IPICO Application Note : Automated Vehicle Access Control

Vehicle Access Control & Monitoring Systems

IPICO's® products, based on radio frequency identification (RFID) technology, are being used to provide everything from automated, controlled access to accurate, electronic collection of parking and toll fees - resulting in significant time and money savings. By combining this leading-edge technology with sophisticated software for billing, reporting, and revenue collection, IPICO is able to provide cost and time efficiency to toll operators, parking garage operators, gated community managers, and corporate and municipal parking facilities.

Traditional manual or mechanical systems require drivers to stop, roll down their windows, swipe a magnetic stripe card, wave a proximity card, type into a keypad, or speak to a guard, to gain access. In contrast, IPICO's non-stop system lets vehicles flow quickly through gates and controlled entrances, or spotting stations at full highway speed.

RFID controlled entrance – Reader circled.

The Benefits

- Non-stop, hands-free operation
- Reduced traffic backup at entrances and exits
- Increased personal security
- Discreet control of security authorisation by identification
- Low maintenance and repair costs
- No ticket-issuing machines
- No equipment in the lane that can be damaged by vehicles
- Tags have a life of many years unless damaged – cannot be lost or wear out
- Automated operation of remote or unmanned gates
- Convenient access for the disabled
- Automatic vehicle inventory monitoring
- Automated fee collection
- Intelligent access control, e.g. only certain vehicles can enter after hours
- Optional Wiegand output from reader

Tag on windscreen

Required components

- UHF Readers. The High Performance readers can be used mounted above the roadway (as in the picture above), or above an entrance to a building.
- UHF tags. The **ENP label tags** are 170 x 10 mm in size, and are adhesively attached to the windscreen. If attached correctly, they cannot be removed intact. For vehicles without windscreens, the **Industrial vehicle tag** or **Industrial On-Metal tag can be used**. These are weather proof long range passive tags, and can be mounted onto body-work of the vehicle.
- Controller. This must be supplied by the System Integrator, and is required to control readers, receive ID numbers from the reader, and operate the access boom or gate and any other hardware devices, e.g. displays or alarms. Depending on the design, the controller may upload the tag data to a network where the tag IDs are checked against a database or the controller may check against its own local database.
- Network connection. Unless the Controller contains a local database, a network connection will be required.

Group

IPICO INC
Ontario, Canada
tel: +1 905 631 6310
fax: +1 905 631 6614
info.can@ipico.com
www.ipico.com

Operations

South Africa

Pretoria
tel: +27 12 345 9520
fax: +27 12 345 5834
info.sa@ipico.com

Australasia

Clontarf, Queensland
tel:+61 7 3889 5799
fax: +61 7 3889 5980
info.aus@ipico.com

North Asia

Shanghai, China
tel: +86 21 5080 0345
fax: +86 21 5027 8271
info.cn@ipico.com

China

Beijing, China
tel: +86 10 8280 0541
fax: +86 21 8280 0546
info.cn@ipico.com

Europe

Valence, France
tel: +33 475 443 238
fax: +33 475 443 238
info.europe@ipico.com

USA

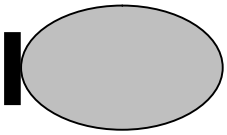
Georgia, USA
tel: +1 770 552 9654
fax: +1 404 601 9679
info.usa@ipico.com

Factors to consider in designing the system

- **Height of the access entrance** With a power setting of 0.5 W ERP, the general limit in Europe, 2 to 3 metres read range will be obtained. This is adequate for building vehicle access purposes. For toll gate applications and open road traffic monitoring, higher power is required, e.g. 4 W EIRP, which will result in a minimum range of 5 metres, . Depending on the physical constraints of the location, overhead or side-mounted readers can be used.
- **The type of vehicle**. In most cases the 170 x 10 mm ENP tag will be used. However, if the vehicle does not have a windscreen (e.g. a tractor), then the Industrial Vehicle tag can be fitted to any surface of the vehicle, metallic or non-metallic, or the Industrial On-Metal tag can be used, but this should only be used on metal surfaces.
- For **automatic control of a gate or boom**, an application-specific controller is required. This is typically a device (e.g. a PLC) which can receive reader output via RS232, Wiegand, or Ethernet connection, with output switches to control external hardware, e.g. a gate motors. It must also either (1) carry out local verification of tag IDs, which means that it must check each tag ID against its own local list previously downloaded from a computer or network, or (2) be able to operate the gate or boom in response to an instruction from a remote networked computer.
- The **number of access points**. One reader per traffic lane is required. The IPICO I-PX protocol allows all the readers to operate on a single UHF frequency. Each gate or boom will require its own control, and depending on the system architecture, a controller could service several access points.
- **Authorisation of access**. This is specific to the particular application, and depends on issues such as whether billing is done (monthly or per entry), or whether a simple verification of tag IDs is sufficient. In every case, the controller must receive an instruction to effect access, or if so designed, it requires a list of authorised

Positioning the Readers

The Reader RF beam size (the volume where tags are readable) depends on the power transmitted, and looks something like this:



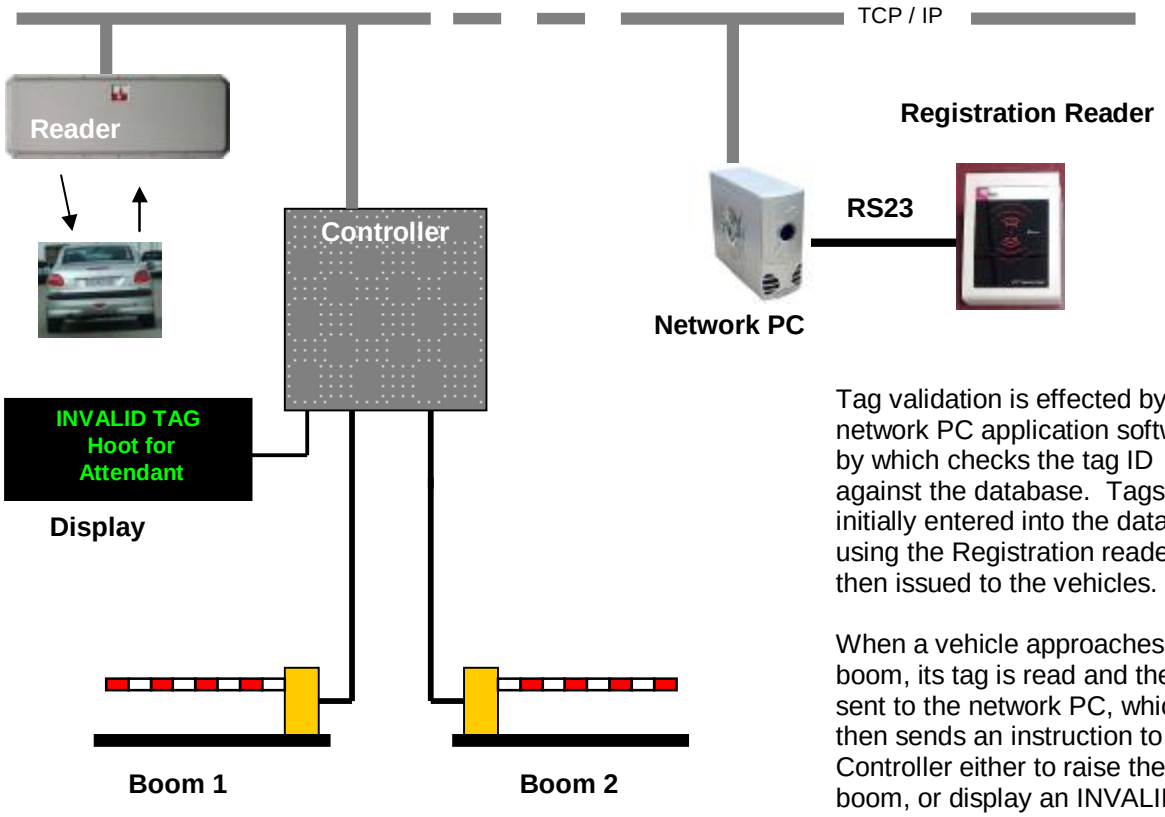
The width is about half the length at the half-range point, and varies according to the transmitted power. At 4 W EIRP, the beam is about 7 x 3.5 m, whereas at 0.5 W ERP it is about 2.75 m x 1.4 m. The shape and size of the beam varies when other objects, like cars, are nearby. Depending on the size of the read zone, that is, the reader beam, readers can be positioned either above the lanes, or at the side. In all first time implementations, some experimentation may be required.

Overhead readers generally are more easily positioned optimally to cover only one lane. Readers at the side may require more care in setting up, but can be made to work reliably. In one application the side readers were placed at a height of 2.1 m, and angled at 45° to the lane. This proved to be optimum in that case, and would be a good starting point for other applications. The use of humps in the road to encourage cars to allow a longer following distance, or magnetic sensor loops to activate the reader only when a vehicle is in the reader beam, are not normally necessary. If it is necessary, in the unusual case where a vehicle's tag is read both by the reader covering the lane, and by a reader covering another lane, the correct reader can still be determined. The software compares the read rates (the number of tag IDs transmitted per second) from the readers, and selects the reader with the highest rate.

Antenna polarisation:
High performance Readers are produced with both with circularly polarised and linearly polarised antennas. It has been found that linearly polarised antennas work better (since the tag orientation is horizontal), and a special High Performance reader, HPEVI reader, with linearly polarised antennas is available for Electronic Vehicle Identification applications. In general, HPEVI readers should be mounted horizontally, so that the tag and reader polarisations are aligned. If horizontal mounting of the tags cannot be guaranteed, then circularly polarised readers should be used.

The whole system

In the diagram below is shown a possible configuration for a vehicle access system. In this application a controller is used for to operate the boom mechanism. The tag ID's are sent via the network to a remote PC which checks the validity of the tag ID, and if authorised, it sends an instruction to the boom controller. The PC is also connected to a Registration reader which is used for reading tags before mounting and allocation to vehicles. As tags are read and allocated, the database is built up.



Tag validation is effected by the network PC application software by which checks the tag ID against the database. Tags are initially entered into the database using the Registration reader, then issued to the vehicles.

When a vehicle approaches the boom, its tag is read and the ID sent to the network PC, which then sends an instruction to the Controller either to raise the boom, or display an INVALID TAG message if the tag is invalid.

EXAMPLE: IMPLEMENTING AN AUTOMATIC GATE CONTROL

Other issues

- **Design of the Controller**
  This is specific to the particular application. The diagram above shows one way of implementing a system. There are many other possible configurations, depending on the hardware used, how much computing power is resident in the Controller itself (e.g. whether validation is a Controller function.)
- **Checking suspect tags**
  A Mobile reader can be used to read tags to check functionality or authenticity**.**