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УПРАВЛЕНИЕ ДИСТАНЦИОННОГО ОБУЧЕНИЯ И ПОВЫШЕНИЯ КВАЛИФИКАЦИИ

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Аннотация

Целью данного учебного пособия является раскрытие актуальных вопросов интеллектуальных транспортных систем, а также введение международных базовых понятий и терминов. В пособие включены 4 раздела, состоящие из тем и разнообразных типов заданий, направленных на развитие навыков профессионально-ориентированной устной и письменной речи, а также терминологический словарь.

Учебное пособие предназначено для направления подготовки квалифицированных бакалавров по направлению 23.03.01 «Технология транспортных процессов» профилей «Управление в транспортно-логистических системах», «Интеллектуальные транспортные системы в дорожном движении», «Организация перевозок на автомобильном транспорте».

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UNIT 1
INTELLIGENT TRANSPORT SYSTEM (ITS) ARCHITECTURE

Topic 1: What is as ITS Architecture

1. Discuss the following with your partner:
- What do you know about ITS?
- What do you know about ITS Architecture?

2. Read and translate the text:

Informal Definition

An Intelligent Transport System (ITS) Architecture is a set of high level viewpoints that enable plans to be made for integrating ITS applications and services. It normally covers technical aspects, plus the related organisational, legal and business issues.

ITS Architectures can be created at national, regional or city level, or relate to specific sectors or services. They help to ensure that the resulting ITS deployment:

- can be planned in a logical manner;
- integrates successfully with other systems;
- meets the desired performance levels;
- has the desired behaviour;
- is easy to manage;
- is easy to maintain;
- is easy to extend;
- satisfies the expectations of the users.

Formal Definition

An ITS architecture is the conceptual design that defines the structure and/or behavior of an integrated Intelligent Transport System (ITS).

An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the system components or building blocks and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system. This may enable one to manage investment in a way that meets business needs.

Technical Definition

Thus an ITS Architecture is:

- a top-level framework;
- a strategic plan for designs;
- non-deterministic;
- it states "What is needed" and not "How it is to be implemented";
- it is technology independant;
- the life-time of an ITS Architecture is normally longer than any particular technology;
- a set of top-level assumptions;
- the minimum necessary not the maximum possible.

3. Give the informal definition of ITS.

4. Give the formal definition of ITS.

5. Give the technical definition of ITS.

Topic 2: Intelligent transport applications

1. New words and expressions to learn:

legal requirements – нормативно-правовые требования
lane – полоса движения
intersection – пересечение
speed limit – ограничение скорости
road congestion – затор
collision – столкновение
traffic light – светофор

2. Read and translate the text:

Automatic road enforcement

A traffic enforcement camera system, consisting of a camera and a vehicle-monitoring device, is used to detect and identify vehicles disobeying a speed limit or some other road legal requirement and automatically ticket offenders based on the license plate number. Traffic tickets are sent by mail. Applications include:

- Speed cameras that identify vehicles traveling over the legal speed limit. Many such devices use radar to detect a vehicle's speed or electromagnetic loops buried in each lane of the road.
- Red light cameras that detect vehicles that cross a stop line or designated stopping place while a red traffic light is showing.
- Bus lane cameras that identify vehicles traveling in lanes reserved for buses. In some jurisdictions, bus lanes can also be used by taxis or vehicles engaged in car pooling.

- Level crossing cameras that identify vehicles crossing railways at grade illegally.
- Double white line cameras that identify vehicles crossing these lines.
- High-occupancy vehicle lane cameras for that identify vehicles violating HOV requirements.
- Turn cameras at intersections where specific turns are prohibited on red. This type of camera is mostly used in cities or heavy populated areas.

Variable speed limits

Recently some jurisdictions have begun experimenting with variable speed limits that change with road congestion and other factors. Typically such speed limits only change to decline during poor conditions, rather than being improved in good ones. One example is on Britain's M25 motorway, which circumnavigates London. On the most heavily traveled 14-mile (23 km) section (junction 10 to 16) of the M25 variable speed limits combined with automated enforcement have been in force since 1995. Initial results indicated savings in journey times, smoother-flowing traffic, and a fall in the number of accidents, so the implementation was made permanent in 1997. Further trials on the M25 have been thus far proven inconclusive.

Collision avoidance systems

Japan has installed sensors on its highways to notify motorists that a car is stalled ahead.

Dynamic Traffic Light Sequence

Intelligent RFID (Radio-frequency identification) traffic control has been developed for dynamic traffic light sequence. It circumvents or avoids problems that usually arise with systems that use image processing and beam interruption techniques. RFID technology with appropriate algorithm and database were applied to a multi vehicle, multi lane and multi road junction area to provide an efficient time management scheme. A dynamic time schedule was worked out for the passage of each column. The simulation has shown that, the dynamic sequence algorithm has the ability to intelligently adjust itself even with the presence of some extreme cases. The real time operation of the system able to emulate the judgment of a traffic police officer on duty, by considering the number of vehicles in each column and the routing proprieties.

Cooperative systems on the road

Communication cooperation on the road includes car-to-car, car-to-infrastructure, and vice versa. Data available from vehicles are acquired and transmitted to a server for central fusion and processing. These data can be used to detect events such as rain (wiper activity) and congestion (frequent braking activities). The server processes a driving recommendation dedicated to a single or a specific group of drivers and transmits it wirelessly to vehicles. The goal of cooperative systems is to use and plan communication and sensor infrastructure to increase road safety.

Automatic Vehicle Location

Automatic Vehicle Location (AVL) technology is applied to monitor the location of transit vehicles in real time through the use of GPS devices or other location monitoring methods. Information about the vehicle location is transmitted to a centralized control center in either raw data format or as processed data.

As of 2006, based on data provided by FHWA, 69% of the fixed route transit vehicles (including BRT and non-BRT) in the 78 largest metro agencies in the U.S. use AVL systems. The capital cost associated with implementing AVL has ranged from $1,000 to $10,000 per vehicle.

There are several benefits associated with application of an AVL system on BRT vehicles:

- Improved system control. The system can be calibrated with greater ease to distribute service times and coverage adequately through the application of signal priority and control centre and on-street supervision.
- Improved bus safety. In an emergency, the transit control center can relay vehicle location immediately to emergency response agencies.
- Improved quality of service. Passengers can be notified in real time of the location of the next bus and its expected arrival time.
- Improved system integration. Bus transfers can be better scheduled and controlled by knowing the location of each vehicle.
- Reduced need for voice communication. This can simplify vehicle operation for the bus operator.
- Follow-up analysis. Storing the AVL data that is collected over time can provide the opportunity to complete off-line analysis of service performance and comparison of scheduled with actual running times.

In addition to these points, some agencies have reported economic benefits from reductions in bus fleet size, increased ridership, and lower operating costs associated with their AVL systems.

An AVL system can be integrated with certain vehicle diagnostic systems and security features incorporated to provide enhanced vehicle monitoring. This results in quicker response to breakdowns and emergencies on vehicles.

AVL can be integrated with transit signal priority as mentioned previously to allow the provision for TSP conditional priority. AVL also can be integrated with passenger information systems, both onboard stop annunciators and station passenger information systems, to provide real-time information on stop arrivals. AVL can also be integrated with APC systems to provide transit agencies with transit origin-destination data.

3. Match the words from the column on the left to those from the column on the right to make up collocations and give their Russian equivalents.

1. traffic	a. identification
2. speed	b. congestion
3. road	c. light
4. legal	d. limit
5. plate	e. device
6. vehicle-monitoring	f. data
7. origin-destination	g. number
8. radio-frequency	h. requirements

4. Answer the questions:

1) What is traffic enforcement camera system used for?
2) What kinds of cameras are there?
3) What are variable speed limits?
4) What do you know about RFID technology?
5) What is AVL technology is applied for?
6) What are benefits associated with application of an AVL system on BRT vehicles?

Topic 3: Computer-Aided Dispatching

1. New words and expressions to learn:

Computer Aided Dispatch – компьютеризованное диспетчерское управление

software – программное обеспечение (ПО), "софт"

to retrieve data – выбирать данные

radio log – радиожурнал

two-way radio – дуплексная радиосвязь, одновременная двусторонняя радиосвязь

alphanumeric pager – алфавитно-цифровой абонентский приёмник системы поискового вызова, алфавитно-цифровой пейджер

mobile data terminal – подвижное оконечное оборудование данных

public safety – общественная безопасность

field personnel – эксплуатационный персонал

automatic vehicle location – автоматическое определение местоположения транспортных средств

2. Read and translate the text:

Computer Aided Dispatch (CAD) is often used by operators of demand-responsive transit (DRT) services. DRT services are typically used to provide disabled passengers with a complementary transit service that usually includes door-to-door services on an as-needed basis. DRT services are often provided by a combination of one or more type of vehicle: in-house transit vehicle, taxicab, or independent service contractor operating a small bus or a modified van or car.

Because the demands on the service fluctuate greatly from day-to-day and even hour-to-hour, many transit agencies have acquired CAD software to improve the efficiency of their operations. The software can either be used to send messages to the transit vehicle or taxicab via a mobile data terminal and/or used to store and retrieve data (i.e. radio logs, field interviews, client information, schedules, etc.). A dispatcher may announce the call details to field units over a two-way radio. Some systems communicate using a two-way radio system's selective calling features. CAD systems may send text messages with call-for-service details to alphanumeric pagers or wireless telephony text services. The central idea is that persons in a dispatch center are able to easily view and understand the status of all units being dispatched. CAD provides displays and tools so that the dispatcher has an opportunity to handle calls-for-service as efficiently as possible.

CAD typically consists of a suite of software packages used to initiate public safety calls for service, dispatch, and maintain the status of responding resources in the field. It is generally used by emergency communications dispatchers, call-takers, and 911 operators in centralized, public-safety call centers, as well as by field personnel utilizing mobile data terminals (MDTs) or mobile data computers (MDCs).

CAD systems consist of several modules that provide services at multiple levels in a dispatch center and in the field of public safety. These services include call input, call dispatching, call status maintenance, event notes, field unit status and tracking, and call resolution and disposition. CAD systems also include interfaces that permit the software to provide services to dispatchers, call takers, and field personnel with respect to control and use of analog radio and telephony equipment, as well as logger-recorder functions.

Computerized mapping, automatic vehicle location (AVL), automatic number identification and caller-identification technology are often used to enhance the service by pinpointing the locations of both the customer and the most suitable vehicle for serving the customer.

Some CAD systems allow several sources of information to be combined. For example, adding AVL and geographic information systems (GIS) could improve service by getting transit vehicles to a call location faster. Ideally, CAD is connected to monitor vehicle locations provided by an AVL system. This information is used to suggest the closest vehicle to a customer.

3. Match the words and phrases with the definitions:

1. disabled	a. facts and statistics collected together for reference or analysis
2. to fluctuate	b. the act or process of following something or someone
3. wireless	c. rise and fall irregularly in number or amount
4. tracking	d. (of a person) having a physical or mental condition that limits movements, senses, or activities
5.data	e. using radio, microwaves, etc. (as opposed to wires or cables) to transmit signals

4. Answer the questions:

1) What are DRT services typically used for?
2) What does CAD typically consist of?
3) What do CAD systems consist of?

4) What do some CAD systems allow?

Topic 4: Surveillance/CCTV/Security Systems

1. New words and expressions to learn:

surveillance – надзор, наблюдение
CCTV (closed circuit television) – система видеонаблюдения
AVL (Automatic Vehicle Location) – система автоматического определения местоположения транспортных средств
panic button – аварийная кнопка; кнопка сигнала тревоги
overt – открытый, публичный; несекретный, нескрываемый
covert – невидимый, скрытый; тайный, секретный

2. Read and translate the text:

Security systems include both surveillance-CCTV as well as alarms, both of which can be located both onboard vehicles as well as off-board in stations or along guideways.

Surveillance devices are principally made up of Closed Circuit Television (CCTV) cameras, occasionally equipped with microphones. These enable a central dispatch and/or control center to remotely monitor vehicles, stations and guideways. Increased resolution recording can be triggered by an operator onboard or remotely by central dispatch.

Alarms can include passenger-activated alarm strips or buttons on vehicles or in stations, and operator panic buttons including those found on mobile data terminals (MDTs) as part of real-time CAD/AVL communication systems.

There are two types of panic alarms: overt and covert. Once activated, overt alarms can be heard by all passengers, which are preferred in emergencies to alert all passengers to take immediate action (i.e.: evacuate the bus). In contrast, the activation of covert alarms is only known to the operator and central dispatch.

Integration to real-time CAD/AVL communications means that central dispatch is able to track the exact location and direction of travel of a bus requiring assistance, and can identify what resources are accessible to the bus (i.e.: law enforcement, emergency response, transit support staff, other buses, etc). Information can also be passed on to other agencies tied to 911 services for improved, integrated support.

Benefits

Operator/public benefit of improved assistance and emergency response. Cameras and microphones can allow central dispatch to continually monitor and assess the onboard and off-board situation to determine appropriate help by transit security, law enforcement or other forms of emergency response (i.e.: medical aid, Haz/Mat, terror threat).

Operator/agency benefit of increased surveillance of properties and vehicles, with limited staffing requirements & high quality archival data. Provides strong evidence for criminal investigations, MVA investigation/adjudication and related on-board incidents (i.e.: fare evasion, physical assaults, etc).

Perceived to reduce vandalism and crime, including operator assaults. May also contribute to increasing passengers' sense of safety, though may also have the adverse effect of heightening anxiety if CCTV is viewed as an indicator of high risk environments.

3. Match the words and phrases with the definitions:

1. vandalism	a. concealed or secret
2.alarm	b. ground for belief or disbelief; data on which to base proof or to establish truth or falsehood
3.panic button	c. action involving deliberate destruction of or damage to public or private property
4.overt	d. done or shown openly; plainly or readily apparent, not secret or hidden
5.evidence	e. a button for summoning help in an emergency
6.covert	f. an anxious awareness of danger

4. Answer the questions:

1) What do security systems include?
2) What are two types of panic alarms?
3) What are surveillance devices principally made up of?
4) What does integration to real-time CAD/AVL communications mean?
5) What are the benefits of Surveillance/CCTV/Security Systems?

Topic 5: Intelligent speed adaptation

1. New words and expressions to learn:

digital map – цифровая карта
adverse weather – неблагоприятная погода
railway level crossing – железнодорожный переезд
railroad grade crossing – пересечение в одном уровне с железной дорогой
to quadruple – учетверять, увеличивать в четыре раза; умножать на четыре
traffic congestion – затор

2. Read and translate the text:

Intelligent Speed Adaptation (ISA), also known as Intelligent Speed Assistance and Speed Alerting, is any system that constantly monitors vehicle speed and the local speed limit on a road and implements an action when the vehicle is detected to be exceeding the speed limit. This can be done through an advisory system, where the driver is warned, or through an intervention system where the driving systems of the vehicle are controlled automatically to reduce the vehicle's speed.

Intelligent speed adaptation uses information about the road on which the vehicle travels to make decisions about what the correct speed should be. This information can be obtained through use of a digital maps incorporating roadway coordinates as well as data on the speed zoning for that roadway at that location, through general speed zoning information for a defined geographical area (e.g., an urban area which has a single defined speed limit), or through feature recognition technology that detects and interprets speed limit signage. ISA systems are designed to detect and alert a driver when a vehicle has entered a new speed zone, when variable speed zones are in force (e.g., variable speed limits in school zones that apply at certain times of the day and only on certain days), and when temporary speed zones are imposed (such as speed limit changes in adverse weather or during traffic congestion, at accident scenes, or near roadworks). Many ISA systems will also provide information about locations where hazards may occur (e.g., in high pedestrian movement areas, railway level crossings or railroad grade crossings, schools, hospitals, etc.) or where enforcement actions is indicated (e.g., speed camera and red light camera locations). The purpose of ISA is to assist the driver in keeping to the lawful speed limit at all times, particularly as they pass through different speed ‘zones’. This is particularly useful when drivers are in unfamiliar areas or when they pass through areas where variable speed limits are used.

Research has found that that, in urban areas, the risk of a casualty crash is doubled for each 5 km/h over the limit. So travelling at 70 km/h in a 60 km/h zone quadruples the risk of a crash in which someone is hospitalised. As a result, it is estimated that about 10% of casualties could be prevented if the large group of motorists who routinely travel at up to 10 km/h over the limit were encouraged to obey the speed limits. About 20% of casualties could be prevented if all vehicles complied with the speed limits. Savings in fatal crashes would be larger.

3. Match the words and phrases with the definitions:

1.signage	a. the maximum speed at which a vehicle may legally travel on a particular stretch of road
2.hazard	b. causing death
3.pedestrian	c. signs, especially road signs and advertising signs, considered collectively
4.speed limit	d. a danger or risk
5.fatal crash	e. a person walking along a road or in a developed area

4. Answer the questions:

1) How is Intelligent Speed Adaptation also known?

2) What kind of information does intelligent speed adaptation use?

3) What are ISA systems designed for?

4) What is the purpose of ISA?

UNIT 2
AUTOMATED CRUISE-ASSIST HIGHWAY SYSTEMS (AHS)

Topic 1: What is an Automated Highway System?

1. New words and expressions to learn:

steering – рулевое управление

antilock brake system – противоблокировочная тормозная система

warning system – система предупреждения

2. Read and translate the text:

The Automated Highway System (AHS) concept defines a new relationship between vehicles and the highway infrastructure. AHS refers to a set of designated lanes on a limited access roadway where specially equipped vehicles are operated under completely automatic control. AHS uses vehicle and highway control technologies that shift driving functions from the driver/ operator the vehicle. Throttle, steering, and braking are automatically controlled to provide safer and more convenient travel. AHS also uses communication, sensor and obstacle-detection technologies to recognize and react to external infrastructure conditions. The vehicles and highway cooperate to coordinate vehicle movement, avoid obstacles and improve traffic flow, improving safety and reducing congestion. In sum, the AHS concept combines on-board vehicle intelligence with a range of intelligent technologies installed onto existing highway infrastructure and communication technologies that connect vehicles to highway infrastructure.

The System Concept and Technologies

Concept of Automated Highway System (AHS) can be classified into two groups, partially automated systems and fully automated systems, depending on the extent of the automation. Partially automated systems include notification and warning systems, temporary emergency controls and continuous partial controls, which take limited control of the vehicle in emergency situations. They automate certain routine parts of driving but rely on manual control for most driving functions. Fully automated driving would let drivers be totally disengaged from all driving tasks.

The National Automated Highway System Consortium (NNAHSC) defined several alternative AHS concepts, from cooperative to fully automated, depending on the degree to which vehicles and infrastructure work together. Table 1 shows these alternative concepts and four functions that they can address – vehicle positioning, lane changing, dealing with obstructions in the road, and managing congestion.

While current vehicles use new technologies mostly for safety or driver convenience, e.g. air bags, antilock brakes, adaptive cruise control, power steering, the vehicles on an AHS system would require much more new technology that communicates with the roadway. As Table 1 suggests, in the simplest forms of AHS these would focus on the detection of other vehicles and obstacles. Technologies that already do this to some extend are beginning to be added to luxury vehicles or are sometimes an option that can be selected by the consumer; e.g., collision warning systems. Other technologies that would be precursors to the communications technologies in an AHS system are also being introduced; these include navigation assistance systems, traveler information systems, and vehicle locator systems. Their acceptance in the market is taken as an indicator of eventual consumer acceptance of the broader AHS concept.

Table 1. Alternative Concepts for Automated Highway Systems

System Concept	**Local Position Keeping**	**Lane Changing**	**Obstruction on Roadway**	**Flow Control**
Autonomous: Fully automated vehicles employing sensors and computers operate along with manually driven vehicles without requiring infrastructure assistance and communication.	Vehicle automatically senses vehicle ahead and roadway problems	Looks for and moves into an opening	Vehicle brakes for detected obstacles, changes lanes if possible	
Cooperative: Vehicles equipped with onboard sensors and computers would share information with other vehicles to coordinate	Vehicle Sensors, communications from other vehicle for land changes or platoons	Cooperative negotiation among vehicles	Vehicle senses, communicate s warning and coordinates maneuvers	

maneuvers and enable fully automated travel.				
Infrastructure supported: Fully automated vehicles operate on dedicated lanes, using global information and two-way communication with smart infrastructure to support vehicle decision-making.	Same as cooperative, but within guidelines from the infrastructure	Same as cooperative	Infrastructure or vehicle senses, communicates to vehicles; vehicles coordinate	Infrastructure monitors traffic, formulates responses, send parameters, send parameters to local groups of vehicles
Infrastructure managed: The automated roadside system provides inter-vehicle coordination during entry, exit, merging, and emergencies.	Vehicles sensors, communications from other vehicles and infrastructure as needed	Vehicle request lane change; infrastructure responds with commands for surrounding vehicles	Infrastructure senses sends commands to vehicles based on infrastructure or vehicle detection, or vehicle actions	Infrastructure monitors individual vehicles, commands vehicle as needed, including entry and exit
Infrastructure controlled: Same as above, but infrastructure takes the entire control in all driving situations.	Infrastructure sense vehicle positions and sends commands to control throttle, braking and steering	Infrastructure determines need for lane change from origin-destination data, controls all necessary vehicles	Infrastructure senses, sends commands to vehicles based on infrastructure or vehicle detection, or vehicle actions	Infrastructure monitors individual vehicle, performs optimizing strategy through control of individual vehicles

3. Answer the questions:

1. What does AHS use to recognize and react to external infrastructure conditions?
2. Concept of AHS can be classified into two groups. What are they?
3. What do partially automated systems include?

4. What is the function of partially automated systems?
5. What alternative AHS concepts are there?

4. Choose the correct word to complete the sentences:

1. Throttle, steering, and braking are automatically controlled *to recognize / to provide* safer and more convenient travel.

2. The AHS concept *defines / combines* on-board vehicle intelligence with a range of intelligent technologies

3. The vehicles and highway cooperate *to coordinate / to combine* vehicle movement.

4. Partially automated systems *include / rely on* notification and warning systems, temporary emergency controls and continuous partial controls.

Topic 2: Potential Benefits of AHS

1. New words and expressions to learn:

energy consumption – расход энергии
economic gain – экономическая выгода
road(way) capacity – пропускная способность дороги
to impede – мешать, препятствовать, быть помехой чему-л., затруднять

2. Read and translate the text:

Researchers have attempted to estimate benefits that might accrue from the implementation of automated highway systems. Table 2 summarizes potential benefits. Many of the benefits shown in the table are fairly speculative; the systems they would depend upon are not yet in existence and there is no clear evidence that the system can produce the following benefits in reality.

Table 2. The Potential Benefits of AHS

Element	Benefits
Roadway capacity	More vehicles can be accommodated on the highway. The number of vehicles per hour per lane can be significantly increased as traffic speeds are standardized and increased and headway distances are decreased. It is expected that two to three times more vehicles could be accommodated through elimination of inefficiencies caused by inattentiveness, merging,

	weaving, and lane changing.
Safety	Driving safety will be significantly greater than at present. The human error factor will be removed. Some estimates state that overall 50 percent improvement can be realized with AHS application.
Weather	Weather and environmental conditions will impact little on high performance driving. Fog, haze, blowing dirt, low sun angle, rain, snow, darkness, and other conditions affecting driver visibility and thus, safety and traffic flow will no longer impede
Mobility	All drivers using AHS can be safe, efficient drivers, AHS offers enhanced mobility for people with disabilities, the elderly, and less experienced drivers.
Energy consumption and air quality	Fuel consumption emissions can be reduced. In the short term, these reductions will be accomplished because started-an-stop driving will be minimized and because on-board sensors will be monitored to ensure that the vehicle is operating at top performance. In the long term, the AHS can support future vehicle propulsion/fuel designs.
Land use	Land can be used more efficiently. Roads will not need to take up as much room, since AHS facilities should allow for more effective use of the right of way.
Commercial and transit efficiency and economic gains	More efficient commercial operations and transit operations. Commercial trucking can realize better trip reliability to support "just-in-time" delivery. And, transit operations can be automated, extending the flexibility and convenience of the transit option to increase ridership and service.
Travel time savings and economic gains	Travel time savings: AHS can restore free-flow travel conditions from congested speeds in urban highway travel, thereby reducing the travel times. In addition, for long-distance intercity travel, it permitted higher cruising speed than today's driving. Therefore, time that AHS frees up could be used for other purposes.

As the table indicates, it is anticipates that automated highway and related advanced vehicle control and safety technologies would significantly reduce congestion and enhance safety in highway driving. This in turn would potentially cut travel time, and therefore, driving would be more predictable and reliable. The Mobility 2000 report, sponsored by the Texas Transportation Institute, projected that collision prevention systems could reduce accidents by 70 percent, or 90 percent on fully automated highways.

Research focused on collision prevention systems has estimated possible savings in a relatively short period of time. For example, collision avoidance systems have been estimated to have the potential to reduce annual loss of life on U.S. roads by 50 percent by 2020. In addition, preliminary National Highway Traffic Safety Administration estimates show that rear-end, lane-change, and roadway-departure crash-avoidance systems have the potential to reduce crashes by one-sixth, or about 1.2 million crashes a year.

3. Say whether the given sentences are true or false. Correct the false ones:

1. The systems the benefits would depend upon are in existence.
2. The number of vehicles per hour per lane can be significantly increased as traffic speeds are standardized and increased and headway distances are decreased.
3. Commercial trucking can realize worse trip reliability to support "just-in-time" delivery.
4. Research focused on collision prevention systems has estimated possible savings in a relatively short period of time.
5. Automated highway and related advanced vehicle control and safety technologies would significantly reduce crashes by one-sixth, or about 1.2 million crashes a year.

4. Answer the questions:

1. What benefits have researchers attempted to estimate?
2. Why are the benefits shown in the table speculative?
3. What did the Mobility 2000 report project?

Topic 3: Road Line Traffic Control

1. New words and expressions to learn:

traffic volume – интенсивность движения
traffic accident – дорожно-транспортное происшествие, ДТП

traffic load – нагрузка от транспортных средств
long-awaited – долгожданный
prohibitory sign = restrictive sign – запрещающий знак
precaution – предосторожность; предусмотрительность
inverse direction – обратное направление

2. Read and translate the text:

Outstanding increase of traffic volume during the last years reflects in more often traffic congestions. Their sources are besides high traffic loads both incidents, which substantially increase the risk of traffic accidents.

Last year a long-awaited construction of the southern part of Prague Ring road was completed in the Czech Republic. This built has significant importance not only in terms of Prague city area, where significantly decreases traffic, but for entire state because of cross connection of important highways. Traffic forecasts predicted traffic load up to 60 000 vehicles per day at this important construction.

For this reason the first Road line traffic control system in the Czech Republic was installed at the southern part of Ring road and part of D1. General supplier of the technological equipment was ELTODO group, which has an experience with similar implementations. It supplied Road Line Traffic Control System, Tunnel control system and technological equipment in tunnels and highway technological equipment.

Southern part of RRAP measures 30 km. during the construction was necessary to built 70 bridges in total length of 6,7 km, two road tunnels Cholupice and Lochkov with length 1937 m and 1661 m. Road Line Traffic Control System is installed in both directions on RRAP marked as motorway R1, between intersections with D1 and D5 highways and on D1 highway between intersections Mirošovice and RRAP.

Currently, we already have more than a half year operation and functioning of RLTC system on RRAP, thus in this article we can evaluate its first results.

Road Line Traffic Control principle

Road Line Traffic Control System (RLTC) was supplied for open route and cooperates closely with control systems of both tunnels. Based on measuring traffic flow parameters system affects flow fluency, increases communication permeability and security of traffic flow. Based on timely provision of information drivers may adapt their driving way and substantially reduce the risk of traffic accidents.

Range of functions

In cases when the situation requires, variable message signs (VMS) with warning symbols, prohibitory signs limiting maximum allowed speed or prohibiting drive of trucks outside of right lane are displayed on control profiles of RLTC system. Important parts of each control profile (RLTC Gantry) are detectors measuring volume, speed, traffic flow composition and other parameters. Based on these data system is able to perform these proceedings automatically, without system operator intervention.

Thanks to RLTC system it is possible to extend highway capacity during the peak hours and reduce creation of congestions, which often causes traffic accidents. During high traffic volumes "Stop and Go" waves occur, which are typical with high differences in speeds in the downstream sections. Consolidation of these speeds on the same level reduces accumulation of these waves together with increasing communication permeability. At lower speeds spaces between vehicles are minimized which leads to higher road capacity. The traffic flow harmonization is assured by Road Line Traffic Control system by reducing maximum speed using variable message signs (VMS) installed on control profile gantries, which are located on regularly spaced locations. Further RLTC system detects formation of vehicle queue and warns concerned drivers against these drivers using VMS. Another important feature is warning against meteorological states inconvenient for traffic and based on dangerousness traffic flow speed is reduced. In this case system collects data from meteosensors on the highway, which are automatically processed and evaluated. Of course there is a warning before accident, work or obstacle on the road, for example debris or animals. In case of restrictions on driving in selected lanes it is possible to activate light arrow, which ordered to leave the driving lane.

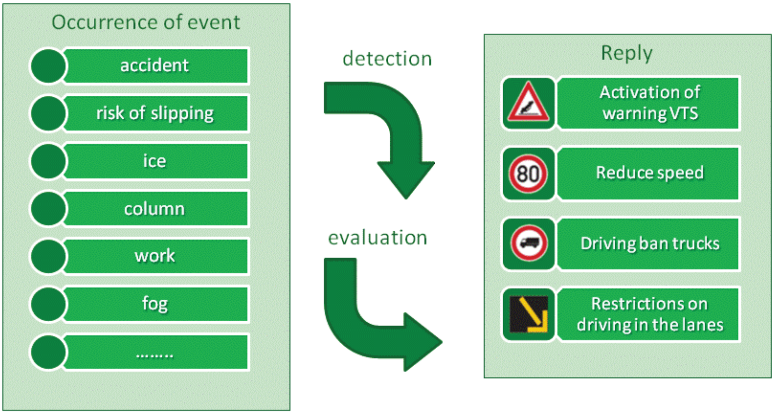
Control Algorithm

All algorithms were designed and tested under project of science and research of Ministry of Transport of the Czech Republic. During the traffic solution design algorithms were applied on particular conditions and in some cases were modified based on experiences from real operation. Together with algorithms for evaluation of untypical traffic states was necessary to develop principles of application of single action on multiple sections simultaneously. Traffic precaution is applied on one particular profile or a group of profiles, but during operation there are situations, when it is necessary to combine more precautions together with preserving the rules of reducing speed on highways and avoiding to display speed steps on subsequent profiles. In order to avoid step changes of speed, which has negative influence on flow fluency, special smoothing algorithms were developed. Smoothing algorithms manage displayed symbols in consecutive profiles with regard to exact profile location on the route.

Finally, it is necessary to activate the maximum speed limits in time shifts instead of simultaneously. This provides so-called dynamic sequences, which reduces speed on requested level in the shortest time so that drivers actually moving on route are not forced to slow down sharply on low speeds. RLTC system doesn't forget on extreme event of driving in inverse direction. Although this is not very frequent, but may have fatal consequences. In case of detected inverse driving event, RLTC system automatically reduces speed on its minimum and displays warning on traffic signs including information transmission in information gantries close to event occurrence. Road line traffic control system, thanks to which is Prague ring road often called "Intelligent highway" is closely linked to traffic states of both tunnels located on the route of RRAP. Besides smoothing maximum allowed speeds on open route and inside tunnels there exist connections for traffic restrictions inside tunnels, which have significant influence on operation on open route and backwards.

Information between these systems must be shared with regard on a good coordination of all precautions. Road line traffic control system is connected to newly constructed supervisory centre SSUD Rudna, where proceeds uninterrupted surveillance of the completed part of the Prague ring road. Systems are monitored and during test operation are adjusted for having most fluent and safety traffic.

Schematic principle of Road Line Traffic Control functionality



3. Complete the sentences with the correct form of the verbs:

reduce *cooperate* *be modified* *occur*
be installed *be applied*

1. The first Road line traffic control system in the Czech Republic ____________ at the southern part of Ring road and part of D1.

2. Road Line Traffic Control System (RLTC) ______________ closely with control systems of both tunnels.

3. During high traffic volumes "Stop and Go" waves _____________ .

4. During the traffic solution design algorithms ________________ on particular conditions and in some cases _________________ based on experiences from real operation.

5. In case of detected inverse driving event, RLTC system automatically __________ speed on its minimum.

4. Answer the questions:

1) Where in the Czech Republic was the first Road line traffic control system installed? Why?

2) What is Road Line Traffic Control principle?

3) What are the functions of RLTC system?

UNIT 3
PUBLIC TRANSPORT MANAGEMENT SYSTEM IN THE ITS STRUCTURE

Topic 1: Automatic Vehicle Identification

1. New words and expressions to learn:

lorry – грузовой автомобиль, грузовик
rapid access – быстрый доступ
to track down – обнаруживать; выслеживать
RFID = Radio-frequency identification

2. Read and translate the text:

AVI (Automatic Vehicle Identification) systems can be found all over the world. AVI is the biggest player in the area of recognition, identification and management of vehicles and drivers. This involves the regulated, rapid access to city centres, car parks, airports, ports, gated communities, military complexes, secure areas and areas with heavy industry. AVI also makes sensor technology which detects vehicles on parking spaces. This system notifies drivers about available parking spaces and helps car park attendants track down cars that have been parked too long.

AVI develops, produces and tests all its products and systems in house. Thanks to its many years of experience with RFID technology, AVI has a solution for practically every situation.

Remote recognition improves throughflow

Unique to AVI is driver based vehicle access. This system remotely recognizes, at a distance, not only the car, lorry or bus, but also the driver of the vehicle. So you know exactly who is on your site, and when.

As the system operates at a distance of 10 metres, the access barrier opens earlier, and you can drive through straightaway without stopping. In the case of large companies with thousands of employees, this improves throughflow and prevents irritation. Long-distance remote identification systems are also used in controlling public transport, taxis and industrial processes. AVI is the only company in the world which has managed to integrate vehicle and driver recognition into a single solution.

When every second counts

These days, city centres are often only accessible by foot. Cars are kept out by a system of sinkable poles and barriers around the centre. AVI developed Stadstoegang ('City Access') especially for emergency services, such as the fire brigade and ambulances, but also for taxis, residents, and lorries supplying shops. The system can be managed from a single central point, so you can see exactly who has had access, and when. AVI has sales offices in the Netherlands, the United States, Italy, Dubai and Singapore. Worldwide, they work together with more than 300 business partners in 85 countries.

3.Match the words and phrases with the definitions:

1.ambulance	a. happening in a short time or at a great rate
2.fire brigade	b. a person who lives somewhere permanently or on a long-term basis
3.resident	c. a vehicle equipped for taking sick or injured people to and from hospital, especially in emergencies
4.employee	d. a feeling of annoyance, especially when something is happening that you cannot easily stop or control.
5.rapid	e. an organized body of people trained and employed to extinguish fires
6. irritation	f. a person who is paid to work for an organization or for another person.

4. Answer the questions:

1) Is AVI systems popular all over the world?
2) At what distance does the system operate?
3) Where does AVI have sales offices?

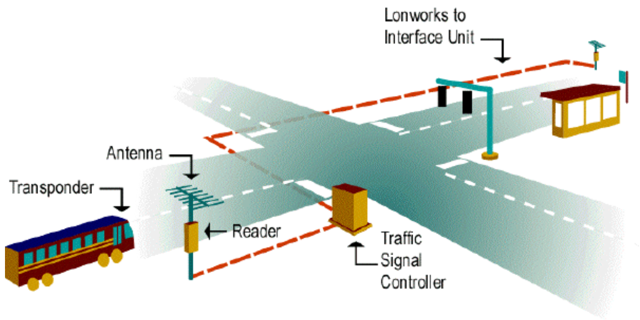
Topic 2: Transit Signal Priority

1. New words and expressions to learn:

to truncate – укорачивать; сокращать
delay – задержка, приостановка; простой
emitter – 1) эмиттер; источник 2) генератор
schedule adherence – строгое соблюдение расписания
grade crossing – переезд
negligible change – незначительное изменение
BRT = Bus Rapid Transit
Transit Signal Priority = Public Transport Signal Priority

2. Read and translate the text:

Transit signal priority (TSP) is the process of altering traffic signal timing at intersections to give a priority to transit operations. TSP can be triggered by BRT vehicles operating in their own right-of-way or in mixed traffic along a street (known as "mainline" priority), or operating in an auxiliary lane at an intersection (known as a "queue jump"). With mainline TSP, the typical treatment is to extend the green signal or truncate the red signal to allow priority for BRT vehicles, thus reducing intersection delay. With a queue jump, the transit vehicle receives a separate green phase to go through the intersection before adjacent through traffic. In either case, the signal timing is adjusted to preserve the signal cycle length and thus keeps a signal system in coordination. TSP is different from signal preemption, which interrupts normal signal operation and changes the signal cycle length to accommodate special events, such as a train approaching a railroad grade crossing adjacent to a signal or an emergency vehicle responding to an emergency call.



TSP systems can be manually implemented by the transit operator, or activated automatically using on-board technology. The latter is preferred because it eliminates requiring the operator to remember to activate the emitter or to deactivate the emitter when not required. Two types of priority can be implemented – 1) unconditional priority, where a BRT vehicle would have priority all of the time at a particular intersection, or 2) conditional priority, where the BRT vehicle would only receive priority at an intersection if certain transit or traffic operating conditions are met.

TSP is typically applied when there is significant traffic congestion and hence bus delays along a roadway. Studies have found that TSP is most effective at signalized intersections operating in congested conditions (in traffic engineering terms, this means under level of service F conditions with a volume to capacity ratio between 0.80 and 1.00). A basic guideline is to apply TSP when there is an estimated reduction in bus delay with negligible change in general traffic delay. Given this condition, the total person delay (on both buses and general traffic) should decrease with application of TSP at a particular intersection or along an extended corridor.

For mainline TSP to be most effective, bus stops should be located on the far side of signalized intersections so that a bus activates the priority call and travels through the intersection and then makes a stop. For queue jump treatments, it is preferable to have the transit stop near side of the intersection, where a bus serves the stop and then the operator triggers the queue jump call.

Costs for implementing TSP along a BRT corridor will vary based on the configuration of the existing signal system (with higher cost associated with signal upgrades), equipment/software for the intersection, vehicles, and the central management system. Costs are highly dependent on whether the TSP system will be localized to a corridor or centralized and integrated into a transit or regional traffic management center. The key cost elements to consider are:

- Need for replacement of any traffic signal controller equipment.
- Communications linkages.
- On-bus or in-ground equipment requirements for detection.

Benefits from TSP to BRT operations can be found in three different areas: 1) reduced bus travel time 2) improved service reliability and 3) reduced bus operating costs.

Bus Travel Time

Travel time savings associated with TSP in North America and Europe have ranged from 2% to 18%, depending on the length of corridor, particular traffic conditions, bus operations, and the TSP strategy implemented. The reduction in bus delay at signals has ranged from 6% to 80%, again variable based on particular local conditions and strategies.

Service Reliability

Schedule adherence as measured by the variability in BRT travel times and arrival times at stops can improve significantly with TSP application. In Seattle and Vancouver, bus travel time variability with TSP application was reduced by 35 to 40%. In Portland, Tri-Met avoided adding a bus to a corridor by using TSP, and experienced up to 19% reduction in bus travel time variability.

Bus Operating Costs

By reducing bus travel time and delay and the variability in travel time and delay, transit agencies have experienced both capital cost savings (by saving one or more buses during the day on a route) and operating cost savings (due to more efficient bus operation). For the first two BRT corridors implemented in Los Angeles (along Wilshire/Whittier and Ventura Blvds.), an estimated cost savings of $110 per bus per day or $3.3 million per year.

To implement TSP, there must be an emitter-type device to interact with a wayside reader or receiver at the intersection tied to the signal controller. Different TSP detection systems include optical, GPS, wayside reader, "smart" inductive loops, and wi-fi. The signal controller must also have appropriate software to interpret and process a signal priority call, either at the controller cabinet or through communication back to centralized signal control. With automated TSP, in many cases it will be tied to an Automatic Vehicle Location (AVL) and/or Automatic Passenger Counting (APC) system so that only conditional priority can be implemented. In the case of integration with an AVL system, TSP would be activated only if the BRT vehicle is behind schedule, with the degree of lateness triggering priority to be programmed and possibly adjusted over time. If TSP is integrated with an APC system, that would provide the capability of activating TSP at an intersection only if the BRT vehicle had a certain number of passengers on-board, and again this could be adjusted over time.

As of 2005, over 40 urban areas provided some form of TSP (for bus and/or rail) in North America. This included most BRT systems, including Los Angeles; Kansas City, Eugene, San Jose, York Region and Vancouver.

3. ITS use lots of abbreviations. How many do you know? Test yourself by writing these ones out?

BRT ____

AVL ____

GPS ____

APC ____

TSP ____

4.Find the synonyms of these words in the text:

1. traffic jam ____________ 4. lateness ______________
2. to shorten _____________ 5. crossing ______________
3. trifling ________________ 6. advantage ____________

5. Say whether the given sentences are true or false. Correct the false ones:

1. With mainline TSP, the transit vehicle receives a separate green phase to go through the intersection before adjacent through traffic.
2. TSP systems can be activated only automatically.
3. TSP is most effective under level of service F conditions with a volume to capacity ratio between 0.80 and 1.00.
4. For queue jump treatments, bus stops should be located on the far side of signalized intersections so that a bus activates the priority call and travels through the intersection and then makes a stop.
5. Travel time savings associated with TSP in North America and Europe have ranged from 6% to 80%.
6. An emitter-type device is necessary to implement TSP.

6. Answer the questions:

1. What is the difference between TSP and signal preemption?
2. What types of priority can be implemented?
3. When is TSP typically applied?
4. Under what circumstances will mainline TSP be most effective?
5. What are costs for implementing TSP along a BRT corridor dependent on?
6. What are the key cost elements?
7. Are there any benefits from TSP to BRT operations?
8. What positive changes are associated with TSP application?
9. What is the function of the emitter-type device?
10. What do TSP detection systems include?

Topic 3: Automatic Passenger Counting

1. New words and expressions to learn:

boardings and alightings – посадка и высадка пассажиров
ridership – пассажирские перевозки
snapshot – моментальный снимок, стопкадр
maintenance costs – стоимость технического обслуживания, эксплуатационные расходы
BRT = Bus Rapid Transit

2. Read and translate the text:

Automatic Passenger Counters (APC) are devices onboard transit vehicles to record boardings and alightings at each stop and a running total of passengers onboard the vehicle. The APC units include sensors (typically infrared) at doorways to monitor passenger movements on and off a vehicle. An APC system creates an electronic record at each bus stop, typically including stop location, stop date and time, time of door opening and closing, and number of passengers boarding and alighting. APC data downloading options include manual downloading via a laptop computer, wireless data via a local area network, and real time reporting.

A key benefit associated with an APC system is the ability to provide a continual record of ridership onboard a transit route, and the ability of quickly summarizing data. The cost of conducting ridership surveys historically has been labor extensive, and has provided only a snapshot of ridership conditions to transit agencies, given the number of stops to be surveyed and only a sampling of bus routes typically possible due to the labor required.

APC units can be tied into an overall vehicle ITS monitoring system, including integration with the AVL and TSP systems. If integrated with TSP, conditional priority to buses is given based on a minimum number of passengers onboard a vehicle. In some cases in the past, APC systems have been implemented as stand-alone with its own GPS separate from the AVL system, either because the APC preceded the AVL or the APC was deployed after the AVL but with a different vendor. These situations have created incomplete and mismatched data and higher maintenance costs, with added post data collection processing needed to match the APC with AVL data.

Of the existing BRT systems in North America, ten (Albuquerque, Chicago, Las Vegas, Los Angeles, Oakland, Orlando, Ottawa, Sacramento, San Jose, and York Region) have APC systems on all or a portion of their BRT fleet. In general, typically transit agencies that have installed APC systems have been able to replicate existing ridership about 95% of the time based on field checks.

3. Choose the correct word to complete the sentences:

1. The APC units include sensors at doorways *to implement / to monitor* passenger movements on and off a vehicle.
2. An APC system *creates / includes* an electronic record at each bus stop.
3. A key benefit associated with an APC system is the ability *to conduct / to provide* a continual record of ridership.
4. APC units can be *tied / transited* into an overall vehicle ITS monitoring system.

4. Answer the questions:

1) What are Automatic Passenger Counters?
2) What is a key benefit associated with an APC system?
3) What existing BRT systems have APC systems?

Topic 4: Lane Control Technologies (i.e., intermittent bus lanes)

1. New words and expressions to learn:

intermittent – прерывистый
threshold – порог
to embed – вставлять, врезать, вделывать
frequency – частота, частотность
moderate – умеренный, избегающий крайностей, сдержанный

LED (Light Emitting Diode) – светодиод, светоизлучающий диод, СИД
saturated – интенсивный
backup – запас, резерв, поддержка
flashing light – мигающий свет
feasibility – применимость, техническая применимость

2. Read and translate the text:

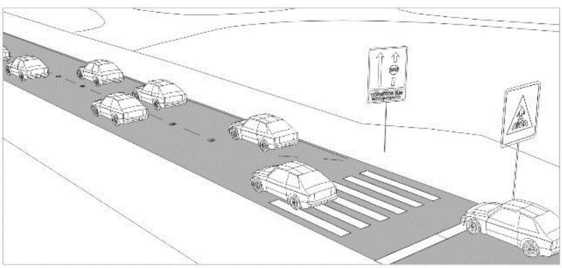
An Intermittent Bus lane (IBL) is a restricted lane for the short time duration that the bus uses that particular lane.

Intermittent bus lanes or IBL can also be called a moving bus lane. This concept consists of using the general-purpose lane that can be changed to a bus only lane for only the duration of time needed for the bus to pass. After which the lane reverts back to a general purpose lane until another approaching bus needs the lane for its movement.

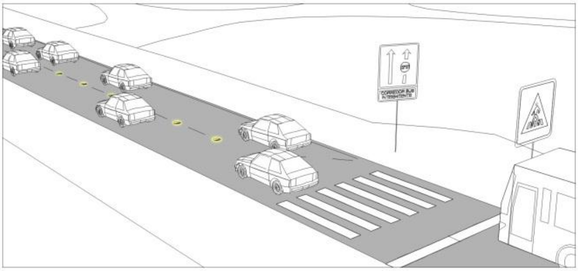
From an operational protocol standpoint, the IBL system is intended to be activated only when the flow of the general traffic is operating below a speed that inhibits bus transit speeds. When that threshold is reached – through the technologies of computers and sensors which can provide knowledge of real time traffic conditions - longitudinal flashing lights embedded in the roadway lane divider are activated to warn general purpose drivers that they cannot enter that lane and a bus is approaching. Vehicles already in the lane are allowed to continue on. This leaves a moving gap or moving time window for the bus to travel through. This moving gap can be best described as a zone measured from the back of the bus bumper to a fixed distance ahead of the bus

When the traffic conditions are not expected to cause delays to the bus movement, the intermittent bus lanes should not be activated.

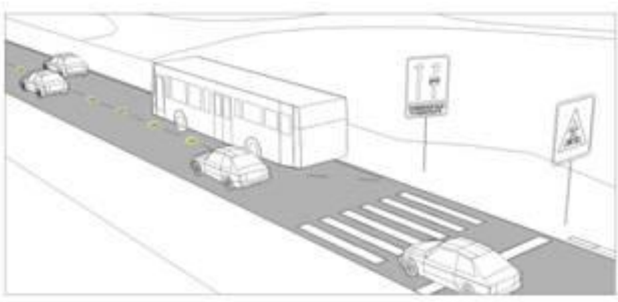
The following describes the IBL sequence:



IBL in “off” status – LED signals are “off” and any vehicle can use the rightmost lane



Bus approaching the IBL – the LEDs are flashing and general traffic vehicles are not allowed to enter the rightmost lane



Bus flowing in the IBL – The LEDs are flashing and still no cars can enter the rightmost lane

Bus speeds and reliability are improved whenever the bus is able to flow independently from the general traffic.

The cost of building exclusive bus lanes is expensive for bus routes that are lower in frequency. This concept does not require expensive capital costs by utilizing the existing roadway infrastructure such that it takes just only enough of the time it needs to move separately from general traffic. This allows the bus lane to be used for the majority of time for general traffic.

Low implementation costs using well known, widely used and proven traffic signal management technologies and products.

An AVL (Automatic Vehicle Location) system is required to establish the bus location. This system ties into variable message signs (VMS) to inform the drivers of lane restriction. This system also requires integration into real time ITS traffic monitoring systems that record levels of congestion and computes the dynamic space and approach length required to activate on and off the longitudinal embedded flashers. This system is dependant on an interconnect and special software within the signal controller system of the existing roadway.

Feasibility is still a question for this treatment as the two known IBL systems have varying degrees of success.

In Lisbon, Portugal a demonstration project of IBL was conducted by professor Viegas in 2005/2006. Field data reported transit travel speed increases of 15%-25%. This system was inserted into a 2 lane two way arterial street 0.5 miles long. The system works effectively when traffic congestion is moderate. In saturated flow conditions the reduced road capacity – if even for a few seconds - can create significant backups in the general traffic. Driver compliance was good as the as drivers understood that the restriction would be for only a short time.

In Melbourne, Australia the Dynamic Fairway project started in 2001 on Toorak Road and continues today. This 1.3 mile stretch is a 2lane two way urban street that utilizes VMS signing and embedded LED flashing lights similar to Lisbon. The transit mode is a TRAM operating in the center lanes as the restricted lane. Performance of travel speeds increases of 1% -10% were reported. Melbourne is developing a study for the bus lines called the MBTL (Moving Bus/Tram Lane). This study also modeled simulations for the bus lanes and has yet to build a pilot project.

In general IBL/MBL systems can be promising for specific applications and circumstances.

IBL applications do not work well in saturated traffic flow conditions at peak.

IBL seems better suited for lower bus headways (3 buses per hour)

3. Match the first half of the sentences 1-4 with their endings a-d.

1. When the traffic conditions are not expected to cause delays to the bus movement
2. Bus speeds and reliability are improved
3. This system ties into variable message signs (VMS)
4. The system works effectively

a) whenever the bus is able to flow independently from the general traffic.

b) when traffic congestion is moderate.

c) to inform the drivers of lane restriction.

d) the intermittent bus lanes should not be activated.

4. Answer the questions:

1. What does the concept of IBL consist of?
2. When is the IBL system intended to be activated?
3. What is the purpose of flashing lights embedded in the roadway lane divider?
4. What is an AVL system dependant on?
5. When did the Dynamic Fairway project start in Australia?

Topic 5: Lane Guidance

1. New words and expressions to learn:

feedback – отклик, отзыв, ответная реакция, обратная связь
tire – обод колеса; шина; покрышка
curb – обочина(тротуара), бордюр
chassis – ходовая часть
lateral deviation – боковое отклонение, боковое смещение
acquisition costs – затраты на приобретение
vender – продавец, торговец
curvature – выгиб, изгиб, искривление, кривизна
steering – управление
to accomplish – выполнять, совершать
steering linkage – рулевой привод
to triangulate – делать тригонометрическую съёмку
trailing section – прицепная секция (сочленённого автобуса)

2. Read and translate the text:

Lane Guidance, also called lane assist, is a system that provides feedback to the bus operator for more precise steering. They can also provide the ability for a bus to steer itself through computerized or mechanical means. The bus driver still operates the throttle and brake, much like the operator on a train, but is hands-free on the steering wheel except in emergency situations. It should be noted that newer computerized guidance systems have been implemented to various levels of success, and should still be considered experimental while there is a proven mechanical system that has been in service for a number of years. Types of technologies used to accomplish lane guidance are described below.

Mechanical guide wheel - A small 4-1/2 to 6-inch diameter "guide" wheel mounted laterally onto near each front bus tire that makes contact with the vertical face of the platform curb. These guide wheels are connected directly to the vehicle's steering linkage. Guide wheels can additionally be mounted on the rear of the bus chassis. This type of guidance system is of modest cost. This type of guidance system called the O-bahn, originated in Essen Germany, and has been applied successfully on the in Adeliade, Australia; Leeds and Bradford, UK, and will be used on the Cleveland, USA Euclid Corridor BRT and the Cambridgeshire BRT, Cambridge, UK.

Optical guidance – In this vision based technology, a camera is mounted on the vehicle that uses optics to "see" specific lane markings on the road ahead to determine the vehicle relation in the lane. A computer analyzes the image looking for special striping within bus way to steer the bus to follow.

Magnetic guidance - Magnets at 4 meter intervals are imbedded within the bus way. A sensor on the vehicle detects the magnetic material, using it to determine the vehicle's lateral deviation from the magnet. This deviation is then relayed to an on-board computer to compute a steerage correction in order to guide the vehicle along a programmed path.

GLONASS/GPS guidance - using a highly accurate constellation satellite network system and antenna mounted on the bus can triangulate the precise location of the bus and with the addition of differential correction can to locate the bus to know its location to within 1-2 inches. This technology enables the bus to be guided by comparison the real time GPS coordinate set of the moving bus to a predetermined alignment that has coordinates established along its route.

Lane guidance or lane assist technology allows for reduced lane width requirements, within the tolerances of the guidance system implemented, due to the precision and repeatability of the guidance system. The bus way width can be reduced to a ten foot (3 metre) wide lane from the standard twelve foot (3.5 to 3.75 metre) lane. Mechanical guidance can reduce the lane to a width as little as 50 millimeters (2-inches) to either side of the vehicle guidance systems. As a result of the reduced cross section width, lane guidance systems can result in reduced right of way acquisition costs together with the reduced facility construction costs.

Another benefit cited by venders of lane guidance systems is its ability to provide a high level of safety due to stress relief and to the fact that the system more reliably stays on track compared with the typical performance of a human operator. In the case of the mechanically guided system, the bus is confined to the guideway and unable to move laterally if the driver removes his hands from the steering wheel.

These systems do have some dis-benefits. Careful study of the tracking of the bus vehicle is necessary in curvilinear sections of the alignment to make certain adequate width for the vehicle dynamic envelope is provided. This is especially true with mechanical guidance where physical contact with guidance rails is necessary, but the curvature of such rails could pinch the trailing section of the vehicle. The turning radius of the vehicle is slightly larger with guidance systems.

The maximum speed for some optical guidance systems is 45 to 50 miles per hour (70 to 80 kilometers per hour).

Additionally, any implemented guidance system has to have the full confidence of the bus drivers to be effective. If the drivers to not have such confidence, they will often override the system and steer the vehicles themselves, potentially creating a hazardous condition if the lane widths are too narrow for the skill level of the driver.

3. Complete these sentences with the correct form of the verbs in the box.

be connected *operate* *provide* *analyze* *detect*

1. The bus driver still _______________ the throttle and brake.
2. These guide wheels___________________ directly to the vehicle's steering linkage.
3. A computer________________ the image looking for special striping within bus way to steer the bus to follow.
4. A sensor on the vehicle __________________ the magnetic material.
5. Another benefit cited by venders of lane guidance systems is its ability to________________ a high level of safety.

4. Answer the questions.

1. What are the types of technologies used to accomplish lane guidance?
2. Which of them uses constellation satellite network system?
3. What are the benefits of lane guidance?
4. Do these systems have any dis-benefits?
5. What is the maximum speed for optical guidance systems?

UNIT 4
HIGHWAY TRAFFIC MANAGEMENT SYSTEM (HTMS)

Topic 1: What is HTMS?

1. New words and expressions to learn:

toll collection – автомат для сбора платы при въезде на платный мост или платную автомагистраль или при выезде с них.

collision sensor – датчик предотвращения столкновений

Closed Circuit Television Surveillance – система видеонаблюдения

2.Scan the text and answer the following questions:

1) What is HTMS?
2) What HTMS technologies do you know?
3) What does HTMS field equipment include?

The Highway Traffic Management System (HTMS) integrates multiple technologies to improve the flow of vehicle traffic and improve safety. Real-time traffic data from a traffic detection system flows into a Traffic Control Center (TCC) where it is integrated and processed and may result in actions (e.g. traffic routing, VMS messages) with the goal of improving traffic flow and minimizing losses.

HTMS complementry technologies include:

1. Automatic Vehicle Classification and Counting (AVCC)
2. Incident Detection (Speed, Crash detection) (IDS)
3. Closed Circuit Television Surveillance (CCTV)
4. Meteorology Data Station (MDS)
5. Emergency Call Box (ECB)
6. Variable Message (VMS)
7. Toll Collection (TCS)

HTMS field equipment includes:

- Vehicle detectors and classifiers
- Weigh-In-Motion (WIM) sensors
- Speed detectors (radar, video, loops)
- Collision sensors, readers
- CCTV cameras
- Weather and visibility detectors
- ECB (Emergency Call Box)
- VMS (Variable Message Signs)

3. Which of the following are HTMS complementary technologies:

1. Meteorology Data Station
2. Collision sensors, readers
3. Toll Collection
4. Weigh-In-Motion sensors
5. Closed Circuit Television Surveillance cameras

4. Explain in English what does the following mean:

1. Real-time traffic data
2. Toll Collection
3. Emergency Call Box
4. Incident Detection

Topic 2: Advanced Traffic Management System

1. New words and expressions to learn:

deployment – применение, использование, оснащение
overlap – частичное наложение; частичное совпадение
ramp – пандус, наклонная плоскость, уклон
closed circuit television – система видеонаблюдения
verification – контроль, проверка, удостоверение, подтверждение, засвидетельствование
irrespective – безотносительный, независимый
accuracy – правильность, соответствие, точность
violation – нарушение
toll – плата
toll booth – контрольный пост
DOT (Department of Transportation) – Министерство транспорта (в США)
fatality – смерть (от несчастного случая и пр.)
to alert – предупреждать (об опасности)

2. Read and translate the text:

ITS deployments themselves typically include surveillance systems that enable a more comprehensive understanding of how the existing transportation system operates and facilitates proactive strategies for managing it more efficiently. ITS deployments have benefited from advances in computer processing and miniaturization, communications technology, and enhanced institutional arrangements. Ten ITS systems will be introduced with some examples of how archived data have been used to provide evidence for the effectiveness of these systems. The ITS benefits and unit costs database has classified the benefits of implementing ITS into the following 10 program areas. Note that each program area includes different ITS applications and that there is some potential overlap:

- Freeway management
- Incident management
- Transit management
- Arterial management
- Emergency management
- Electronic payment
- Traveler information
- Crash prevention and safety
- Operations and maintenance
- Road weather management.

Freeway Management Systems

Three primary ITS functions make up freeway management systems: monitoring and surveillance, control of freeway operations, and the display or provision of information to motorists via dynamic message signs, highway advisory radio, in-vehicle navigation or information systems, or specialized information transmitted only to specific set of vehicles. Evaluations of freeway management system improvements such as ramp metering systems have demonstrated improvements in safety, reduction in travel time and delay, increased flows, and flow improvements. Despite early efforts to deploy metering and management systems, actual traffic monitoring over a widespread area and real-time response is easier now due to advances in technology and greater system coverage. Typical traffic operations centers (TOCs) collect and process surveillance and monitoring data, most often from inductive loop detectors, and supplemented this with closed circuit television (CCTV) cameras that are also directly controlled from the TOC.

Incident Management Systems

Incidents are defined as crashes, breakdowns, and other random events that occur on our highway system. Congestion caused by incidents are serious problems that face any transportation agency. Incidents are known to cause more than 50 percent of urban congestion and lead to economic losses, air pollution, and human pain and suffering. Many urban areas have developed quick response incident management systems, recognizing that transporting victims to trauma centers within the "golden hour" can save lives. Further, through coordination among highway operations, law enforcement, and emergency personnel, secondary crashes can be prevented and responder safety can be enhanced. So incident management systems are coordinated, preplanned, and/or real-time use of human resources to reduce the duration of incidents. Incident management systems contain components such as incident detection, incident verification, response to the incidents, clearance of the incidents, and traffic management at the incident locations. In many locations, incident data are archived on a regular basis to identify locations of high incident frequency. These locations can be used in planning the responders' routes on the highway and for identification of reasons for incident causation in an effort to improve the existing roadway characteristics to avoid future incidents at the same location. Numerous studies have been conducted to evaluate the implementation of incident management programs. Most of these studies came to the same findings that incident management programs have a substantial effect on delay time.

Transit Management Systems

Transit management systems are concerned with increasing operational efficiency of all transit modes and increasing ridership by making the transit system more reliable. The emergence of the global positioning systems (GPS) and the increase in its accuracy has helped this field substantially. Several transit agencies have equipped their vehicles with GPS to create automatic vehicle location (AVL). AVL technology has been widely implemented in North America and Europe. In the year 2000 about 35 bus systems had AVL technology implemented in the U.S., in both light-rail and bus systems.

The Tri-County Metropolitan Transportation District of Oregon (TriMet) operates 97 bus routes and a 38-mile light rail line within the tri-county Portland metropolitan region. TriMet's bus lines carry approximately 200,000 trips per day, serving a total population of 1.3 million persons within an area of 590 square miles (1,530 square kilometers). TriMet is considered as one of the leading ITS deployers in the U.S. TriMet has implemented a Bus Dispatch System (BDS) as a part of its overall operation and monitoring control system. The main components of the BDS include:

- Automatic vehicle location (AVL) based upon differential global positioning system (GPS) technology, supplemented by dead reckoning sensors;
- Voice and data communication system using radio and cellular digital packed data (CDPD) networks;

- On-board computer and control head displaying schedule adherence information to operators, detection, and reporting of schedule and route adherence to dispatchers;
- Automatic passenger counters (APCs) on front and rear doors of most vehicles; and
- Computer-aided dispatch (CAD) center.

The implementation of the BDS in Portland, Oregon has resulted in substantial savings to the existing system and increased the service reliability in the region for both bus and light-rail. The total annual benefits derived from implementing the TriMet BDS system is estimated at $5.4 million dollars, and the present value imposing a 12-year expected life on the BDS is $47.8 million.

Arterial Management Systems

An arterial management system is used to manage traffic by employing various detection and control devices along arterial roadways. This includes surveillance and traffic signal control, and sometimes includes audio or visual information on arterial roadway conditions. Detectors collect basic traffic condition data (typically flow and speed information) and adaptive control systems can be used to coordinate traffic signal control across a metropolitan area by adjusting the lengths of signal phases and cycles. Without centralized control, vehicles would be delayed at intersections irrespective of actual traffic conditions as the vehicle progressed through the route. This caused undue vehicular delay to all vehicles including transit vehicles. Using knowledge of real-time traffic characteristics and coordination, arterial management systems have contributed to reductions in red light violations of 20–75 percent and reductions in fuel consumption by 2–13 percent in the studied areas. It was shown that St. Paul, Minnesota, traffic signal preemption systems reduced crashes for emergency vehicles by 71 percent in seven years. An arterial management system can be also monitored by the existing vehicles running on the system. For example several transit agencies have equipped their vehicles with GPS which reports the location of the vehicle back to a dispatch center every few seconds.

Emergency Management Systems

Emergency management systems are used by fire departments, police departments, ambulance services, and freeway service patrols. These systems respond to emergencies and direct the various departments to the incident location through the shortest path in order to clear the incident or save a life. These systems include traffic signal priority to give the right of way to the departments' vehicle.

The emergency management systems use the AVL technology in order to locate the nearest vehicle and direct it to the incident. This system is managed by a transportation management center. The delivery of emergency service to the communities is an important responsibility that should be met when any person is facing an emergency.

A study of the Minnesota Highway Helper Program found that the program reduced the duration of a stall by eight minutes. Based upon representative numbers, annual benefits through reduced delay totaled $1.4 million for a program that cost $600,000 to operate. While in another pilot study looking at the Courtesy Patrol Program in Denver, Colorado, the estimates concluded a reduction cost in traffic delay by $0.8–$1.0 million for the morning period and by $0.90–$0.95 million in the evening. The study assumed a time value of $10 per hour. Program costs varied between the tow truck operators between $29 to $38 per truck-hour, which results in a benefitto-cost ratio of 10.5:1 to 16.9:1.

Electronic Payment

Electronic payment systems are present on many of the highways in the U.S. Several DOTs are turning to toll collection in order to finance new roads and maintain existing highways. The congestion caused upstream of toll booths began to be a problem so the idea of electronic payments has emerged as an important response. Typically, drivers subscribe to an electronic payment system and are given radio frequency (RF) transponders that communicate with the toll collection system. Vehicles passing through the toll facility entrance and/or exit are not required to stop as their payment is automatically deducted from their accounts. Electronic payment is also used for collecting transit fares and commercial vehicle operating fees where the transponder can be used in various ways and it is linked to a bank account or credit card line. A typical manual toll lane might process 350 vehicles per hour while applying electronic payment on all lanes will result in about 1,200 vehicles per hour. If the toll plaza was eliminated the rate could be 2,000 vehicles per hour per lane. This application will save on both toll booth construction and administration fees.

Traveler Information

Traveler information systems are used to inform travelers regarding road conditions via broadcast media. The system collects data regarding the current status of the transportation network and broadcasts it to travelers via communication channels and media. The objective is to provide travelers with current information so they can avoid congested routes. This kind of system tries to avoid the externalities caused by additional vehicles in the congested system. The communication system can be one-way or two-way where the vehicle will be equipped with GPS to identify the vehicle location and a traveler information center would direct the vehicle to an uncongested route. This system is known as a vehicle-motorist service information system. Several DOTs have started to apply similar systems and have begun to broadcast one-way communication to travelers via the radio and via the Internet. In Seattle, Washington, a Web-based traveler information system is available on the Internet.

The system is updated every minute. This kind of information system can also be implemented for transit. Several transit agencies have implemented Internet-based trip planners to transit riders. These trip planners save time and increase reliability to transit services.

Crash Prevention and Safety

In 1990, there were an estimated 16 million U.S. vehicle crashes. Forty five thousand fatalities occurred during these crashes, along with 5.4 million nonfatal injuries and 28 million damaged vehicles. The average cost per crash is approximately $8,600. Crashes are mainly caused by human errors, including errors in recognition, decision, and performance. An ITS-based crash prevention and safety system will include an advisory crash avoidance system to alert the driver with a warning when the vehicle detects a crash is about to occur. This system can include an advisory system to indicate the optimum headway and the best speed. Vehicles can also be equipped with an in-vehicle safety and warning system where warnings of immediate hazards and road conditions affecting the roadway ahead of the driver are reported to the driver.

Operations and Maintenance

Operations and maintenance systems are created during the process of implementation of any ITS application to measure the success or the decline of the system. Operations and management systems are encouraged by the USDOT. The USDOT is responsible for monitoring 75 metropolitan areas in the U.S. that have deployed ITS and received federal funding for ITS investments. In addition, archived surveillance and performance data can be used later for generating various performance measures and feeding performance data back into the planning process. Performance measures can lead to a better understanding of the existing system and the archived data can be used by various stakeholders in ways we cannot yet imagine. Collection of every single type of data needed for advanced traffic control for the entire traffic system is unrealistically costly and inefficient. Processing of disorderly and incomplete information reported from the field is usually complex and time consuming.

Road Weather Management

Weather impacts on transportation are pervasive. The weather can cause many incidents especially in the cold regions of the country. A study trying to quantify the benefits of an anti-icing program in seven different states in the United States was conducted in order to encourage the use of anti-icing/road weather information system technologies. The strategy of anti-icing involves the use of chemical freeze point depressants to prevent a bond from forming between pavement and snow or ice. NCHRP Project 20-7, Task 117 was initiated to address these needs and quantify the benefits. The study concluded that the anti-icing program can reduce costs of providing a defined level of service by 10–20 percent, while the snow and ice control costs per lane mile can be reduced up to 50 percent.

3. Match the words and phrases with the definitions:

1. surveillance	a. spreading widely throughout an area or a group of people
2. pervasive	b. a way or course taken in getting from a starting point to a destination
3. crash	c. the state of being safe from harm or danger.
4. route	d. collide violently with an obstacle or another vehicle
5. safety	e. the careful watching of someone, especially by an organization such as the police

4. Match the words from the column on the left to those from the column on the right to make up collocations and give their Russian equivalents.

1.electronic	a. media
2.closed	b. booth
3.broadcast	c. circuit television
4.computer-aided	d. payment
5.toll	e. computer
6.on-board	f. dispatch

5. Answer the questions.

1) What components do incident management systems contain?
2) What do the main components of the BDS include?
3) What is an arterial management system used for?
4) Who uses emergency management systems?
5) What are traveler information systems used for?

Topic 3: Sydney Coordinated Adaptive Traffic System

1. New words and expressions to learn:

deployment – применение, использование
intersection – перекрёсток
traffic signal – дорожный сигнальный знак
loop detector – петлевой детектор
road pavement – дорожная одежда, дорожное покрытие
public vehicle – общественный транспорт

2. Read and translate the text:

The **Sydney Coordinated Adaptive Traffic System**, abbreviated **SCATS**, is an intelligent transportation system developed in Sydney, Australia by former constituents of the Roads and Maritime Services in the 1970s, used in Melbourne since 1982 and Western Australia since 1983.

It is also used in New Zerland, Hong Kong, Shanghai, Guangzhou, Amman, Tehran, Dublin, Rzeszow, Gdynia and soon in part of Metro Atlanta, among several other places.

The system may be referred to by an alternative name in a specific installation (except Sydney), although since deployment wider than Australia, New Zealand and Singapore, these localized names do not appear to be commonly used. The following are some local alternative names that have been or are in use:

Canberra **"CATSS"** (**Canberra Automated Traffic Signal System**)

Melbourne **"SCRAM"**

Adelaide **"ACATS"**

Perth **"PCATS"**

Singapore **"GLIDE"**

In total, about 34,350 intersections in over 154 cities in 25 countries use the system. In Australia, the majority of signalized intersections are SCATS operated (around 11,000).

SCATS primarily manages the dynamic (on-line, real-time) timing of signal phases at traffic signals, meaning that it tries to find the best phasing (i.e. cycle times, phase splits and offsets) for the current traffic situation (for individual intersections as well as for the whole network). This is based on the automatic plan selection from a library in response to the data derived from loop detectors or other road traffic sensors.

The system uses sensors at each traffic signal to detect vehicle presence in each lane and pedestrians waiting to cross at the local site. The vehicle sensors are generally inductive loops installed within the road pavement. The pedestrian sensors are usually push buttons. Various other types of sensors can be used for vehicle presence detection, provided that a similar and consistent output is achieved. Information collected from the vehicle sensors allows SCATS to calculate and adapt the timing of traffic signals in the network.

Public Vehicle priority in SCATS (using data provided from PTIPS) caters for both buses and trams. SCATS has a facility to provide three levels of priority:

High – In the high priority mode the hurry call facility is used. i.e. the phase needed by the tram is called immediately, skipping other phases if necessary

Medium (*Flexible window*) – Phases can be shortened to allow the bus/tram phase to be brought in early. The bus/tram phase can occur at more than one place in the cycle.

Low – takes its turn. Trams would normally be given high priority, the aim of which is to get the tram through without it stopping. Buses would normally expect to receive a medium level of priority.

The architecture of the system is at two basic levels, LOCAL and MASTER. The LOCAL is the control cabinet at the roadside, which provides the normal signal control as well as processing of traffic information deduced from the vehicle detectors. The MASTER is a remote computer which provides area based traffic control, i.e. area traffic control (ATC) or urban traffic control (UTC). Detailed traffic signal and hardware diagnostics are passed from the LOCAL to the MASTER, with the ability to notify staff when a traffic signal has a fault.

SCATS is able to operate over PAPL, ADSL, PSTN and 3G IP network connections to each intersection. SCATS can also operate on a network of private cables not requiring third party telecommunications support and large parts of inner Sydney have always operated this way.

SCATS is already a recognized worldwide market leader in intelligent transport systems, however the New South Wales Roads and Maritime Services is continuing to develop SCATS to meet emerging technological, user and traffic demands.

Hong Kong

In Hong Kong, SCATS is currently adopted in the area traffic control systems at Hong Kong Island, Kowloon, Tsuen Wan and Shatin.

Instant fault detection and quick repair

The ATC system is equipped with the function of fault detection and logging the fault detected in order to facilitate repair and maintenance. Should there be a telecommunication breakdown, the ATC junction controller concerned will switch to standalone mode and continue to function.

Traffic Adaptive Operation

ATC systems provide advanced method of traffic signal control called Traffic Adaptive Control where the operational timing plans including cycle length, splits and offsets are continuously reviewed and modified in small increment, almost on a cycle-by-cycle basis, to match with the prevailing demand measured by the detectors connected to the on-street traffic controllers.

3. Match the words and phrases with the definitions:

1. intersection	a. a passenger vehicle powered by electricity conveyed by overhead cables, and running on rails laid in a public road
2. pavement	b. a point at which things intersect, esp a road junction
3. detector	c. the fact or condition of being regarded or treated as more important than others
4. tram	d. a device or instrument designed to detect the presence of a particular object or substance and to emit a signal in response
5. priority	e. a path with a hard surface, usually by the side of a road

4. Answer the questions:

1) What do you know about the Sydney Coordinated Adaptive Traffic System?

2) Where is SCAT used?
3) What are the local alternative names of SCAT?
4) What levels of priority does SCATS provide?
5) What basic levels is the architecture of the system at?

Topic 4: Electronic toll collection

1. New words and expressions to learn:

foe – недруг, недоброжелатель, неприятель

transponder – транспондер, преобразователь непрерывных данных в цифровые, повторитель сигналов; ретранслятор

feasible – реальный, выполнимый, осуществимый, подходящий, годный, вероятный, возможный

2. Read and translate the text:

Electronic toll collection (E-Tolls), an adaptation of military "identification friend or foe" technology, aims to eliminate the delay on toll roads by collecting tolls electronically. ETC determines whether the cars passing are enrolled in the program, alerts enforcers for those that are not, and electronically debits the accounts of registered car owners without requiring them to stop.

In 1959, Nobel Economics Prize winner William Vickrey was the first to propose a system of electronic tolling for the Washington Metropolitan Area. He proposed that each car would be equipped with a transponder. "The transponder's personalized signal would be picked up when the car passed through an intersection, and then relayed to a central computer which would calculate the charge according to the intersection and the time of day and add it to the car's bill". Electronic toll collection has facilitated the concession to the private sector of the construction and operation of urban freeways, as well as made feasible the improvement and the practical implementation of road congestion pricing schemes in a limited number of urban areas to restrict auto travel in the most congested areas.

In the 1960s and 1970s, free flow tolling was tested with fixed transponders at the undersides of the vehicles and readers, which were located under the surface of the highway.

Norway has been the world's pioneer in the widespread implementation of this technology. ETC was first introduced in Bergen, in 1986, operating together with traditional tollbooths. In 1991Trondheim introduced the world's first use of completely unaided full-speed electronic tolling. Norway now has 25 toll roads operating with electronic fee collection (EFC), as the Norwegian technology is called. In 1995, Portugal became the first country to apply a single, universal system to all tolls in the country, the Via Verde, which can also be used in parking lots and gas stations. The United States is another country with widespread use of ETC in several states, though many U.S. toll roads maintain the option of manual collection.

Open road tolling (ORT) is a type of electronic toll collection without the use of toll booths. The major advantage to ORT is that users are able to drive through the toll plaza at highway speeds without having to slow down to pay the toll.

3. Find the synonyms of these words in the text:

1. to eradicate ________________
2. traffic jam ________________
3. realization ________________
4. filling station ________________
5. crossing ________________

4. Match the words and phrases with the definitions:

1.parking lot	a. a place where you can buy fuel for your car
2.widespread	b. can be done, made, or achieved
3.gas station	c. found or distributed over a large area or number of people
4.feasible	d. make (an action or process) easy or easier
5.to facilitate	e. an area where cars or other vehicles may be left temporarily

5. Answer the questions:

1) What is the aim of Electronic toll collection?
2) Who was William Vickrey?
3) Who was the world's pioneer in the widespread implementation of E-Tolls?
4) Where was ETC first introduced?
5) What is open road tolling?

Topic 5: Heavy Vehicle Fee / LSVA (Switzerland)

1. New words and expressions to learn:

bilateral treaty – двусторонний договор
flat fee – фиксированная плата
distortion – искажение; искривление; перекашивание
detour –– окольный путь, обход; объезд
laden weight – вес с грузом; вес брутто; масса с грузом
mandatory – обязательный, принудительный

2. Read and translate the text:

On an average working day about 4,500 lorries drive through the Gotthard road tunnel crossing the Alps. In the valleys on the approaches north and south of the Gotthard noise and air pollution frequently exceeds the legal limits. On peak travelling days, traffic jams regularly form in front of the tunnel entrances. Following the general trend in the EU, also in Switzerland the transport performance of heavy goods traffic increased enormously in the last decades. For various reasons the railways became increasingly less able to compete with road transport. Still, in Switzerland the railways carry a far higher share of goods across the Alps than in Austria and France. Among other reasons this is partly due to the fact that in Switzerland vehicle weights were limited to 28 tons. However, after the agreement of the bilateral treaties with the European Union this weight limit is being extended to 34 tons and to 40 tons later on. Studies forecasted that this increase in weight limit would lead to a doubling of heavy goods traffic on the Swiss road network by 2015 if no measure were to be taken up. Facing these problems, Swiss parliament drew a federal law that wanted to replace the since 1985 existing flat fee for Heavy Goods Vehicles (HGV) by a nation-wide distant-related fee, the LSVA (Leistungsabhängige Schwerverkehrsabgabe). A referendum against the law was called. In the subsequent plebiscite on September 27, 1998, the Swiss people adopted the law with a large majority. Subsequently, the LSVA started on January 1st 2001.

Basic facts

The main reasons and basic principles for the introduction of the LSVA were:

- Internalisation of external cost of heavy vehicle traffic (principle of true costs).
- Shifting heavy vehicle traffic from road to rail and increasing the rail's competitiveness.
- Preventing the forecasted increase in heavy vehicles traffic.

• Compensating for the increase in productivity due to the admission of 40-tons goods vehicles that became legal after the bilateral treaties with the European Union.

• Generating revenue for financing large-scale public transport projects, e.g. the New Alpine Rail Transversal (NEAT).

• Bringing the Swiss transit fee for crossing the Alps in line with the corresponding fees in France and Austria, thus avoiding distortion of competition and ecologically undesirable detours.

The basic principles of the LSVA are that it is distant-related (driving more means paying more) and that empty vehicles cost as much as fully loaded ones. It is levied for HGV on all public roads, including both urban and non-urban roads.

Users and stakeholders

The LSVA applies to all domestic and foreign heavy vehicles and trailers for goods or passenger transport with a maximum laden weight in excess of 3.5 tons.

Implementation set-up

The LSVA is levied according to:

the number of kilometres driven on all public roads in Switzerland;

the maximum permissible laden weight (tons);

the emission category of the heavy goods vehicle.

This pricing structure aims at reducing overall transport distances and increasing vehicle capacity usage. As the levied fee depends on the emission category of the vehicle too, the LSVA will also influence the choice of vehicles towards environmentally friendlier solutions.

Passenger transport vehicles such as coaches, motor homes etc. are charged a time-related flat fee (no distance relation). There are special regulations for the transport of log, unpacked milk and livestock. Agricultural and public transport vehicles, ambulances and vehicles of the armed forces, police, etc. are completely exempted from the LSVA. In order to improve the competitiveness of intermodal transport pre- and end-haulage for intermodal transport are granted a flat rate refund compensating for the Heavy Vehicle Fee. Around 54,000 domestic trucks and 30,000 trailers are affected by the fee. In addition, around 20,000 foreign trucks cross the Swiss border daily.

For the years 2001-2004 the following values were applicable:

Emission class Euro 0: 2.0 Rp. (approximately 1.4 c.) per ton-kilometre

· Emission class Euro I: 1.68 Rp. (approximately 1.1 c.) per ton-kilometre

· Emission class Euro II and III: 1.42 Rp. (approximately 1 c.) per ton-kilometre

For 2005 the Federal Council set new rates, taking into account technical developments. However, the maximum rate is fixed by 2.75 Rp. (approximately 1.9 cents) per tonne-kilometre. Furthermore federal law states that the fee must not exceed infrastructure costs and external costs related to road transport. With the LSVA the transalpine route from Basel to Chiasso became approximately 6 times more expensive: from 17 Euro (before 2000) to 34 Euro (year 2000) and approximately 100 Euro (LSVA, after 2001). The fee level is a result of both political negotiations and the calculations of external costs.

The fee collection is based on the principle of self-declaration. The liable person (vehicle owner or driver) is obliged to actively participate. For domestic vehicles an On-Board-Unit (OBU) is mandatory. Foreign vehicles basically are using a ticket fetched at self-service machines. The OBU records the required trip data automatically. The distance is recorded by the tachograph. A GPS sensor and a movement sensor provide a second, redundant measurement in order to make sure that the tachograph signal is not intentionally interrupted or falsified. A Dedicated Short Range Communication (DSRC) air-link is used to switch the recording of the kilometres on and off when crossing the border. Radio beacons are installed over the carriageways at the 82 border crossings concerned.

For foreign vehicles an ID-Card issued at the first entry provides for self-service on entry and simplifies the processes on exit. When entering the driver declares the relevant data (mileage reading, trailer status, payment mode) at the self-serving machines and receives a ticket. The whole declaration process takes less than 2 minutes. Domestic vehicles can drive for a long time within Switzerland without ever crossing the border where the correctness of their recorded data is checked.

Therefore checks in the interior are indispensable in order to enforce a correct declaration. The checks do not influence the moving traffic as they are done via the DSCR air-link and by making use of the externally visible lamps of the OBU. Vehicles with a wrong declaration, e.g. a missing trailer declaration, can be sued.

Domestic vehicle owners monthly declare the fee parameters (distances and weights) to the Swiss Customs Authority SCA. The SCA processes the data, determines the amount due, invoices the vehicle owner and collects the fee. Foreign vehicles declare their trip data when leaving Switzerland. The fee may be settled via a petrol card or via an account held with the SCA. Immediate cash payment is also possible.

The rather costly OBU (about 800 Euro each) are distributed free of charge to domestic and foreign vehicle owners until 2004. The installation costs of up to about 300 EUR have to be carried by the vehicle owner. Implementation costs were within the credit limit of 100 Million EUR, plus another 50 Million EUR for the free distribution of the OBU. Operations costs are only 4-6 % of revenues which is very low compared to the usual figures of around 20%.

3. Match the words and phrases with the definitions:

1.plebiscite	a. refers to the distance that you have travelled, measured in miles
2.livestock	b. a long or roundabout route that is taken to avoid something or to visit somewhere along the way
3.mileage	c. a device that is put in vehicles such as lorries and coaches in order to record information such as how fast the vehicle goes, how far it travels, and the number of breaks the driver takes
4.redundant	d. farm animals regarded as an asset
5.detour	e. required by law or mandate; compulsory
6.free of charge	f. no longer needed or useful; superfluous
7.tachograph	g. the direct vote of all the members of an electorate on an important public question such as a change in the constitution
8. mandatory	h.without any payment due

4. Answer the questions:

1) Why did Swiss parliament decide to replace the existing flat fee for Heavy Goods Vehicles (HGV) by a nation-wide distant-related fee, the LSVA?

2) What were the main reasons and basic principles for the introduction of the LSVA?

3) What principle is the fee collection based on?

4) What vehicles does the LSVA apply to?

Topic 6: Telepass

1. New words and expressions to learn:

affiliate – филиал, отделение
toll booth – контрольный пост
beep – гудок, звуковой сигнал
to span – охватывать, распространяться
number plate – номерной знак (на автомобиле)

2. Read and translate the text:

Telepass is the brand name for an electronic toll collection system used to collect toll (*pedaggio*) on motorways (*autostrade*) in Italy operated by Autostrade per l'Italia S.p.A., its affiliates, and other legal entities. The system was introduced in 1989.

There are three main Telepass implementations:

- Telepass Family, which can be linked to a bank account or a credit card account,
- Telepass with ViaCard, which can be used with a ViaCard toll charge card linked to a bank account or credit card account,
- Telepass Ricaricabile, which does not require nether a bank nor credit card account.

Telepass can be used for all types of vehicles which can travel on Italian motorways. Telepass consists of an On-Board Unit (OBU) mounted at the top of the vehicle's windscreen. The OBU is battery-powered. Telepass Family and Telepass with ViaCard OBUs need to be replaced after approx. three years. Telepass Ricaricabile OBUs have user-replaceable batteries. The OBUs communicate with the electronic toll booths by dedicated short-range communications.

Telepass is used on motorways in the *open* and the *closed* systems. Toll in the open system consists of a flat fee charged for the use of a motorway or a part thereof, regardless of the distance travelled. Toll in the closed system is charged depending on the distance. In both systems, the toll varies according to the type of vehicle (car, bus, lorry etc.) and to the upkeep for the motorway.

Telepass is currently available on most motorway entries and exits. At large toll stations, like the Brenner Pass station, all lanes, including lanes supervised by toll cashiers (*esattori*), are equipped for Telepass use, at smaller stations, there are special Telepass-only lanes and lanes for Telepass and ViaCard use (*porta bimodale* or *porta multimodale*).

Telepass Ricaricabile (*rechargeable*) was introduced in March 2006 in the Naples area in southern Italy. It is currently being tested for reliability and is eventually to be available on all Italian motorways which support Telepass family. For Telepass Ricaricabile, the user is required to make pre-payments in person, by phone or on-line. No current or credit card accounts are required, and Telepass Ricaricabile is therefore of special interest to foreign visitors. Telepass Ricaricabile uses an OBU different from the other Telepass versions.

Telepass Family is open to any user with an approved Italian credit card or bank account; Telepass with ViaCard is open to all ViaCard holders. Telepass Ricaricabile is open to any user. For all three implementations, the user doesn't need to be a citizen or resident of Italy, and the vehicle doesn't need to have Italian number plates.

The quarterly service charge for Telepass Family and Telepass with ViaCard is EUR 3.75. If the toll incurred in a quarter exceeds EUR 258.23, the service charge is increased to EUR 3.72 per month until the toll incurred in a quarter falls to below EUR 258.23. The initial service charge for Telepass Ricaricabile is EUR 55.00 plus Italian VAT. There are no discounts on tolls for Telepass users.

Telepass users must use lanes designated with the Telepass logo and travel no faster than 30 km/h when in the Telepass lane. Once the OBU has been identified and verified, the OBU emits a single high beep, and the barrier blocking the lane is lifted. When the user exits the toll lane, the OBU emits a second single high beep. A series of three high beeps indicates the OBU's battery is nearing exhaustion and the OBU or its battery should be replaced. A low beep indicates the OBU has not been able to communicate with the toll station, was identified as blocked, or, in case of Telepass Ricaricabile, does not have sufficient funds left to pay for the toll incurred. In all these cases, the barrier remains closed, and the user must signal the toll station supervisor by pressing the red Help (*Assistenza*) button. The number plate is then photographed, and the vehicle allowed to continue. The vehicle is subsequently identified by its number plate, and the owner is sent a bill for the toll which could not be collected automatically.

In case no Telepass lanes are available when entering the motorway, the user is issued an entry ticket and must insert that ticket upon exiting the motorway through a multimode lane capable of handling Telepass and ViaCard (*porta bimodale* or *porta multimodale*). In such a multimode lane, the toll will be charged automatically by the OBU once the ticket has been inserted, in cashier-only lanes, the toll cashier will manually conclude the transaction and have the toll charged to the user's account.

The toll collection and billing systems of all motorway operators in Italy have been interoperating automatically since 1988. Since that time, a driver needs to pay toll only once when exiting the motorway, even if the journey has spanned motorways operated by different carriers.

3. Match the words and phrases with the definitions:

1. motorway	a. a charge payable for permission to use a particular bridge or road
2. vehicle	b. a major road that has been specially built for fast travel over long distances
3. ticket	c. a sign affixed to the front and rear of a vehicle displaying its registration number
4. number plate	d. a short, high-pitched sound emitted by electronic equipment or a vehicle horn
5. toll	e. a machine with an engine, for example a bus, car, or truck, that carries people or things from place to place.
6. beep	f. a piece of paper or card that gives the holder a certain right, especially to enter a place, travel by public transport, or participate in an event

4. Answer the questions:

1) What is Telepass?
2) What are three main Telepass implementations?
3) When is Telepass used?
4) What do you know about Telepass Ricaricabile?
5) What does a series of three high beeps indicate?
6) What does a low beep indicate?

List of road-related terminology

A

aggregate

A substance composed of mineral crystals or mineral rock fragments, used in pavement.

alley

A privately maintained thoroughfare, tract, or easement, usually narrower than a street, which provides access to the rear boundary of one or more lots and is, not intended for general traffic circulation.

alligator cracking (or fatigue cracking)

Cracks in an asphalt pavement surface forming a pattern that resembles an alligator's hide or chicken wire. Alligator cracking may begin with a single longitudinal crack in the wheel path. The cracks indicate failure of the surface layer generally caused by repeated traffic loadings.

average daily traffic counts

The average number of vehicles using a roadway in one day.

auxiliary lane

An additional lane at the side of the mainline carriageway to provide increased merge or diverge opportunity or additional space for weaving traffic.

B

bulb

A round area for vehicle turnaround typically located at the end of a cul-de-sac street.

boulevard (BLVD)

A wide street with a landscaped center island running the length of the street. Boulevards are usually found in urbanized areas.

bridge

A structure spanning and providing passage over an obstacle, such as a waterway.

button copy

An older style of road sign using button-shaped reflectors to increase nighttime visibility of the sign.

bump

Where two routes both turn in opposite directions at an intersection. For example, Route 1 makes a turn from north to east, while Route 2 makes a turn from east to north. Thus, traffic approaching the intersection on northbound Route 1 will end up on Route 2 unless they make a right turn. Some believe that a "bump" is where a concurrency should have formed instead.

business Loop (BL)

A business loop is a surface route that leads into a downtown business district and returns to the freeway at the other end. Frequently, the business loop is the alignment of the original highway before that highway was bypassed.

business Route (BR)

A business route connects the freeway or through highway with the downtown and commercial areas of a city or town. Business routes are primary arterials and begin and end on the Interstate. Business Loops and Business Spurs are types of Business Routes. Business Loop implies that the business route will return to the parent route, while a business spur implies that the business route will only spur into the commercial area and not return to the parent route.

business Spur

A business spur is a surface street route leading from the Interstate highway into the central commercial district. The spur route ends upon reaching a specified point within that urban area.

C

capital Preventive Maintenance

plan for cost-effective treatments to an existing road system that preserves or improves the condition of the system without (significantly) increasing structural capacity.

chip seal

A surface treatment in which the pavement is sprayed with asphalt (generally emulsified) and then immediately covered with aggregate and rolled. Chip seals are used primarily to seal the surface of a pavement with non load-associated cracks and to improve surface friction. This is typically used to extend the life of the pavement surface by sealing out moisture, which can cause major damage to pavement, until major repairs are made.

cold mill

Removal of pavement material from the surface of the pavement either to prepare the surface to receive overlays (by removing rutting and surface irregularities) or to restore pavement to the correct specifications. This process is also used to remove oxidized asphalt concrete.

cloverleaf interchange

A type of interchange consisting of eight ramps, four loop ramps and four straight ramps. Each direction of a highway has two exits to the other highway, one for each direction.

concurrency

An overlap of two or more highways. Also referred to as *multiplex*, with *duplex*, *triplex*, etc. referring to the number of highways involved in the concurrency.

connector road

A collective term for interchange links, link roads, slip roads and loops.

crack

A fracture of the pavement surface not necessarily extending through the entire thickness of the pavement. Cracks generally develop after initial construction of the pavement and may be caused by temperature changes, excess loadings, or excess deflections, which are movements in or under the pavement.

crack filling

placing materials into non-working cracks to reduce the infiltration of water and other matter, while also reinforcing the adjacent pavement. Crack filling should be distinguished from crack sealing

crack sealing

Placing specialized materials into working cracks in unique configurations to keep water and other matter out of the crack and the underlying pavement layers.

crash potential

The relative degree of safety of a location or area.

cross-pledging

Using toll revenue obtained from one turnpike to finance another owned by the same agency. Cross-pledging is used by the Oklahoma Turnpike Authority to maintain turnpikes that could not sustain themselves.

continuous traffic flow

A steady, unbroken stream of traffic.

cul-de-sac

A short street having one end open to traffic and the other temporarily or permanently terminated by a vehicle turnaround at or near the terminus.

culvert

A conduit or conveyance structure under a roadway that is used to pass stream flow, storm water runoff or wildlife to improve safety, prevent accidents and improve traffic flow on the roadway. A culvert has a diameter or width of not more than 20 feet. Any crossing exceeding 20-feet in width is considered a bridge, length is not considered in the definition and is measured perpendicular to the direction of traffic on the roadway.

D

decommission

To remove a highway, in whole or in part, from the state highway system. The physical roadbed typically remains usable. The highway may then receive a "lower" designation, such as a U.S. route becoming a state or county route. A decommissioned highway may not receive a new highway designation, but may become a city street or a county- or township-maintained road.

delineators

Road markers that define lanes and shoulders; safety measures intended to guide drivers.

demountable copy

A style of road sign where each character of the sign's legend is a separate, cut out piece of metal, attached to the sign face using rivets, screws, or some other fastener. This allows for easy modification of the sign's text when needed. Used in only a few states in the U.S., notably Kansas.

diamond grinding

A process that uses a series of diamond-tipped saw blades mounted on a shaft to shave the upper surface of a pavement to remove bumps, restore pavement rideability, and improve surface friction.

diamond interchange

A common type of interchange involving four ramps, one in each quadrant. Diamond interchanges are simple to build, requiring a relatively small number of ramps, only one bridge, and allow all possible movements. However, the intersection of the ramps with the non-freeway road require some form of traffic control, like a traffic light or stop signs, making them less suited to interchanges with heavy traffic.

dowel

A plain round steel bar which extends into two adjoining slabs of pavement at a joint. Dowels are used to keep concrete slabs from heaving up and down.

dowel bar retrofits

A rehabilitation technique used to distribute the weight of vehicles across existing joined pavements by placing dowel bars across joints and/or cracks.

downstream

Points on a route further ahead in the direction of traffic flow.

driver response

driver reaction to a message or condition on a highway such as a sign or traffic signal.

driveway

A privately maintained access to residential, commercial or industrial properties.

dumbbell interchange

A variation of the diamond interchange with roundabouts where the ramps intersect the non-freeway road. Most often found in the U.K. Named as such because the two roundabouts and the bridge connecting them resemble a dumbbell when seen from an aerial view.

E

efficient systems

A route or network of routes on which traffic flows with minimum delay and congestion.

emulsified asphalt

A liquid mixture of asphalt binder, water and an emulsifying agent.

eyebrow

A partial bulb located adjacent to the serving road that provides access to lots and serves as a vehicle turnaround.

F

fork

An at-grade junction of two roads, usually within an interchange, which diverge from the approach road at similar angles. Usually both diverging roads have equal status. (For a fork junction, as defined in BS 6100: Subsection 2.4.1, the minor road deviates from the straight major road.)

freeway

A freeway is an access-controlled, divided highway designed for the unimpeded movement of large volumes of traffic. Characteristics of a freeway include controlled access through the use of interchanges, and use of underpasses or overpasses at intersections.

frost heave

A process in which the ground freezes and thaws, creating potholes.

G

gaps

Breaks in the traffic stream long enough to permit vehicles or pedestrians access across or into the traffic stream.

gore

The V-shaped area that separates through-traffic from exiting or entering traffic on freeways and highways.

grade separation

A crossing that uses an underpass or overpass to eliminate conflict points.

grooving

The process used to cut slots into a pavement surface to provide channels for water to escape beneath tires. This improves skid resistance and reduces the potential for hydroplaning.

Ghost Island

An area of the carriageway suitably marked to separate lanes of traffic travelling in the same direction on both merge and diverge layouts. The purpose of the ghost island at a merge is to separate the points of entry of two slip road traffic lanes. At a diverge it is to separate the points of exit to a slip road.

H

Highway (HWY)

A main road that provides direct access to buildings and intersections. Unlike a limited access freeway, a highway has intersections at grade level and signs and signals to control traffic.

Hot Mix Asphalt Concrete (HMAC or HMA)

A carefully controlled mixture of asphalt binder and well-graded, high quality aggregate thoroughly compacted into a uniform density. HMAC pavements may also contain additives such as anti-stripping agents and polymers.

I

interchange

A grade separated junction that provides free flow from one mainline to another.

interchange link

A connector road, one or two way, carrying free flowing traffic within an interchange between one level and/or direction and another.

J

jughandle

A ramp used to facilitate turns, especially left turns. Most often used in New Jersey, with a few in the surrounding states.

L

lane gain

A layout where a merging connector road becomes a lane or lanes of the downstream main carriageway.

lane drop

A layout where a lane or lanes of the upstream carriageway becomes the diverging connector.

Large Goods Vehicle (LGV): A goods vehicle, the permissible maximum weight of which exceeds 7.5 tonnes.

lane miles

The number of miles of pavement going in one direction on any given road. Miles of roadway x (times) number of lanes = lane miles.

limited Access

A highway or section of highway designed for travel by registered motor vehicles. Access is limited to intersections, and driveways are generally not allowed. Freeways are a common type of limited access highway.

link road

In the context of junctions, a one way connector road adjacent to but separate from the mainline carriageway carrying traffic in the same direction, which is used to connect the mainline carriageway to the local highway network where successive direct connections cannot be provided to an adequate standard because the junction spacing is too close.

load transfer

The ability to distribute the weight of vehicles across joined sections of pavement. This is a critical factor in extending pavement life.

loop

A connector road, one or two way, which is made up of the elements of and which passes through an angle in the range of approximately 180 to 270 degrees. The loop is considered to extend to the end of the near straight length of road contiguous with the back of the diverge or merge nose.

M

mainline

The carriageway carrying the main flow of traffic; generally traffic passing straight through the junction or interchange.

median

A barrier, constructed of concrete, asphalt, or landscaping, that separates two directions of traffic.

michigan left

A maneuver required when a left turn is prohibited, as in much of the U.S. state of Michigan, which involves turning *right* at the desired street and making a U-turn.

microsurfacing

A mixture of polymer-modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed, and spread on a paved surface. Unlike slurry seal, microsurfacing can be used on high volume roadways to correct wheel path rutting and provide a skid resistant pavement surface.

milling - Grinding off the top layer of pavement.

N

neutered shield

An Interstate shield which lacks the name of the state above the route number.

nose

A paved area, approximately triangular in shape, between a connector road and the mainline at a merge or diverge, suitably marked to discourage drivers from crossing it.

P

Parallel Merge/Diverge

A layout where an auxiliary lane is provided alongside the mainline carriageway.

partial interchange

An interchange that is missing one or more ramps, making some movements impossible. Partial interchanges are built when consecutive interchanges are spaced too tightly to allow all ramps to be built safely, or when a movement would make no sense (such as going from eastbound I-240 to westbound I-40 in Oklahoma City) or would be executed rarely enough that it would not justify the cost of building the ramp, of which is common for leftover bifurcations for former endpoints of a freeway before being extended, though some deviations like that are eliminated too when the freeway is extended. Some toll roads also use partial interchanges in order to force traffic through toll plazas, either located on the ramps themselves or further down the road.

patch

Repair of a localized defect in the pavement surface.

pavement miles

The number of miles of pavement in both directions of a road/freeway.

pavement preventive maintenance

Planned strategy of cost-effective treatments to an existing roadway system to extend the life of the pavement, retard future deterioration, and maintain or improve the functional condition of the system (without increasing the structural capacity).

pavement reconstruction

Complete removal and replacement of the existing pavement structure and may include new and/or recycled materials.

pavement rehabilitation

Structural enhancements that extend the service life of an existing pavement and/or improve its load carrying capability. Rehabilitation techniques include restoration treatments and structural overlays.

performance period

Period of time that a newly constructed or rehabilitated pavement structure will perform before deteriorating.

platoon

A group of vehicles moving, more or less as a unit, along a signalized roadway system.

potholes

A hole in the pavement surface- commonly caused by moisture.

preserve

A project type involving rehabilitation of existing roadways and may include resurfacing or reconstruction of existing roads and bridges.

private Street

A privately owned and maintained access provided for by a tract, easement or other legal means, typically serving three or more potential dwelling units.

profilameter

A computer-aided device used to measure the smoothness of the road.

progressive movement

Traffic moving at a constant speed with a minimum number of stops.

public Street

Publicly owned facility-providing access, including the roadway and all other improvements, inside the right-of-way.

R

reserved Lane

A lane carrying traffic that is segregated from weaving traffic.

resurfacing

The addition of a layer or layers of paving material to provide additional structural integrity, improve serviceability, and rideability.

retrofit Dowel Bars

Dowels that are installed into slots cut into the surface of an existing concrete pavement to distribute the weight of vehicles across existing joined pavements.

rideability

A measure of the ride quality of a pavement as perceived by its users or roughness measuring equipment

right-of-way

Public land, property, or property interest (e.g., an easement), usually in a strip, as well as bridges, trestles, or other structures, acquired for or devoted to transportation purposes. This does not include recreational or nature trails except where they intersect with or are located within road rights-of-way

right-of-way assignment

The "green" phase of a stop-and-go signal when a certain movement of traffic is permitted to flow.

roadgeek

A hobbyist who enjoys traveling and/or studying roads and or road systems.

route Miles

The number of miles a car travels to get from point A to point B.

rural Road

An all-purpose roads and motorways that are generally not subject to a local speed limit.

S

shoulder

The paved or unpaved portion of the roadway outside the traveled way that is available for emergency parking or non-motorized use.

signal Cycle

The time required for all phases of a signal to take place - from beginning of green to beginning of green.

signal Warrants

A set of guidelines designed to determine the need for a stop-and-go traffic signal.

single-Point Urban Interchange (SPUI)

A single-point urban interchange is a variant on the standard diamond interchange, whereby all traffic meets at one single traffic signal in the center of the bridge over the freeway (or underneath the freeway). These interchanges can accommodate more traffic in smaller spaces, hence their appeal in urban areas.

sinkhole

Deep or large voids underneath the roadway surface.

Slip Road

A connector road within a junction between a mainline carriageway and the local highway network, or vice versa, which meets the local highway network at-grade. Traffic using a slip road usually has to give way to traffic already on the mainline or on the local highway network.

SPUI

Abbreviation for *single point urban interchange*. A variant of the diamond interchange most often used in urban areas that only requires one traffic signal.

superstructure

A bridge.

T

Taper Merge/Diverge

A layout where merging or diverging traffic joins or leaves the mainline carriageway through an area forming a funnel to or flare from the mainline carriageway.

terminus

The end point of a highway. Signage denoting the end of the route may be present at the terminus.

Texas U-turn

A lane allowing cars traveling on one side of a one-way frontage road to U-turn into the opposite frontage road (typically crossing over or under a freeway or expressway) without being stopped by traffic lights or crossing the highway traffic at-grade. Also referred to as a Texas Turnaround.

"Tiger Tail"

A ghost island layout at a diverge utilising TSRGD diagram 1042.1 to separate the points of exit to a slip road. So called because the vertical sign used to inform drivers of the layout incorporates an illustration that resembles a tiger's tail.

TOTSO

"Turn off to stay on"—a term used when one has to turn off the main carriageway to stay on the route being followed (such as junction 5 of the M25). This term was developed by the Society for All British and Irish Road Enthusiasts and has been adopted by similar groups in Germany and in the Netherlands and warrants a mention in Wikipedia in those countries. The term has also made an appearance in the British National Press.

traffic Calming

A set of street designs and traffic rules that slow and reduce traffic while encouraging walkers and cyclists to share the street. Traffic calming measures include: traffic circles, raised crosswalks, sidewalk extensions speed humps and medians.

traffic Circle

An intersection where traffic moves around a circular center island. Some traffic circles have traffic signals.

traffic Volumes

The actual number of vehicles passing a given point.

trumpet interchange

A type of interchange used for a "T"-junction where a road or highway ends at a freeway.

U

upstream

That part of the carriageway(s) where traffic is flowing towards the section in question.

urban All-Purpose Road (UAP)

An all-purpose road within a built up area, either a single carriageway with a speed limit of 40 mph (65 km/h) or less or a dual carriageway with a speed limit of 60 mph (100 km/h) or less.

urban Motorway

A motorway with a speed limit of 60 mph (100 km/h) or less within a built up area.

useless concurrency

A concurrency between a highway's terminus and the point where it splits off on an independent alignment. The concurrency is "useless" because the highway could have just as well ended at the point it intersected with the concurrent road, rather than being extended to some other point by means of a concurrency. useless concurrencies also occur when a numbered 2-lane road paralleling a freeway is sufficient enough for state highway standards, though Interstate business loops that are concurrent with a parallelling state or US highway cease to be "useless" as the short business loop serves a practical purpose.

W

weaving Section

The length of the carriageway between a successive merge or lane gain and diverge or lane drop, where vehicles leaving the mainline at the diverge or lane drop have to cross the paths of vehicles that have joined the mainline at the merge or lane gain.

working Crack

A crack in a pavement that changes, becoming narrower or wider under different temperature conditions. A working crack develops through movement in or under the pavement, for example, when an old expansion joint fails.

wrong-way concurrency

A concurrency between two roads with opposite signed directions, e.g. a westbound highway and an eastbound highway. Often, the physical roadbed is actually headed in a totally different cardinal direction. Some wrong-way concurrencies are often regarded as "useless concurrencies" too.

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