

PARKING MANAGEMENT AND CONTROL SYSTEMS

Parking activity, as inseparable part of individual car travel, is extremely important for urban traffic system mobility and overall efficiency. More than 90 % of the daily time average passenger car spent in stationary state, and each car travel starts and terminates with parking activity. Terminal part of individual motorized travel is especially critical, connected with task of finding corresponding available parking place, often within large and non-transparent area or in large multi-level object.

That is enough reason for investing effort and engage advanced technology for providing reasonable and the most efficient use of limited parking capacities of urban area. At the other hand, building and maintenance of parking facilities produce certain costs, so its exploitation should be efficiently and economically organized, and finally, user may be charged for its use in a precise and fair way. These facts define the various requirements from modern parking management technology.

The next table presents different parking facility types available within urban space, with optional control systems which can be embedded for more efficient and economic traffic process and facility use.

Table 1 - Parking object typology with optional control applications

Optional application	Parking object		
	On the street	Off-street/ parking lot or garage	
		In level/ outdoor or garage	Multi-level garage
On street navigation	+	+	+
Object availability info	+	+	+
Access control	+/-	+	+
Occupancy determination	+/-	+/-	+
Parking guidance	-	+/-	+
Parking charging	+/-	+/-	+/-

Explication:

Navigation is providing drivers at selected street network location, usually in front of route decision points, with information of nearby parking objects availability (the identification of, direction to reach it and number of currently free parking positions). **Guidance** implies almost continual providing of information which path to follow within parking object for efficient access to free parking position.

On-street parking is commonly organized on carriageway curb area or adjacent off-road surface. Availability control (free position detection) can be provided using single space buried in the ground detectors, and eventual parking navigation system can treat street sections as parking object for directing user to. Service charging is the most efficient organized through mobile phone network/ SMS communication.

Functionally important feature of **off-street parking** is the gate-oriented access, suitable for variety of access control options (permit to use, privileges, different charging models, etc.). For most of the

control systems single space detection of parking occupancy is needed, although simple vehicle counting (entering/ exiting) can also provide relatively reliable information about parking capacity availability.

For complex (not linear) parking lots and within multi-level garages parking guidance is evitable for its reasonable and efficient exploitation.

On street navigation – Dynamic information on the street network directing potential users towards available nearby parking objects by use of VMS displays located at network decision points;

Object availability info – Information of actual number of free parking spaces of different users categories in particular parking object, presented on VMS displays located close to object entrance, also suitable for other web based information services;

Access control – User registration (entry permit, user identification or just vehicle counting) at the parking entrance/ exit, for access permission control, collecting details for service charging, or just for facility occupancy calculation;

Occupancy determination – System for providing information of actual availability of free parking positions within the whole facility or its particular part (e.g. building level), for user on street navigation, informing in front of the facility, or for guiding user to free parking positions within facility.

Parking guidance – Dynamic information at VMS displays regarding free parking space location within complex, usually multi-level parking facility;

Parking charging – Specific mode of access control, includes collection of necessary information regarding user servicing within parking facility (identification, time spent, charge calculation) and toll collection for the service done.

In fact, three main functional systems can be recognised as a optional constitutive part/ subsystem of different parking control solutions: **occupancy detection, access control and parking charging**.

What ElcomBgd can offer

ElcomBgd is widely engaged in the field of access control and efficient use of different forms of parking facilities, as manufacturer of system components, and as a system integrator for complex parking solutions. It is between few company's main business orientations.

ElcomBgd is system integrator for most of the listed parking control options, integrating its own products (LCC-550 universal parking controller, inductive loop detectors and VMS parking guidance display) with products of partner companies: Q-Free (Norway), Q-Free TCS (US), BFT (Italy), Elka (Germany), etc.

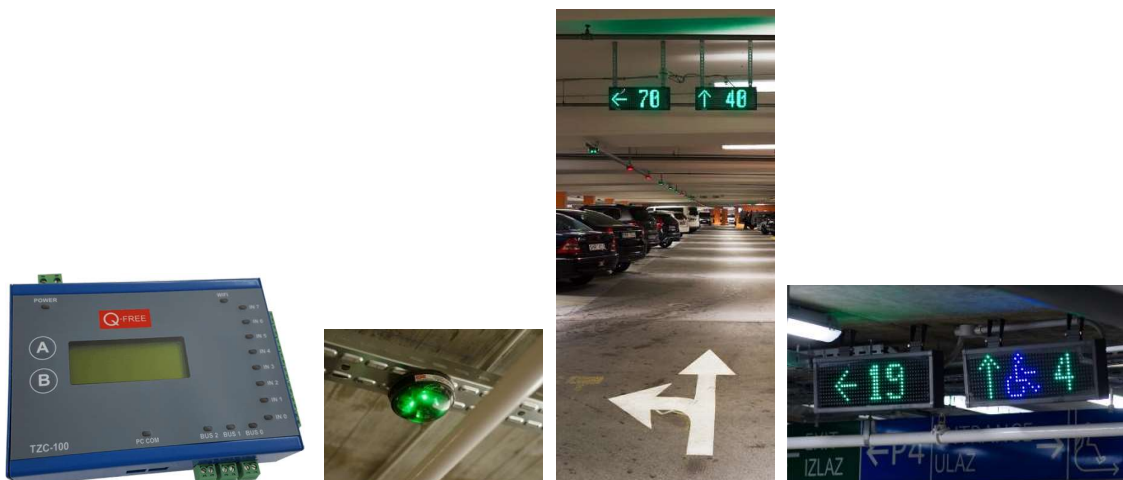
Two comprehensive systems are the main subjects of ElcomBgd integrated offer. These are **Parking Guidance System** and **Parking Management System**. The first one is oriented towards more efficient traffic process and parking capacity exploitation. The second one is access control system for parking facilities, dominantly oriented towards service payment. Very often these two systems are jointly implemented.

The structure of integrated systems offered by ElcomBgd (constitutive components and its common providers) are presented in corresponding tables.

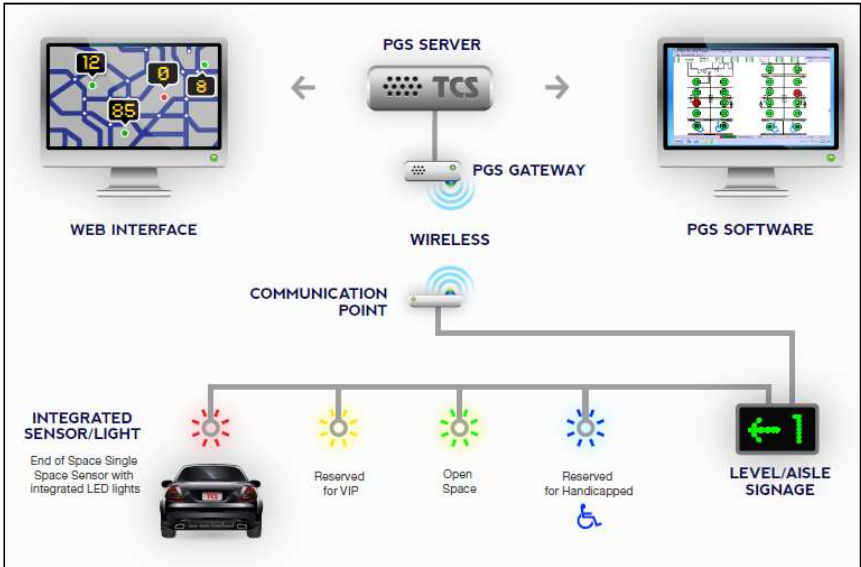
PGS – Parking Guidance System			
OUTDOOR		INDOOR	
DEVICES	VENDORS	DEVICES	VENDORS
Outdoor sensors	Sensys Networks, US World Sensing, E	Indoor sensors	Q-Free TSC, US
Gateway	Sensing, US World Sensing, E	Zone controller	Q-Free TCS, US
Back office	ElcomBgd	Back office	ElcomBgd
Outdoor VMS	ElcomBgd	Indoor VMS	ElcomBgd
		Outdoor VMS	ElcomBgd

Parking Guidance System in general consists of:

- single parking space sensors, for detection occupancy status of each parking position; In outdoor version sensors embedded in carriageway or floor construction are used, driven by microwave or magnetic technology; In indoor version, sensors are mounted above parking position, detecting the presence of vehicle using infrared technology;
- Gateway is device which provide information collecting from from large number of individual outdoor sensors, and its processing; Commonly, the sensor manufacturer provides the corresponding gateway for his sensors; For indoor system Zone controller is playing the same role, controlling 32 sensors each;
- Back office for the PGS systems are provided by ElcomBgd, as a system integrator. Taylor made software solution for each individual PGS implementation provides the best integration and mutual compatibility of devices and subsystems from different origins and performance;
- ElcomBgd LED VMS displays in outdoor and indoor versions cover variety of information presentation formats commonly required by client; For indoor objects outdoor VMS displays are usually also used for advanced information for users on approaching street network or in front of parking object.



PGS system components: Zone controller, Single space sensor and VMS displays



PGS integration provides and distributes information for different user oriented services



PGS summarized information for the facility and its different leveles



Composite VMS displays presenting free parking capacities in refferent surrounding

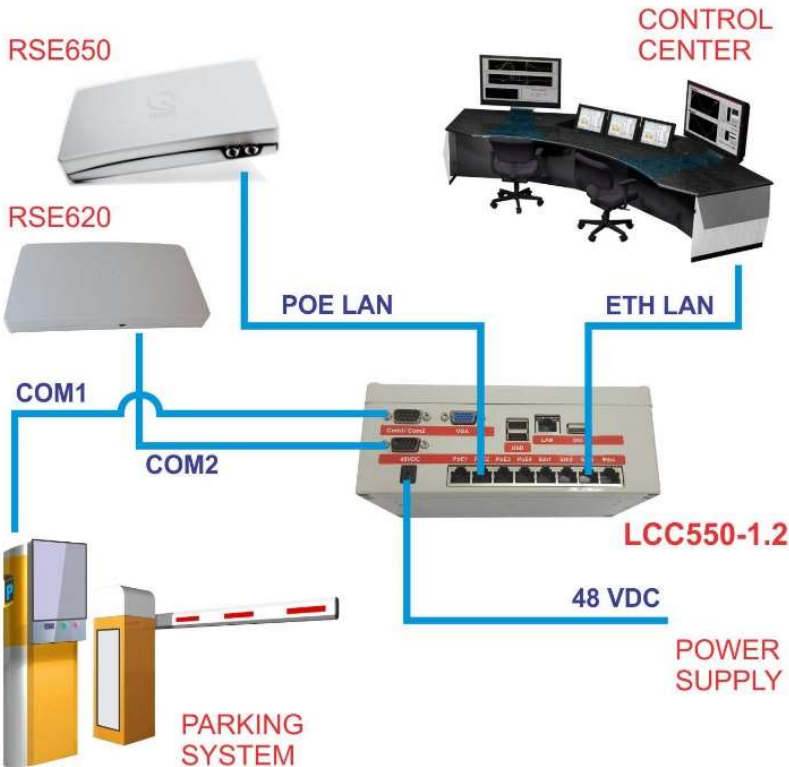
PMS – Parking Management System	
DEVICES	VENDORS
Barriers	BFT, I ELKA, D
Cash/ card machine	BFT, I
ALPR system	Q-Free, N, Intrada, NL ARH, H
Controller/ TAG/ DSRC	ElcomBgd, Q-Free, N
Outdoor VMS	ElcomBgd
Indoor VMS	ElcomBgd

Parking Management System is access control system dominantly oriented towards parking charging function. For such delicate function, its reliability, accuracy, privacy protection and other features, very sophisticated equipment and solutions should be provided:

- Physical barriers (different types of ramps) are commonly used for users direct access control at the entrance and before leaving the parking system space;
- For direct payment card machine are commonly used, operating with bar code cards or with conventional credit cards (e.g. VISA, Master, etc.);
- ALPR system provides user identification based on licence plate number, so user can be charged for using parking service by some type of e-banking service; The common option are contract payment based on prepaid or postpaid method, web payment, etc;
- Remote wireless communication between PMS and user is provided through implementation of advanced LCC555 Universal Parking Controller, developed by ElcomBgd, and Q-Free TAGs and DSRC devices;
- VMS displays of different formats and features are commonly used at different positions around the system, as well as in front of object entrance, providing comfortable and useful information exchange between system and user.



Barrier, entry/ exit terminal with user interface, and ANPR cam for identification confirmation



Parking facility access control integrated via LCC550 Universal parking controller