns 141 million cars.

In the U.K 50% of the population owns a private car, Richards predicted that this percentage will rise of 20% for the next 10 years. (Richards: 2001) As car ownership grows, road space has become congested, parking has become so difficult, traffic is unbearable, accidents are overcoming & pollution is murder.

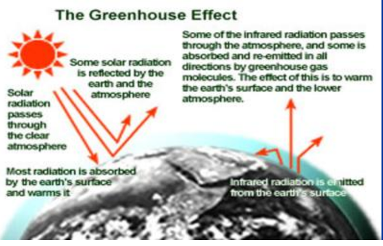
(Photo2): Traffic flow.

The transport vehicle is a major contributor to air pollution, it produces CO2 from fuel combustion. As the CO2 increases in the air, it builds up a blanket and traps heat close to the surface of the earth, causing the phenomenon of Global warming or green house effect. (SEJ: 2005)

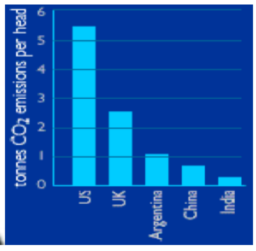


(Figure1): Global warming. (BBC News: 4/7/05)

The highly influential Inter-governmental Panel on Climate Change (IPCC) envisages a report which says that, by the end of the century, CO2 emissions will be 5 times what are today. Many other climatologists say that the emissions of green house gases could rise hugely over the next 100 years. Certainly, the Earth climate system will be affected, with higher global temperatures and sea levels. (Kirby: 1999)

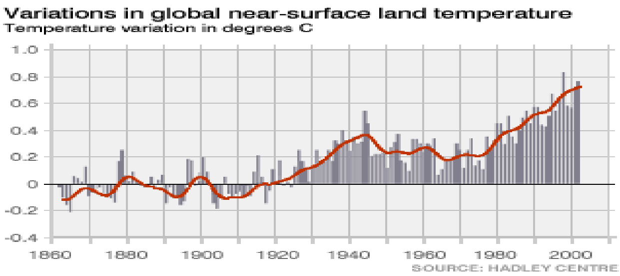


(Figure2): The Greenhouse effect. (US EPA: 2001)



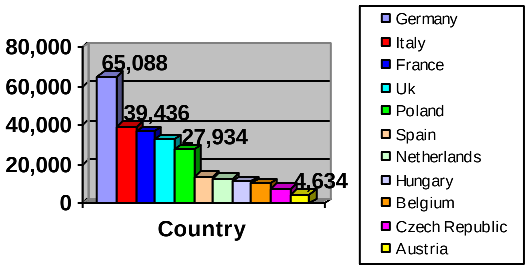
(Graph1): CO2 emissions. (Kirby: 1999)

Even nowadays the Alaskan's locals are saying that the ice is now thinner than it used to be before. (Bissel: 2005)



(Graph2): Variation in Global temperature. (BBC News, 4/7/05)

Pollution reduces the life of the average European by 8.6 months. (BBC News: 4/15/05) It is responsible for 310,000 premature deaths in Europe each year. (BBC News: 21/2/05) This is a natural result from the burning of benzene and all kinds of fuel. "The mechanisms underlying benzene-induced toxicity and leukemogenicity are not yet fully understood, they are likely to be complicated by various pathways, including those of metabolism, growth factor regulation, oxidative stress, DNA damage, cell cycle regulation, and programmed cell death", see graph 3. (Hirabayashi, 2003)



*(*Graph3): European premature deaths. (BBC, 21/2/05)

It also was proved by scientists that car fumes linked to child cough (Grigg: 12/3/2003), cause asthma and damages male fertility. (De Rosa, 2003) The main threat to health is the tiny particles (Known as particulate matter) emitted by traffic, which penetrate the respiratory system and the bloodstream (especially dicsel engines). These particles react with the sun light producing Ozone, which causes respiratory diseases. (BBC: 21/2/05)

Another horror shows according to the World Health Organization: noise levels are estimated in, to affect 80 million persons in Europe. Accidents are increasing in a maniac way; in UK approximately 3000 children get killed or injured in a car accident, see photo3. (Plowden: 1980)


(Photo3): Car accidents. (http://www.car-accidents.com)

For approaching a convenient life style, trying to reduce all the previous transportation disasters. This research aims to illustrate the new GIS technologies and how it solves some of the recent mentioned problems. Part one of the research discusses today's transportation system integrated in our cities as; roads, vehicles, tunnels, trains, busses etc... Part two collaborates the GIS analysis, explaining the reason of its choice as a transport solution. Thus explaining the new Satellite system and GPS navigations, Network Analysis and topological models. Part three is the smart transportation trials of some current governments, discussing some successful international case studies for using GPS and GIS technologies in transport system and improving vehicle industry. Part four is a collector for all conclusions, solutions and management problem solving.

1. TODAYS TRANSPORTATION

The hardest equation today that governments are trying to solve is: "Providing safe and comfortable private transport besides regular and convenient public one". Reliable transport system is required for any urban area. Cities of the world must have at least three types of public transport as buses, trams & railways. (Richards: 2001, p9) Many civilised countries are trying to install more advanced systems for public use. This part of the research is discussing the different types of transport system today, explaining it's from benefits and disadvantages.

1.1 Types of transportation system

The user of public and private transportation systems moves in different ways; by foot or riding a vehicle. That means we can consider roads as a main cord in the system. Vehicles are next with all types of private like; cars, bicycles, motorbikes taxis and public like; buses, trams, trains, monorails and in some countries cable cars and horse carriages (See APPENDIX A).

1.1.1 Roads: There are many kinds of roads provided by governments for people; pedestrian, roadway.

A. Pedestrian: Pedestrian road is for people to walk on foot only. Walkways to circulate people between buildings, in some shopping area, parks (see photo4) and sidewalks. (Rubenstien: 1996) It even can be suspended pedestrian as shown in photo5.


(Photo4): A walkway.

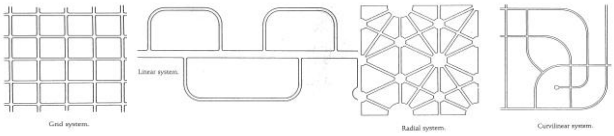

(Photo5): Suspended pedestrian

The formula for calculating pedestrian flow volume (P) is:

$$P = S/M$$

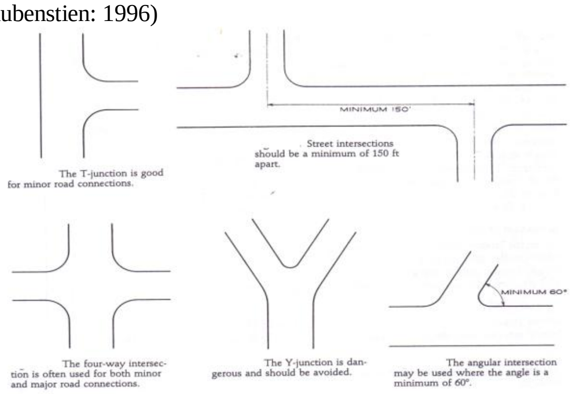
Where P = pedestrian volume.
S = average pedestrian speed per minute.
M = average number of square feet per pedestrian.
(Equation1): Pedestrian volume. (Rubenstien: 1996, p.100)

B. Road ways: Roadways integrates inside the city, for all kinds of cars and vehicles to walk through. In the residential, suburbs areas and highways which even link cities with each other. The usage of roadways is increasing every day with the growth of vehicle numbers all over the world. All the discussed problems of pollution, traffic, pollution, illness and accidents are embryos of the roadway system. Circulation systems are haphazard, they have different classifications; grid, radial, curvilinear and various combinations (see figure2).



(Figure2): road system. (Rubenstien: 1996, p.90, 91)

Also accidents are always a main problem in the roadway transportation system which is most of the time a junction result. Road junction is a fatal design mistake sometimes. (See figure3). Some shapes like the Y junction is an accident responder. (Rubenstien: 1996)



(Figure3): road junctions. (Rubenstien: 1996, p.100)

Even our urban form and city style have been destroyed by all the new suspended roadways. Cities are removed from their historical natural moorings. (Steele: 1997, p.7)

(Photo 6): Integrated suspended roadway. (Steele: 2001p.7)

1.1.2 Vehicles: vehicles are the transport engines which the person rides for translocation from one place to another. They can be classified into private and public vehicles.

A. Private Vehicles: Cars are very popular around the world, as it was explained that the rate of cars ownership is growing all over the world. As it can afford a high degree of comfort and privacy for the user, while public transport doesn't give this luxury. Bicycles and motorcycles have become popular now in many European countries. Cycle-ways have been segregated along side of the main roads (see photo7). (Richards: 2001) It helps in reducing pollution and it needs shrinking parking places.

(Photo7): Cycle ways. (Richards: 2001, p.6)

B. Public Vehicles: Governments are trying to find alternative ways to get the people out of their cars and use public transportation. Buses are the work-horse of the city transport. Now they have with cleaner engines with better designs and some countries are using bus only lanes, but other buses in the third world countries are out of date.

(Photo8): Bus types (http//www.buses.com)

Light rails are one of the successful public transports, probably values along light rails routes are 10% higher than anywhere. It has been given priority lanes to penetrate the traffic and mostly move faster than other vehicles. 11% of new passengers who were driving before are using light rail now in 14 European cities. Its construction cost is cheaper than the subway.

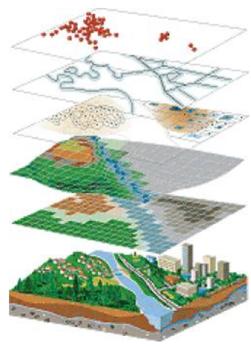
Today Underground system (Metro) runs in 84 cities around the world. It carries passengers with capacity from 20-40,000 people per hour in each direction. With average speed of 30Kilo meter per hour, under mainly the city centres. Deep tunnelled tube lines often 20m down. The trains usually run with two minutes intervals.

Railways cannot be considered as a city transport, it travels between cities and far distances. It moves mostly in rural areas or farm with no interaction with other system. Some countries have different public system from monorails, horse carriages and cable cars, mainly for touristic use.

(Photo9): Cable cars in France. (www.leisuredirection.co)

2. GIS TECHNOLOGY

GIS is the Geographic Information System, it manages, analyzes and disseminates geographic knowledge. It links location to information, as people to addresses (ESRI: 2005) GIS is more than a mapping software. It is a technology that can change any manageable system fundamentally and positively, GIS goes beyond mining data to give you the tools to interpret that data. It allows you to model scenarios to test various hypotheses and see outcomes visually. Its application is unlimited and can be used for mapping the work for better decision-making. (Zeiler: 1999) With a single collection of tools, GIS is able to bridge the gap between curiosity- driven science the practical problem solving, we can finally call it *"The Science of Problem Solving"*. (Longley: 2003, p.5) This part discusses most of the new GIS applications and the related technology to solve transportation system as GPS, network analysis & radar systems.

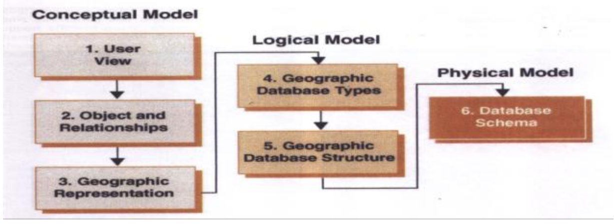


(Figure4): Data interpreting. (ESRI: 1997)

2.1 GIS Views

GIS is a complex beast, with three views; Data base view, Map view, and Model view. These are the ways of GIS working with geographic information. Also its major workhouse (ArcInfo), (ArcView) is designed for viewing, analyzing and mapping data and (ArcIMS) for GIS oriented with web sites, (ArcSDE) for spatial system extensions and many others. (Longley: 2003, p.13)

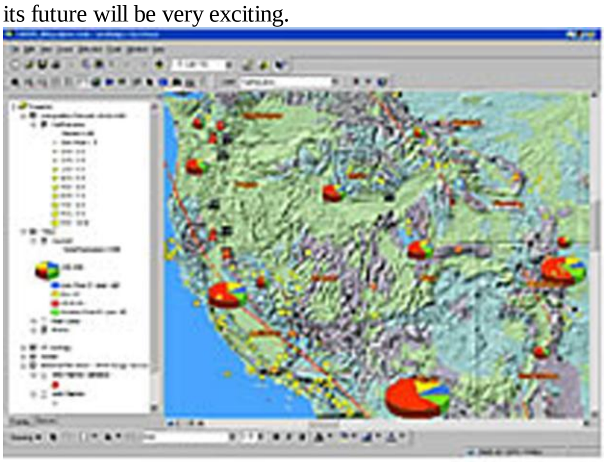
2.1.1 The Data Base View: GIS has a unique data-base called "*geodatabase"*. It can be defined as the "Information System for Geography". (ESRI: 2005) GIS is based on structured database that describes the world in geographic terms. (ESRI: 2005) To design a database you have to pass through three models with a prepared thinking as shown in diagram1.



(Diagram1): Stages in database design (Zeiler: 1999)

2.1.2 The Map View: The system is a group of some intelligent maps and other views, which shows features and features relationships. Maps are geographically constructed under windows in the software inside the database to be edited, support queries, converted and analyzed. This is called the "*geovisualization"*(ESRI: 2005) Any group of maps, having the same geographic place, their related tables and attribute must be under one geodatabase with the same co-ordinate system.

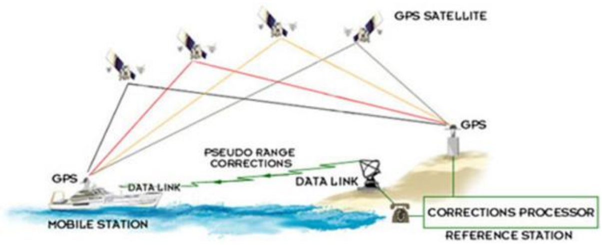
2.1.3 The Model View: GIS is a set of information transformation tools that creates new geographic datasets from the existing ones. This is called *"Geoprocessing"*. These functions take the information and analyze them and derive new datasets. (ESRI: 2005) GIS is a dynamic and evolving field and its future will be very exciting.



(Map1): Analyzed map.

2.2 GPS

GPS is Global Positioning satellite, which is the Global Navigation Satellite System (GNSS). GPS is funded by the U.S. Department of Defence (DOD). GPS is a network of satellites monitoring stations and inexpensive receivers used for primary GIS data capture. (Longley: 2003, p.211) ©1999 Peter H. Dana. Observer.

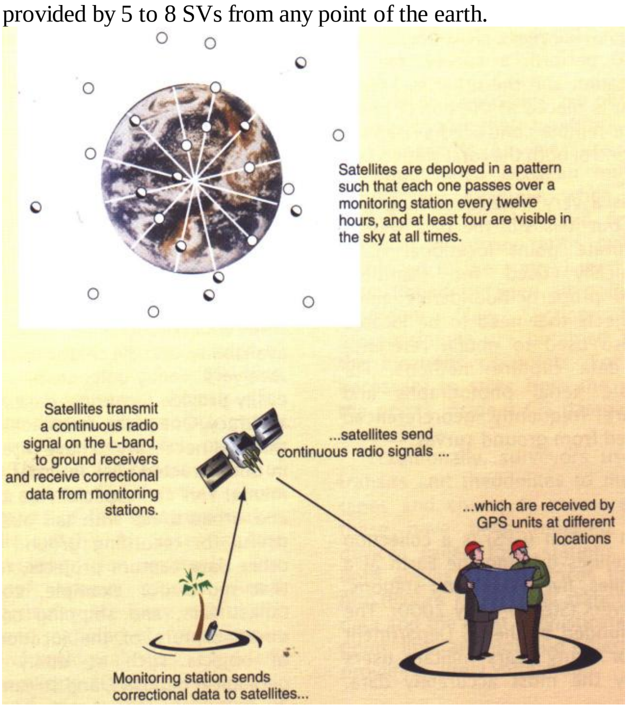


(Figure5): DGPS System. (Thales: 2005)

2.2.1 How does GPS Work? GPS works according to a simple principle, the length of time a signal takes to travel from a satellite to a receiver on the ground. Satellites transmit radio coded signals indicate the position and time. The receiver measures how long it takes the signal to be submitted from the satellite. Four satellite signals are used for positioning computation in three dimensions (see figure5), while the time offset in the receiver clock. The location of the receiver can be detected by triangulation. (Steede: 2000)

2.2.2 GPS Satellite: The GPS Satellites form the Space Segment of the system. They are called space vehicles (SVs) and send radio signals from space.

A. GPS Orbits: The nominal GPS constellation consists of 24 satellites that orbit earth in 24 hours. Often the figure is more than this, as new ones replace older satellites. The orbits repeat the same ground track once each day (4 minutes earlier). There are 6 orbital planes with 4 (SVs) each, so the user will be provided by 5 to 8 SVs from any point of the earth.



(Figure 6): The components involved in GPS. (Steede: 2000)

B. Control Segments: The control segment consists of tracking stations, which are placed around the world. The master station is located at Schriever Air Force Base in Colorado. These stations measure signals from VSs, which are incorporated into orbital models for each satellite. The models compute the orbital data and SV clock corrections for each satellite. The master station uploads all the computed and corrected data again to the VSs. Which subsets the orbital data to the GPS receiver over radio signals. (Peter: 1999) ©1999 Peter H.Dana

C. User segment: The technicians use two GPS receivers; one fixed and the other to take the measurements. (Steede: 2000) It takes the orbital signals back from the VSs and converts it into position, velocity and time. GPS receivers are used for navigation, dissemination, positioning, time and other research.

2.2.3 GPS Navigation: The main function of GPS is the three dimensional navigation. The explained GPS receivers are made especially for the transportation systems as; ships, aircrafts, ground vehicles (which will be discussed in details in the next part), and for individual hand use. Also it can be used in surveying, plate tectonic studies and geodetic control, astronomical observations, telecommunication facilities, measuring atmospheric parameters and network GIS analysis.

(Photo10): GPS navigation.

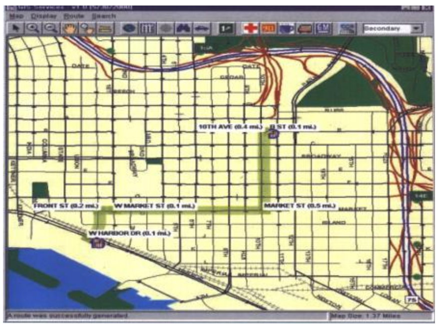
A. Precise Positioning Service (PPS): This accuracy services are equipped receivers for authorized users, in the Federal Radio-navigation plan. Only selected civil users in USA approved to use it. (Peter: 1999)

B. Standard Positioning Service (SPS): Civil users around the world can use this service without any restrictions. Most GPS receivers can receive SPS accuracy directly with no charges.

C. GPS Navigation Signals: The VSs transmit two microwave carrier signals; L1 frequency (1575.42 MHz), which carries two kinds of signals (navigation message & SPS signal) and L2 frequency (1227.60 MHz) to measure atmospheric delay by PPS receivers. (Peter: 1999) ©Peter H.Dana, 1999.

2.3 Network Analysis

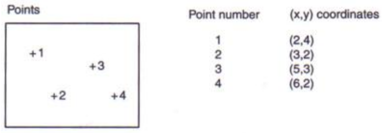
As the navigation system was explained earlier, it is now easy to segregate the GPS navigation data into the GIS Network system to be analyzed. By using the topological models of GIS, all the transport navigated data provided by GPS, can be transferred into vector transport meanings. Either railway, roads, buses or etc…



(Map2): Example of GIS Network analysis.
(Longley: 2003, p.192)

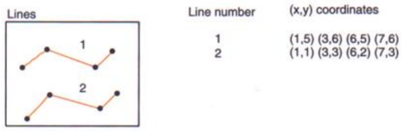
2.3.1 Topological features: Topology is the science and mathematics of relationships used to validate the geometry of vector entities (as point, line and polygon), such as network tracing. So Topological features are simple features structured using topologic rules. (Longley: 2003, p190) Software systems based on vector topologic feature data model are called geo-relational model. The contiguity (adjacency) relationship between features is defined during the process of topologic structuring. (ESRI: 1997)

A. Topological point data model: Topology structuring of point in GIS software systems networks is referred as node, such street intersections, fuses, switches, water valves and so on.



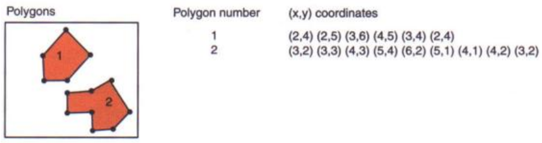
(Figure7): Point data model. (Longley: 2003, p190)

B. Topological line data model: Topology structuring introducing useful line properties and it is called (1-cell, arc, edge and link). It forces all line ends within the user defined distance, to snap together. Putting in each meeting point a node. This data model is refereed to spaghetti with meat balls. (Longley: 2003, p.190)

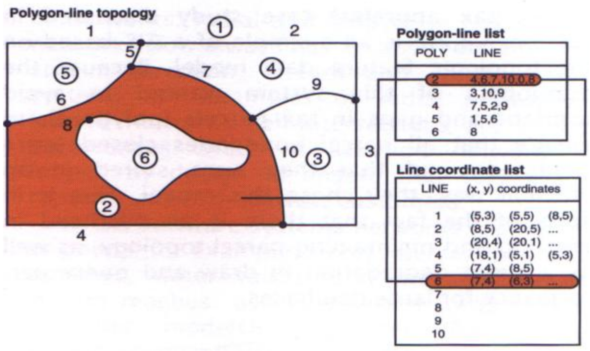


(Figure8): line data model. (Longley: 2003, p190)

C. Topological polygon data model: Topology structuring introducing useful polygon properties and it is called (2-cell, area and face) see Figure9. It defines the polygon as a collection of lines that in turn are made up of an ordered list of vertices. (Longley: 2003, p.190) This list of lines makes a polygon stored with the geometric data. Some lines may appear in the list several times as storing common boundaries between adjacent polygons avoids the problem of gaps (see figure10).



(Figure9): Polygon data model. (Longley: 2003, p190)



(Figure10): Topological structure. (ESRI: 1997)

2.3.2 Network data model: Network data model is a special type of topologic feature model. It has two primary types of networks; radial and looped, for example (see map2 of street network), the network comprises a collection of nodes to verify types of street intersections. And lines to verify types of streets. The topologic relationships between features lie in a connectivity table. By examining the table, it is possible to trace the flow of traffic and examine the impact of street closures.

A. Radial network: Radial or tree network flows in upstream or downstream direction as drainage system.

B. Looped network: Looped network self intersections are always occurred as water distribution networks to make sure that interruptions affect fewer customers.

2.3.3 Linear referencing (Route system): It basic principle is that instead of storing the coordinated of the geographic entities, they are stores as a distances along the network from origin point. (Longley: 2003, p193) Such as road pavement and geological data. The most interesting application in this model, is that the location of entities (called an event) and the two dimensional work is reduced to one. (Longley: 2003)

3. SMART TRANSPORTATION

Future is waiting for more significant transport developments for cities. This part is showing some international trials of GIS technology combination with the transport system. Also some countries have improved the cars industry itself to fulfil the new smart transportation era. Most of the big luxury cars' manufacturers now are establishing new GPS system vehicles models like; Mercedes and Volkswagen. Now alt least three Japanese manufactures (Honda, Toyota & Nissan) are developing smart electric cars. Also some governments integrated GPS navigated system into bus system and used new designs.

3.1 Private smart system: Intelligent smart transport contains all kinds of personal cars, taxis, bicycles and motorcycles.

3.1.1 In-Car navigation: In-Car navigation system saves the driver's time from traffic hassles. It makes it easy way from town to town and discovering new places. As it was explained how the satellite send signals to GPS receivers, the idea is to integrate the system to cars.

(Photo 11): GPS equipments. © Magellan products, 2005.

A. Mercedes-Benz GPS car: The car navigation system components are; the main processing unit (with CD or DVD-Rom) and now they have memory cards, GPS (to determine the exact location of the vehicle), Gyro (electronic compass), electronic

(Photo12): Mercedes GPS Navigation. (In-car: 2005)

speedometer (to calculate and monitor the route) and Traffic Message Channel (TMC).

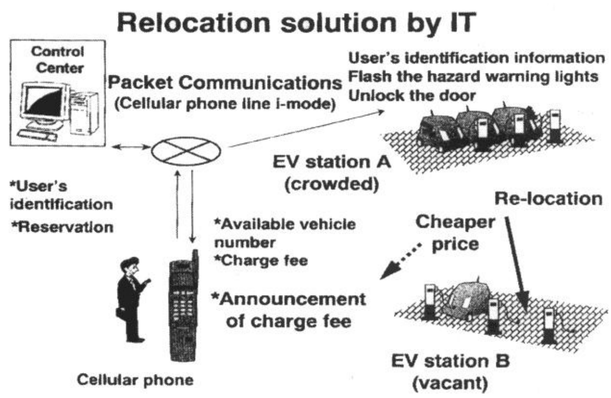
Some cars have displays to show maps and select desired destinations and the system guides the passenger through the traffic with spoken instructions.

3.1.2 Electric cars: It invented a relocation system allowing drivers leave their car at any station based on the projected time of arrival and spare places. (Richards: 2001)

A. Suzuki and Nissan Electric cars: In 1999 Suzuki and Nissan started a real life experiment in a dense business area, one

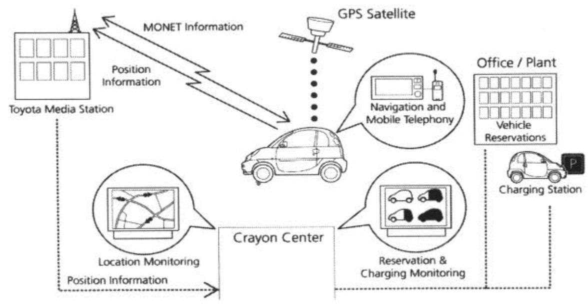
kilometre square, of Yokohama. They invented 50 electric tiny cars, with 10 stations serving 100 members. Each member is provided with a personal transmitter to book a car by his mobile phone.

(Photo13): Nissan's Altra electric vehicles being charged up.



(Figure11): Nissan' relocation system.

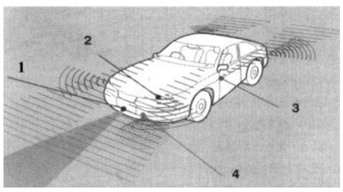
B. Toyota Crayon cars: Toyota in Japan, are using a fleet of electric cars called Crayon, serving 700 users operating from 13 stations in the factory. The Crayon cars walk with batteries that can be quickly charged. Each car has a navigation system to inform the driver about his location and his ways (see figure12).



(Figure12): Crayon cars system. ©Toyota Eco project.

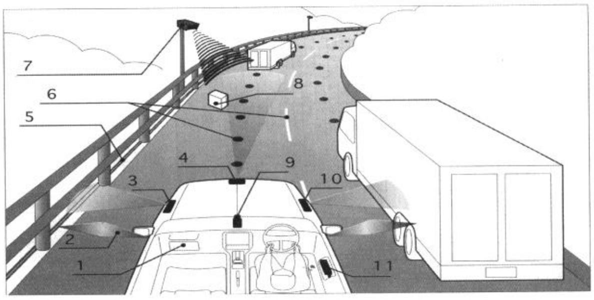
3.1.3 Radar Cars: On the road the driver may use "Cruise-Control", which monitors the vehicle's speed without an accelerator.

A. Hitachi radar car: Hitachi in Japan had made a trial using the intelligent cruise control system in cars. Its principle is having a car's onboard radar adjusting speed automatically to keep it at a safe distance from the car in-front. The future radar devices car has four sensors; Advanced vehicular gap sensor, near-view sensor, surround view sensor and ground-view sensor. (See figure13) The Economist Intelligent Unit estimated that 20% of these cars value in 2001 is based on the electronic system that will rise to 30% in 2005. (Richards: 2001, p.39-40)



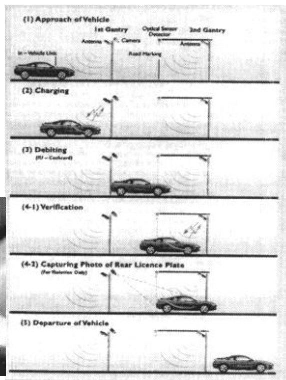
(Figure13): Cruise control car.

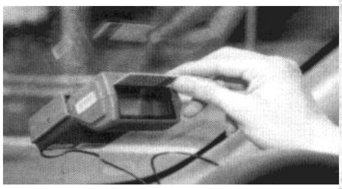
3.1.4 Intelligent road system: Traffic flow now is monitored through pads or sensors and is watched by CCTV at central control points, to identify quickly points of accidents and breakdowns. The futuristic transportation development stages will be, the interaction between the driver and highway which is called "Telematics" system, where the driver enter his vehicle, taps his destination on the onboard computer keyboard or even tells it vocally where he wants to go. Information will be screened via GPS systems explained before. (Howard: 1999). Drivers already in some countries listen to traffic conditions on their car radio; others may use the "Traffic-master" device, which will show them on a dashboard screen where traffic congestion is and alternative routes. The future roadside system will collect a variety of information; Information processor, vehicle roadside communication, sensor, laser radar, road infrastructure for vehicle communication, road infrastructure for vehicle control, information collecting processing sensor, obstacle, camera, sensor, antenna. (Richards: 2001, p. 39-41)



(Figure14): Future road system. . (Richards: 2001, p41)

A. Singapore Road Pricing: As a way of reducing pressure on urban roads. Singapore started usefully 25 years ago a system operation for controlling traffic. It reduced the car entering by 50% in peak hours. Since 1998 the system became an electronic pricing system, with Gantries placed at all entry points checking the validity of cars entering as; number plates which are automatically filmed and the driver fined. In-Vehicle unit are fitted in 97% of Singapore vehicles for the diver to pay prices for the inserted card, depending on its type. (Richards: 2001, p.43)





(Photo14): Self car paying.
(Figure15): Singapore road pricing.

B. San Diego Automated highways: In United States of America, automated highways have been experimented in San Diego Freeway in 1998. Magnetic studs were set at 1 meter interval along the centre of a lane and cars equipped with on board magnets to guide them under "Cruise-Control Theoretically automated highways is a new way of increasing traffic flow safety, without building new roadways". (Richards: 2001, p.40)

(Photo15): San Diego Freeway. (US department of Transport: 1998)
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3.2 Public Smart Transport System: Some of the discussed technologies are being used by some firms and governments, to be integrated into public transport, like busses and light rails. In some European cities, on-board transponders are used by busses and trams to turn traffic lights in their favour. Taxis are having GPS system installed to navigate the routes.

3.2.1 Buses: Buses will continue a basic system in the public transport for their flexibility and low cost.

A. Countdown London buses: Most of the bus stops (25% by 2005) in London are having "real time" boards for passengers, to know the exact arrival time. This service is called "Countdown", which is connected to a central control room. By using global satellite, buses position are tracked within several meters and identified in the central control room. Some bus drivers are having on-board screens to inform them if they are running in time & routes.

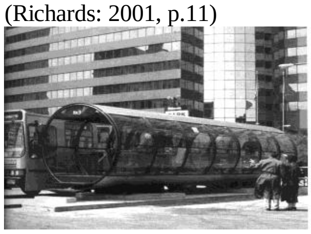
(Photo16) London bus. (London-town: 2005)

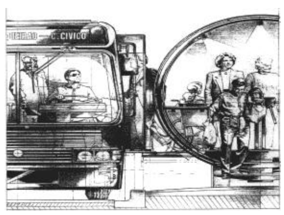
B. Glendale GPS bus: In San Francisco, They experiment with a more advanced system in their bus system. GPS system was integrated in the busses of Glendale region, to locate the bus positions on Glendale routes. The information shows on "real time" boards for passengers. Also some passengers having compatible mobile phones or via internet or in their pagers, can receive bus information. (Longley: 2001)

C. Germany Guided bus: Guided bus system is an alternative to the trams. They even cheaper and lighter in weight, so reduce the cost of guide-ways and roads strengthening. For trams they can cost €2 million per km. (Hass-Klau; al.: 2000) the guidance allows drivers to bring bus close to the raised stops for wheel chair access. The bus runs in the centre of the motorway, having side guidance wheels running against concrete kerb. In Essen, Germany they have 4km long system.

(Photo17): Essen guided bus. (Longley: 2001, p. 34)

E. Curitiba quiet bus: Smart transport is not only computer and Satellite system for managing the bus. Bus technology now has segregated into the design work of busses and bus stops. And how to attract passenger to use it for its beautiful and functional design. Besides the "real time" boards, Curitiba in Brazil bus stops are designed in a tubular way for weather protection. (Newman: 1999) The bus even has a platform which extend from the bus to bridge the gap and allow wheelchair boarding. The bus stop is designed to allow passengers to interchange with local feeder. The circular bus stops can handle twice per hour the passengers as a conventional stop, because of the level boarding. (Richards: 2001, p.11)





(Photo18): Tubular bus stop. (Figure16): Section detail.

3.2.2 Elevated systems: Elevated transport system started mostly in Asians cities like Bangkok and Tokyo for the sake of street environmental concern. Monorails, heavy metros, horizontal elevators and light rails. All these system have considerable Visual impact on the city streets.

A. Bangkok elevated system: Bangkok is a city of a high water table. They have an elevated railway (23km long) opened in 1999 in two lines intersecting in the centre of the city. It took around four years to construct the system, which is less than half the time needed to construct an underground system in such a city. The capacity of the system is: 22thousand passenger per hour in each rail line. In Bangkok a journey which takes two hours on the normal road system, takes 15 minutes in the elevated rail system.

B. Disney's Monorail: Epcot's Park in Disney World is having a monorail for moving visitor to and around the park.

(Photo19): Epcot's monorail. ©Disney.

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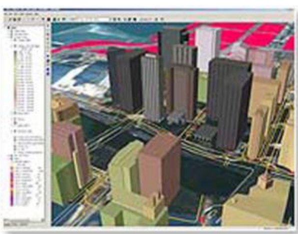
3.3 GIS Transportation management: GIS System facilitates the transportation departments in the local city level. It analyse all the integrated information delivered by all the GPS and technological system.

3.3.1 Vehicle administrator: Information of Motor vehicle can be located in the data base and used by administrators to make sense. They point critical locations and identify jams. By using spatial analysis to find out safety factors, such as zones and weather. Digital maps can be combined up to date and lead to find better solutions. The "Motor Carrier" department use GIS tools to highlight trends such as general traffic route information and safety of roads.

(Map3): Washington traffic flow. (The Puget: 2000)

3.3.2 Railroads: Railroads around the world use GIS to manage key information for rail operations. GIS used in facility & environmental management, commodity flow analysis, passenger information, site selection, risk management and many railroad functions. (ESRI: 2005, Railroads.htm1)

3.3.3 Roadway management: At the stage of development of any nation, transportation infrastructure represents one of the largest investments. ESRI integrated software solutions for analysis support; Evaluation of alternative pavement, integrate information from real time traffic, review construction projects and visualize output from popular transportation planning models. (ESRI: 2005, mva.htm1)



(Map4): Road management.

CONCLUSIONS

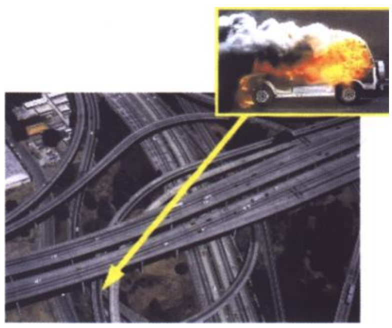
In 2004, the United Kingdom's department of Transport has signed a deal worth €3.25 million over three years, with Traffic-information Company ITIS for satellite data from GPS system in 50,000 private and commercial vehicles. The data is to be used by the government to improve congestion monitoring a planning. (McCue: 2004) And USA the Department of transport had made the ITS Intelligent Transportation systems program for planning use (see APPENDIX B). (ITS: 2005).

Geographic information system GIS is a beast system, that has a lot of applications and spatial analysis which can be used in all levels of our life. It has enormous capabilities to solve most of the manageable problems and help in decision making in all fields. GIS can integrates with other new technological to form a smart and genius system like Global Satellite system, which is now serving all over the world from any position. Network analysis is a spatial system in GIS, working with the topological algorithm, for solving and identifying transport system problems.

(Map5): Traffic flow.

Futuristic smart transportation is tried by many countries, as it has achieved success in many of the countries trials, it has to be a part of the world globalization. GPS system has integrated into personal cars and public busses, to navigate the driver's destination and send him all the needed route information. Radar and electric systems have been used to factorize future cars working with batteries and to be charged in spatial stations, to reduce pollution for the environmental sake. Real time boards are used in many countries, which achieved a real success in informing passengers of the arrival time of busses and railways. Elevated transport system is used to maximize travelling time and reduce pollution in the streets.

Technological and invented designs have to be used by new architects and planners to design vehicles and stations up to-date with the era technology. GIS application must be spread all around the world in the transportation administrator and management offices. GIS will help government even to trace the exact location of accidents as On-star system. Smart intelligent transport is the new era's traffic and pollution solution. Let us hope that the next generations may have better chances to live in a smarter environmental life.



(Photo20): On-star system. (www.onstar.com)

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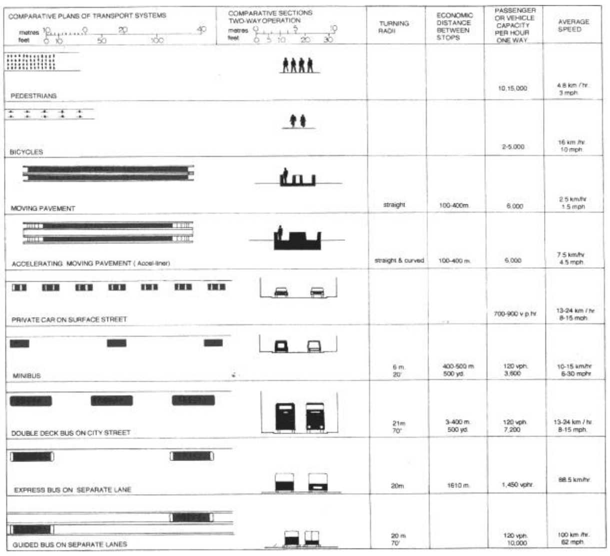
APPENDIX A

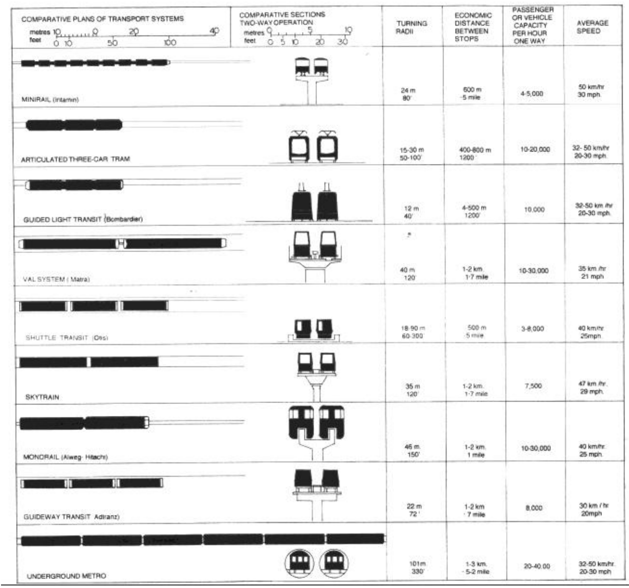
1. GROUND TRANSPORTAON SYSTEM TABLE:
(Longley: 2001)



COMPARATIVE PLANS OF TRANSPORT SYSTEMS (metres 10 0 20 40; feet 0 10 50 100)	COMPARATIVE SECTIONS TWO-WAY OPERATION (metres 0 5 10; feet 0 5 10 20 30)	TURNING RADII	ECONOMIC DISTANCE BETWEEN STOPS	PASSENGER OR VEHICLE CAPACITY PER HOUR ONE WAY	AVERAGE SPEED
PEDESTRIANS				10.15,000	4.8 km / hr 3 mph
BICYCLES				2-5,000	16 km /hr 10 mph
MOVING PAVEMENT		straight	100-400m	6,000	2.5 km/hr 1.5 mph
ACCELERATING MOVING PAVEMENT (Accel-liner)		straight & curved	100-400 m.	6,000	7.5 km/hr 4.5 mph
PRIVATE CAR ON SURFACE STREET				700-900 v p hr	13-24 km / hr 8-15 mph
MINIBUS		6 m. 20'	400-500 m 500 yd.	120 vph. 3,600	10-15 km/hr 6-30 mphr
DOUBLE DECK BUS ON CITY STREET		21m 70'	3-400 m. 500 yd.	120 vph. 7,200	13-24 km / hr. 8-15 mph.
EXPRESS BUS ON SEPARATE LANE		20m	1610 m.	1,450 vphr.	88.5 km/hr
GUIDED BUS ON SEPARATE LANES		20 m. 70'		120 vph. 10,000	100 km /hr. 62 mph.

Tables showing the systems discussed, each drawn to the same scale (shown at the top). The plans of each (on the left) are shown at one scale. The cross sections at a larger scale are on the right. The four columns on the right show the physical characteristics of each system.

2. ELEVATED TRANSPORTAON SYSTEM TABLE:
(Longley: 2001)



COMPARATIVE PLANS OF TRANSPORT SYSTEMS (metres 10 0 20 40; feet 0 10 50 100)	COMPARATIVE SECTIONS TWO-WAY OPERATION (metres 0 5 10; feet 0 5 10 20 30)	TURNING RADII	ECONOMIC DISTANCE BETWEEN STOPS	PASSENGER OR VEHICLE CAPACITY PER HOUR ONE WAY	AVERAGE SPEED
MINIRAIL (Intamin)		24 m 80'	600 m ·5 mile	4-5,000	50 km/hr 30 mph.
ARTICULATED THREE-CAR TRAM		15-30 m 50-100'	400-800 m 1200'	10-20,000	32- 50 km/hr 20-30 mph.
GUIDED LIGHT TRANSIT (Bombardier)		12 m 40'	4-500 m 1200'	10,000	32-50 km /hr 20-30 mph.
VAL SYSTEM (Matra)		40 m 120'	1-2 km. 1·7 mile	10-30,000	35 km /hr 21 mph
SHUTTLE TRANSIT (Otis)		18-90 m 60-300'	500 m ·5 mile	3-8,000	40 km/hr 25mph.
SKYTRAIN		35 m 120'	1-2 km. 1·7 mile	7,500	47 km /hr. 29 mph.
MONORAIL (Alweg- Hitachi)		46 m. 150'	1-2 km. 1 mile	10-30,000	40 km/hr. 25 mph.
GUIDEWAY TRANSIT Adtranz)		22 m 72'	1-2 km ·7 mile	8,000	30 km / hr 20mph
UNDERGROUND METRO		101m 330'	1-3 km. ·5-2 mile	20-40,00	32-50 km/hr. 20-30 mph

APPENDIX B

USA INTELLIGANT TRANSPORTATION PROGRAM
(ITS: 2005).