Vehicle License Plate Recognition (LPR) with Digifort software, version 2.3 – 06/2013 | Camera Positioning Tutorial

The objective of this tutorial is only "to provide suggestions" as to how to ideally position the cameras that will run along with the optional Digifort LPR module. Our intention is not to make an expert out of you, since that even Digifort itself recommends that all of its integrators take a course at a specialized company, in order to enhance their knowledge on this infrastructure. Digifort's responsibility is limited exclusively to the operation of the DIGIFORT LPR software.

Digifort works with the CARMEN engine. Below, we will briefly talk about this license.

1. Use of the CARMEN INTERNACIONAL license

The commercialization process of this license is BY COMPUTER PROCESSOR CORE; therefore, depending on the process to be used, one license for one core can process one or several cameras.

- Carmen FreeFlow Single License = for one core
- Carmen FreeFlow Single Dual = for two cores
- Carmen FreeFlow Quad License = for four cores

This is a license that requires adequate camera positioning; therefore, it is important for the camera not to be crooked and the plate to be horizontally straight in order for a good result to be achieved (30 degrees on the side between the camera and the license plate). There is also the demand for a proper framing as shown below.

There is no minimum speed required for the reading of vehicles in motion, what also enables installations in shopping centers, parking lots, and supermarkets, where triggers cannot be used. In the case of stationary vehicles, the reading will have to be started by means of a trigger, (inductive sensor, infrared sensor, parking access push-buttons, etc.) When the reading is done by means of a trigger, it is important to use an Ethernet I/O module that will be connected to the sensors to start this reading without delays. The trigger can also be done through the Digifort global event, in other words, external software can send the reading command to Digifort and at that time the plate is read.
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An example of this is the operations in shopping centers, supermarkets and parking lots with tollgates. As soon as the driver stops the vehicle, he pushes a button to collect the ticket and at that moment the command is sent to Digifort, which automatically performs the reading, but we remind you that the proprietary company of the software that issues the tickets at the tollgate will have to integrate Digifort to its product. For this process, Digifort provides the APIs.

The difference is that in the case of using this license with a trigger, a single license for one core can process more than 6 to 10 cameras simultaneously, as long as all of them are on the same net, making the entire process less expensive.

1.1 HOW DOES THE LICENSE WORK?

We will use a computer with 4 processing cores as an example. On installing the Single License, only one core will be activated; if installing the Dual, two cores; if installing the Quad License, four cores.

If you are using the Single License, performing the plate reading with a vehicle in motion, this computer, even though it has 4 cores, can only process from one to four cameras, depending on the vehicle speed and the number of simultaneous readings. This happens because license plate readings of vehicles in motion demand greater processor use.

The chance of processing more than two cameras with speeds over 100 km/h is minimal.

If you are using the Quad License, under the same conditions listed above, you will then have the chance of processing up to 8 cameras on the same computer at high speeds or more than 20 cameras with the activation of a trigger (parked cars).

For the official license, a Single, Dual or Quad, a Hard-key is sent. This license cannot be used in virtual machines.

An exclusive server for the LPR is required.

For being a worldwide license and already consolidated in the market, it is not available for testing.
2. HOW TO POSITION A LPR CAMERA?

Some steps must be followed to achieve greater results from the LPR Module.

2.1 Streets, Avenues, roads and highways.

Reading of vehicles in motion, without a trigger.

- Ideal Camera Positioning is at approximately 3.5 to 4.8 meters high.
- and at 30 degrees sideways between the camera and the vehicle’s license plate.
- The camera mounting pole should be installed next to the curbside.
- Install the pole at an approximate distance of 15 to 20 meters from the point of the license plate reading for vehicles in motion.
- Use a 50 to 80 mm lens for a good focus of the plate area without a lot of "visual pollution" (other scenes apart from the front or rear of the vehicle).

- Work with a Frame Rate of 20-30 fps.
- Use cameras with high power shutter for vehicles in motion.
- Use image quality from CIF to 4CIF under MPEG-4 or H.264.
- For vehicles in motion, consider maximum speeds of 150 km/h.

2.2 Shopping Centers, parking lots, supermarkets, condominiums and other places with tollgates.
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Reading of vehicles in motion, without a trigger, with speeds under 30 km/h.

- Ideal Camera Positioning is at approximately 1.5 to 2 meters high and at 30 degrees sideways between the camera and the vehicle’s license plate.
- Install the camera at an approximate distance of 4 to 7 meters from the point of reading.
- Use a 12 mm lens or greater for good focus of the plate area without a lot of "visual pollution" (other scenes other than the front or rear of the vehicle).
- Work with a Frame Rate of 20-30 fps.
- Use cameras with high power shutter for vehicles in motion.
- Use image quality from CIF to 4CIF under MPEG-4 or H.264.

2.3 Shopping Centers, parking lots, supermarkets, condominiums and other places with tollgates.

Reading of STATIONARY vehicles, using a trigger.

- Ideal Camera Positioning is at approximately 1.5 to 2 meters high and at 30 degrees sideways between the camera and the vehicle’s license plate.
- Install the camera at an approximate distance of 4 to 7 meters from the point of reading.
- Use a 12 mm lens or greater for good focus of the plate area without a lot of "visual pollution" (other scenes other than the front or rear of the vehicle).
- Work with a Frame Rate of 20-30 fps.
- IP cameras can be used for stationary vehicles.
- Use image quality from CIF to 4CIF under MPEG-4 or H.264.
- Use Ethernet I/O modules together with Physical Sensor (infrared sensor, inductive sensor, push-buttons, etc.) to enable the reading of stationary vehicles, or to perform the integration of the ticket-issuing software with Digifort, so that when the user pushes the button to issue the ticket, the command is sent to Digifort to perform the reading.

Note: The system allows the automatic opening of the tollgate as soon as the plate is read. This process depends exclusively on the needs of each customer. The system further allows the identification of non-authorized vehicles, if these are registered on the system, automatically sending e-mails to the responsible parties as well as several other features.
3. Comparison of Cameras for LPR use

Analog cameras are more recommended to work with motion, but can also be used for stationary vehicles.

When working with vehicles in motion above 60Km/h, we should choose cameras that have a good shutter to stabilize the image and to avoid traces or image shaking. However, on using an analog camera we must make use of a Video-Server, and since we will have to work with a frame rate of 20 to 30 fps, we cannot use a Video-Server with a high delay.

Some IP cameras already show some efficiency in their Shutter, therefore, they can be used for high-speed processes, but it is important for you to check with your camera manufacturer to obtain guarantees about this feature.

Any IP cameras can be used in conditions where the vehicle is stationary, such as at the entrance of condominiums, parking lots, shopping centers, etc., where the vehicle stops at a physical obstacle, such as a tollgate, gate, etc. Some IP cameras with automatic shutters can also be used for vehicles in motion at speeds around 10 to 60 km/h.

3.1 Megapixel Cameras

These days, high-resolution cameras provide images of over 10 Megapixels. But, the Digifort LPR works with a resolution of 320 x 240, 352 x 240 (CIF), or 640 x 480 even if the camera used is a megapixel one. If the camera image being sent to Digifort is high resolution, this will increase the machine's processing due to the need of redimensioning the image before it is forwarded to the data base for analysis and identification; therefore, the use of Megapixel cameras is not required in this process.

4. Virtual Sensor and Physical Sensor

The Digifort LPR Module can be triggered in two ways:

- By the Virtual Sensor that is triggered by motion detection;
- By the Physical Sensor that is triggered by a sensor, such as an infrared barrier, a magnetic sensor or the push of a button to issue a ticket.

The Virtual Sensor does away with the use of a physical device to allow the software to trigger the cameras through motion detection, but uses the server's processing resources, demanding a lot more from the machine.

For the Physical Sensor, it is necessary the use of a sensor, such as the ones mentioned above, as well are requiring the use of an Ethernet I/O module to trigger the reading. We do not recommend to use the cameras I/O or from the video-server to perform this triggering due to the delays in delivering this information to the server.
5. Use of Lenses for license plate reading cameras

The proper lenses to be used in cameras for reading vehicles in motion are the 50 to 100 mm ones, (streets, avenues, roads, highways) as the position of the camera in relation to the point of reading is too distant and as previously stated, the more in focus the license plate is, the better the reading.

The proper lenses to be used in cameras for reading stationary vehicles are the ones of up to 16 mm, (shopping centers, condominiums, parking lots, etc.) since the position of the camera in relation to the point of reading is not too distant, and as previously stated, the more in focus the license plate is, the better the reading.

6. License Plate reading at night

There are no great problems to perform the reading of a license plate on a vehicle during the day, but at night the conditions are totally adverse and in order for the software to work properly, ideal illumination conditions are necessary, as in any existing LPR process.
Character reading under adverse conditions (low luminosity, heavy rain, etc.) depends on a good infrastructure and special equipment.
Night vision cameras, which adapt to the environment, cameras that allow the decrease of headlight intensity or even that allow the placement of dark masks on these headlights and good infrared illuminators, are key parts for the success of this operation. It is worth considering that license plates with red background (on trucks) can have a high rate of reading failure at night, as when the infrared is activated, there may be no license plate contrast, depending on plate paint - this is a physical and not a technical issue.

6.1 Some suggestions (streets, avenues, roads and highways)

- The illuminator must maintain a minimum vertical distance of 40 cm from the camera and have the capacity of reaching a minimum distance of 20 meters.
- The front transparent shield of the camera’s protection box must be made of quartz crystal, since glass absorbs from 60 to 70% of the infrared rays.
- The camera must, by means of preset configurations, recognize that the illuminator started working at a preset time.
- The camera must be designed for night use and with a high power shutter.
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- For night reading, for now, we suggest analog cameras with video-server, meant exclusively for this use and with the capacity of identification for night operation, activating the illuminators, but there are already some IP cameras meant specifically for this purpose. Check with your camera manufacturer. For more information, we ask you to request more information directly to the manufacturers of illuminators in the market. If you have any questions, ask Digifort.

7. Examples of Digifort LPR applications

We can use LPR in situations where there are vehicles in motion or stationary. Next, we present you with illustrations of some already-tested applications.

7.1 Vehicle in motion: reading via Virtual Sensor

![Diagram of a vehicle in motion with a Virtual Sensor]

In this case, the identification of the vehicle's license plate will be done while the vehicle is in motion, requiring the camera to have a good quality shutter for better image stabilization. The trigger for plate reading, in this case, will be done by the Virtual Sensor, that is, by motion detection. In this case the use of Physical Sensors, like an inductive / magnetic sensor or an infrared barrier, is dispensed, but demands much more from the server's processor.
In this image you can see how the framing should be done, limiting the camera focus to a little beyond the vehicle’s bumper. The sides of the vehicle are basically at the side limits of the image.

7.2 Stationary vehicles whose reading will be done by Physical Sensor

In this next case, the vehicle is forced to stop at an obstacle (infrared barrier, magnetic/inductive sensor, or the need to push a ticket button):
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The vehicle approaches the tollgate where it is forced to stop upon reaching the magnetic sensor area, the infrared barrier, or the need to push a button, and then the triggering is done through the Ethernet I/O Module connected to this equipment or via software. Since this triggering is done from a physical device or software, it will use a lot less processor resources to perform this reading.

7.3 Vehicle in motion or stationary, where the reading will be done by physical or Virtual Sensor with an automatic tollgate opening system

In this next case, we have an example of Digifort integration with an automatic tollgate opening system.

The vehicle approaches the entry point at low speed, and has its plate identified. At that moment Digifort, which is integrated with the tollgate system, fires an event to automatically allow or deny the vehicle's entry.

The same process can be done using a Physical Sensor.
8. How to install an inductive sensor

It has to be placed at a depth of about 4 cm or where it can be set completely below the ground's surface. The enclosing can be done with cement, tar or any other type of material that can cover the entire sensor.

NOTE: The cable leading off from the sensor, in general, is not long enough for the installation and in this case, a coupling must be done using 1.0 mm wires. The wires must be welded at each end. This new extension must have its wires completely interlaced, from the welding point to its arrival at the I/O module. As a suggestion, use a power drill to interlace the wires by placing the ends of the wires in the drill and turning it on. The wires will become completely interlaced. Under no circumstances you should bend the wires or pass the wire over itself. Consult a specialized company if you choose to use this method.

9. LPR Server suggestions for the Digifort LPR system with the International CARMEN International license

As a basis, we will use a mod. 960 Intel Core I7 server.

Example 1: License installation in highways with speeds of up to 150 km/h where the reading is done by motion detection. Depending on the type of license acquired and the reading speed, this server will hold until 8 cameras (Quad license), remembering that the license is for each processor core.

Note: The use of FIBER OPTICS is recommended between the cameras and the central server. Other technologies, such as radios, 3G or concessionaire lines must guarantee that the quality of transmission needed in this process in order not to interfere with OCR readings.

Example 2: License installation in parking lots, shopping centers, gates, etc. with vehicles in motion. Due to the low speed, this server will hold about 4 or more cameras with a single license, remembering that it is one license per core.

Example 3: License installation at parking lots, shopping centers, gates, etc. with a stationary vehicle where the reading is done by Physical Sensor.
As the reading will be done with the vehicle almost stationary, this server will hold about 08 or more cameras with a single license, but will depend on the volume of existing traffic between the entries, remembering that it is one license per core.

Note: In the case of examples 2 and 3, the network that interconnects the cameras can be fiber optics, UTP cable, wireless, concessionaire lines.

The better the server’s processor, the greater will be the possibility of processing several cameras simultaneously.

**IMPORTANT SUGGESTION:** In case of urban installation, for streets and avenues, whenever possible, we suggest the installation of a physical speed bump at the point of plate reading. This will make the reading more efficient and will use less equipment resources due to the need of decreasing the speed.

## 10. Suggestions in how to acquire the Digifort LPR system

The Digifort LPR is composed of a Server Base license (DGFLP1000V1) and camera license (DGFLC1101V1).

To use the Digifort license plate reading system, the customer must have Digifort surveillance installed. If the customer does not have Digifort surveillance, he should then get one of the following versions: Standard, Professional or Enterprise as well as acquiring the desired number of camera licenses (additional packs) corresponding to the quantities of LPR licenses.

**Example 1:** The customer does not have Digifort and wishes to use 8 LPR licenses, he acquires the Professional Base version (DGPR1008V6), as well as the Base LPR SERVER (DGFLP1000V1) and 8 Carmen LPR licenses for 8 cameras (1 x DGFLC1104V1). The example was done using the Professional, but it is valid the Standard and Enterprise as well.

**Example 2:** The customer already has Digifort surveillance and wishes to use the existing fixed cameras to run 4 LPR licenses, then he must acquire the Base LPR SERVER license (1 x DGFLP1000V1) and 4 Carmen LPR licenses for the cameras (1 x DGFLC1102V1) and will be able to run these licenses in any camera he chooses.

**Example 3:** The customer already has Digifort Professional surveillance with 32 cameras and will acquire 4 additional cameras exclusively for LPR. In this case the customer will
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have to acquire 4 Digifort surveillance licenses (1 x DGFP1104V6) + Base LPR SERVER license (1 x DGFLP1000V1) + 4 Carmen LPR licenses for the cameras (1 x DGFLC1102V1).

Note: All of the examples above were done based in virtual readings, that is, per motion. If the reading process is done by means of a Physical Sensor, in addition to the licenses above, the customer must acquire the I/O module license, which will trigger plate reading.

10.1 Along with the LPR Base Server, the distributed server is provided for free.

If the customer acquires two or more LPR servers, the server system will then work as Fail Over, that is, if one fails the other will automatically take over the functions without human intervention and will manage the loads between them; however, the secondary server has to have as many additional licenses installed as there are at the main server and that it has the processing capacity to take over the primary server failure.

- Due to the importance of the plate reading process for the due recognitions, we suggest the use of an exclusive server for this purpose.

11. USE IN A CENTRALIZED OR DECENTRALIZED NETWORK

The LPR system is much used in cities, shopping centers, parking lots and condominiums, and can be with a centralized or decentralized infrastructure. Let us study both options here:

11.1 CENTRALIZED NETWORK VIA VIRTUAL SENSOR

11.1.1 For condominiums, shopping centers, parking lots, businesses, except highways, streets and avenues

The LPR Server is centralized in a set place and has the capacity of processing all the installed cameras. For this, the infrastructure used can be fiber-optics, UPT cable or radios, as long as they allow the transmission of data demanded in this process.

Depending on the type of camera used, up to 1 MB of bandwidth may be needed per camera, without any loss of packets, for data transmission and recognition at the server; therefore, on using wireless radios, you must assure enough bandwidth per camera.
11.1.2 For highways, streets and avenues

The LPR Server is centralized in a set place and has the capacity of processing all the installed cameras. For this, the suggested infrastructure is fiber-optics to assure image capture. Radios, 3G and concessionaire lines can be used as long as there is assurance regarding the required transmission bandwidth.

11.2 CENTRALIZED NETWORK VIA PHYSICAL SENSOR

11.2.1 For condominiums, shopping centers, parking lots, businesses, except streets, avenues and highways

The LPR Server is centralized in a set place and has the capacity of processing all the installed cameras. For this, the infrastructure used can be fiber-optics, UPT cables or radios, as long as they allow the transmission of data demanded in this process, BUT, IN THIS CASE, an Ethernet I/O module is installed and connected to the infrared or magnetic sensors that are responsible for starting the reading, this is the so-called trigger.

The CENTRALIZED NETWORK way is the most indicated for these processes, since they use less equipment and its administration and maintenance is much simpler and less expensive.

11.2.2 For highways, streets and avenues

We do not recommend the use of Physical Sensors on streets, avenues, roads. We suggest performing the reading always via a Virtual Sensor.

11.3 DECENTRALIZED NETWORK VIA VIRTUAL SENSOR

If there is no possibility of taking the camera network to a centralized place, then it will be necessary to use a Digifort surveillance server and LPR as close as possible to the desired camera, even if you must place it inside special boxes and place them on the poles next to the camera.

In this case, to access the information, you will need to install a good-quality Internet line on this pole, thus enabling the remote access to receive the information and perform maintenances.
12. FAILURES IN LICENSE PLATE READING

License plate reading failures are a lot related to the inadequate positioning of the cameras, incorrect configurations, use of unsuitable cameras, dented, bent or unreadable license plates, insufficient lighting, direct sun light on the lens and other atmospheric conditions.

12.1 Use one camera per lane where you wish to perform the process.

12.2 The LPR camera is meant exclusively for this purpose, and should NEVER be used for surveillance.

12.3 Use an illuminator per camera.

12.4 Read the Digifort LPR manual to learn how to install and operate the functionalities of our software and strictly follow the instructions.

This tutorial can be altered at any time without previous notification.

REFERENCES

Ethernet I/O Modules for license plate reading triggers

Commbox / Mr. Marcelo (tel.: +55 51 3026-2300 or +55 51 8124-4095)
Email: MARCELO.ANTUNES@COMMBOX.COM.BR

COMMS5 / Mr. CLAYTON OLIVEIRA (Tel: +55 11 2309.7335)
Email: CLAYTON@COMM5.COM.BR