VaxALPR on PC

User Manual

April 2022

Version 4.0

Contents

Introduction

VaxALPR is a license plate recognition application developed by Vaxtor Recognition Technologies for the most demanding scenarios using our proprietary OCR engine.

This user manual will guide you through the installation, configuration and result publishing procedures. It also includes some tips about camera setup and configuration to maximize the ALPR analytics performance and plate read accuracy.

Main functions

- Manage one or more ALPR cameras from a single application (max 32 per application depending on speed of traffic and resolution of cameras)

- Review real time video whilst performing ALPR analytics

- Run in visual 'application' mode or silently as an operating system (Windows) service

- Switch ALPR analytics between more than one group of cameras

- Supports additional environment cameras (otherwise known as color overview or contextual cameras) associated with the ALPR camera

- Runs in free-flow mode, no external signals are required to trigger the OCR

- Supports a wide variety of default camera manufacturers and models

- Generic ONVIF and RTSP support for legacy camera connections

- Support for recorded video processing

- Additional analytics are available including: vehicle direction, plate color, ADR, Etc.

- Plate reads are saved directly to the hard disk

- Results can be transmitted in real time through TCP/IP sockets, HTTP-POST XML or JSON etc.

- Integrates with the VaxALPR real time results transmission mechanism

- VaxALPR uses the proprietary Vaxtor OCR Engine designed and developed by Vaxtor Recognition Technologies.

Software License options

Once installed, VaxALPR activates a default 30 days trial license.

In order to obtain a commercial perpetual license, please contact info.eu@vaxtor.com

Operating system and software requirements

- Operating System: Microsoft Windows 8 or above (64 bit)
- Microsoft Visual C++ 2015 Redistributable Package (x64)
- MS Framework 4.5.2
- A valid VaxALPR license installed (trial or perpetual)

System requirements and PC specification

Computer specifications will heavily depend on the type of camera scenarios you are going to manage and the number of cameras to be managed simultaneously from the PC.
Please contact us for advice.

RAM memory usage

Your system should have at least 0.5 GB RAM available per ALPR camera. This should be taken into consideration when running a significant number of cameras from a single PC, for example, a deployment with 16 ALPR cameras may require at least 8GB of RAM.

Computer Processor

Taking Intel as a benchmark, the processor required depends on the vehicle speed, camera horizontal angle (it should be below 25 degrees) and the camera vertical angle (it should be below 30 degrees).

These rules are valid for most scenarios but there are many cases where these guidelines may not apply such as ALPR cameras mounted on vehicles, high angled cameras, cameras monitoring vehicles along tight curves etc.

- **Access control, low speed traffic, camera 10 FPS or less**:
  Intel 2.0 GHz with maximum 2 ALPR cameras per virtual core (thread)

- **Urban environment, medium speed traffic, camera 15 FPS or less**:
  Intel 2.5 GHz with maximum 1 ALPR camera per virtual core (thread)

- **Highway environment, high speed traffic, camera 25 FPS or less**:
  Intel 3.0 GHz with maximum 1 ALPR camera per virtual core (thread)

- **Special high-speed traffic, camera 25-50 FPS:**
  Intel 3.5 GHz maximum 1 ALPR camera per physical core

This guide is indicative only. It would be possible to achieve many other valid combinations, for example using an Intel i7 4.0 GHz to manage 4 ALPR cameras per virtual core in an access control environment meaning that up to 32 ALPR cameras could be processed from one single but powerful PC.

In order to manage larger deployments with multiple ALPR cameras we recommend considering high-end XEON and i9 architectures.

Licensing

30 days trial license

Option 1

- Read the VaxALPR Installation section below. You can then run the "VaxALPR Requirements" software and install the trial license from there.

Option 2

- Run **license_trial.bat** manually to install the SafeNet environment and VaxALPR trial license.
  (SafeNet is a commercially available software protection system)

Commercial software license

Commercial licenses are available in both hardware key (USB dongle) or software formats.

- On your PC select the where VaxALPR has been installed and run the application **license_perpetual.exe**
- Select the main Tab '**Collect Status Information'** and click on the '**Collect Information'** button at the bottom and when prompted and save as the suggested .c2v file somewhere on your hard drive. E.g. Desktop
- E-mail this file to info.eu@vaxtor.com
- You will receive a permanent commercial software license (.v2c file) in 1-2 working days. Copy this to your PC (Again the Desktop or Documents directory for example)
- To install this file and license the software, run the application **license_perpetual.exe** once more and select the '**Apply License File'** main tab and upload the "v2c" file you received by clicking on the three dots bottom right to select the directory where it is stored and click Open. This will convert your demonstration license into a commercial one.

Commercial hardware license (USB)

- Request a hardware license by e-mail info.eu@vaxtor.com
- You will receive a USB key by courier in approximately 3 working days

Additional notes

- Trial licenses are not available for a virtual machine environment
- Commercial licenses for virtual machines are only available in USB dongle format
- Once the trial license period expires, is **not** possible to deploy another trial license on the same PC nor expand the duration time of the license

We strongly recommend you to back up your system before installing a software-based key.

Note that you may also use this program to transfer a bought software license key to another machine by selecting the main Tab 'Transfer License'.   A hardware USB key may simply be plugged into another suitable computer to be able to run the software there.

VaxALPR Installation

Run **VaxALPR 4.0.exe** to install the VaxALPR software components onto your PC

- You must have administrator permission to allow the installer to register some of the software components. You normally can right click and 'Run as administrator'.
- Ensure the target installation directory has read/write permission. VaxALPR saves the configuration files inside its installation directory and so the directory must not be read only).

The package VaxALPR is made up of 3 different software components that will be installed:

- **VaxALPR Requirements:**   VaxAlprRequirements.exe
- **VaxALPR Lite:**   VaxAlprLite.exe
- **VaxALPR Viewer:**   VaxALPR.exe

VaxALPR Requirements

This program checks if the third-party software requirements are met and allows the trial license to be installed.

VaxALPR Lite

This program is the setup program where users can add ALPR cameras and configure how the plates should be read and interpreted. For example, the user may set the Plate syntax for the country or State where the system is being used, set any crop zones (regions of interest) for that camera or set the amount of time the program should track a plate before reporting it.
Once this scenario has been defined you should save it as an '.xml' file in the VaxALPR config directory for further use by the VaxALPR Viewer.
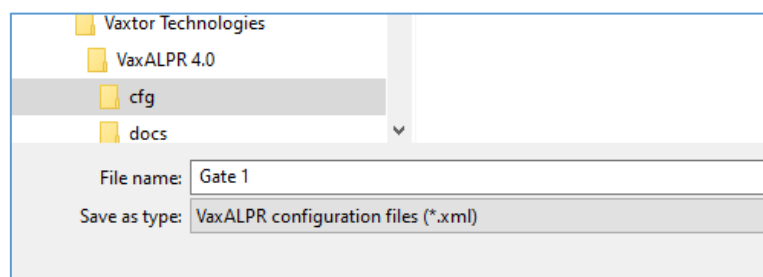
At this point you can test how the OCR works in your scenario by pressing the Play Button at the bottom.   Basic results (a text file of plates and their associated images) can also be saved to your hard disk. See below for details.

VaxALPR Lite can only handle 1 video stream at a time and is intended for setting up each lane (camera) and testing the OCR.   You must repeat this process for each camera and then connect them all to VaxALPR Viewer.

VaxALPR Viewer

This is the main application and is used to launch one or more ALPR lane or camera configurations as defined previously by VaxALPR Lite.

Once all of the ALPR cameras have been setup on this PC and the .xml files saved, run the VaxALPR Viewer. All of the ALPR cameras can then can be added one by one.

This software is basically an '.xml' files launcher and viewer to run in an unattended way passing plates to Helix-6 or other remote programs / Back Offices.

For example, if you have 8 ALPR locations (8 ALPR cameras) use **VaxALPR Lite** to configure the camera scenarios one by one, save the configurations to 8 independent .xml files and then use VaxALPR to group, launch and run the 8 cameras simultaneously.

VaxALPR Requirements

This software checks if the third-party software requirements (see section on Operating system and software requirements) are met including the existence of a valid VaxALPR License. You can optionally deploy the trial license directly from here.

You must have administrator privileges to run this software –
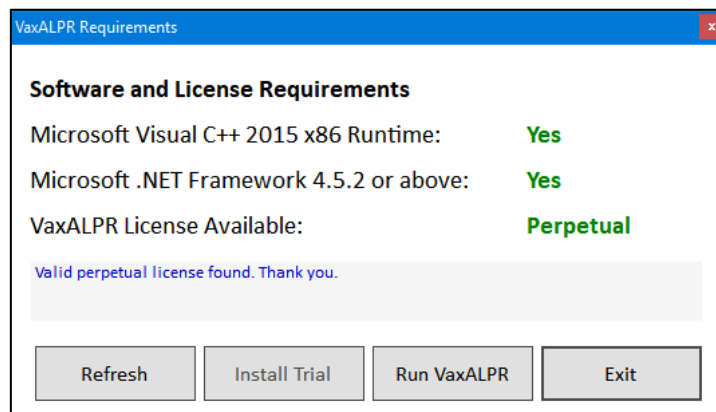
VaxALPR Requirements software

General overview of ALPR configuration

Achieving high accuracy rates in ALPR depends on the following factors:

- **Scenario:** Location of the ALPR camera in terms of distance and angles.
  This is the most important factor in achieving high accuracy. The installer should optimize the license plate character height (in pixels) and the perspective and angle of the license plate within the image.

- **Camera configuration:** High quality images increase OCR accuracy with the appropriate use of IR (Infrared), very low or no image compression, correct adjustment of the camera settings (WDR, shutter speed etc.), the selection of the right video resolution and frame rate and most importantly of all, by selecting the correct camera for the scenario.

- **OCR Technology:** The technology behind the OCR is a key a factor in obtaining high read accuracy – but all of these other elements play a major part.

- **OCR Configuration:** The OCR software MUST be configured correctly. No matter how great a camera we use and how advanced the OCR technology is, … if the configuration is not correct, plates will simply not be read.

Important
OCR technology not Plug and Play and it is important to take into consideration all of these elements together when setting up your system.

Camera Orientation

The image orientation is a key factor to achieve the maximum OCR efficiency. It is recommended that you stay below the following thresholds

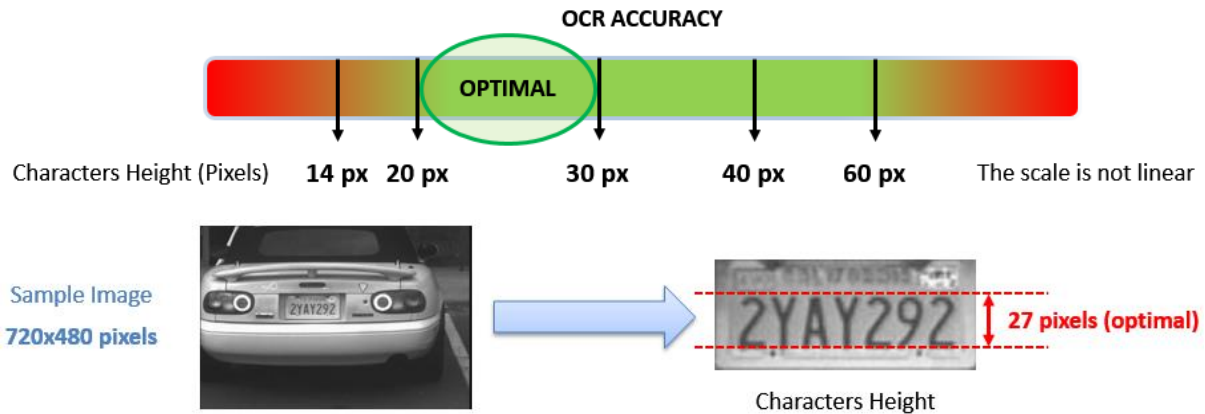|	Roll Rotation	Yaw Rotation	Pitch Rotation
	Below 25 degrees	Below 30 degrees	Below 25 degrees
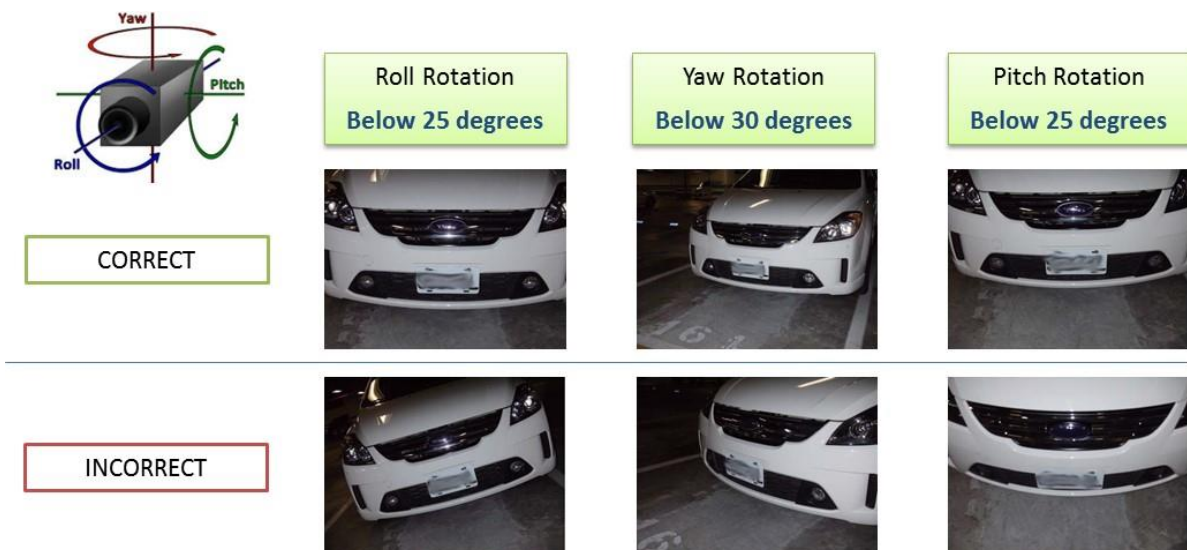
Examples of different camera orientations

Accuracy will decrease significantly if these guidelines are not adhered to.

Character pixel height

The most accurate way of measuring the size of the characters on a plate is to use the height of each character. The optimal range is from 20 to 30 pixels high.

OCR ACCURACY

Characters Height (Pixels) 14 px 20 px 30 px 40 px 60 px The scale is not linear

Sample Image
720x480 pixels

2YAY292

27 pixels (optimal)

Characters Height

By using the VaxALPR Lite settings, the OCR can be configured to read characters as low as 10 pixels high – or as high as +70 pixels high, but in order to maximize reading accuracy and not waste processor time looking for very large plates you should keep to this 20-30 range.

Note that for small plates such as most Arabic plates - or plates with additional small characters such as Costa Rica, – then a minimum character pixel height of 30 pixels is recommended.

Image quality

It is extremely important to select the correct camera and configure it correctly to maximize the quality of the image sent to the OCR program. A bad image will result in lower recognition.

The image quality not only depends on the resolution of the image and correct settings but also the video transmission rate, stream protocol and image format provided by the decoder and/or video filter technology within the camera. This part of the camera setup is often neglected.
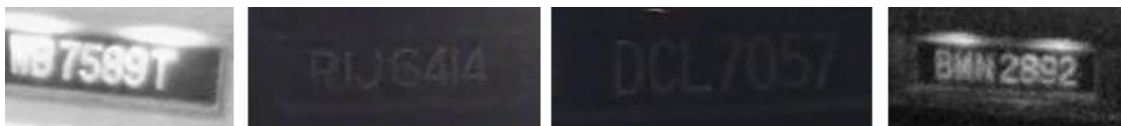
Bad quality images from Malaysian vehicles

Good quality images from Malaysian vehicles

This is what can happen if you have no IR at dusk, have a shutter speed that is too slow and leave WDR on: -

You can't read it, the software can't read it!

VaxALPR Lite

This is where each ALPR camera is connected and the recognition parameters setup.

VaxALPR Lite Main Screen while running

The Settings icons on the Left are where you configure all of the OCR parameters and add a camera (the Tools symbol). These settings can then be saved as an .alpr file in the cfg directory using the Save or Save-As icons above. e.g. *C:\Program Files\Vaxtor Technologies\VaxALPR 4.0\cfg*
The Open icon re-loads this file for further editing.
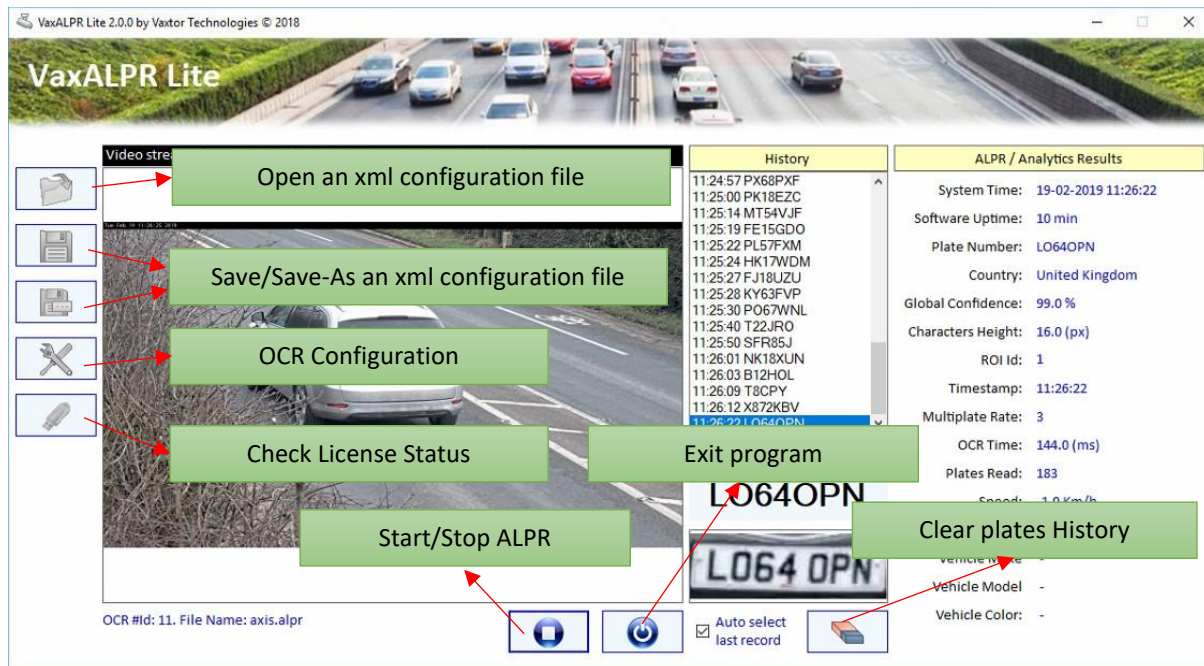
VaxALPR Lite Main Screen at start up

Main screen configuration: OCR parameters

The main configuration screen is where all the OCR parameters are setup.

At the bottom of the window the icons take you to different configuration screens: *Video Configuration, Regions of Interest, Analytics and Results Publishing options.*

OCR Configuration

VaxALPR Lite Main Screen Configuration

Note that all of the parameters shown here default to fairly sensible values on which to fine tune

Instance ID (1 or above)

This is the ID (Identifying number) of the ALPR camera and should be set to one or above. In a system with several lanes, then each time a camera is setup, it should be given a unique ID. This ID is passed on the VaxALPR Viewer to differentiate between cameras / lanes.

Confidence
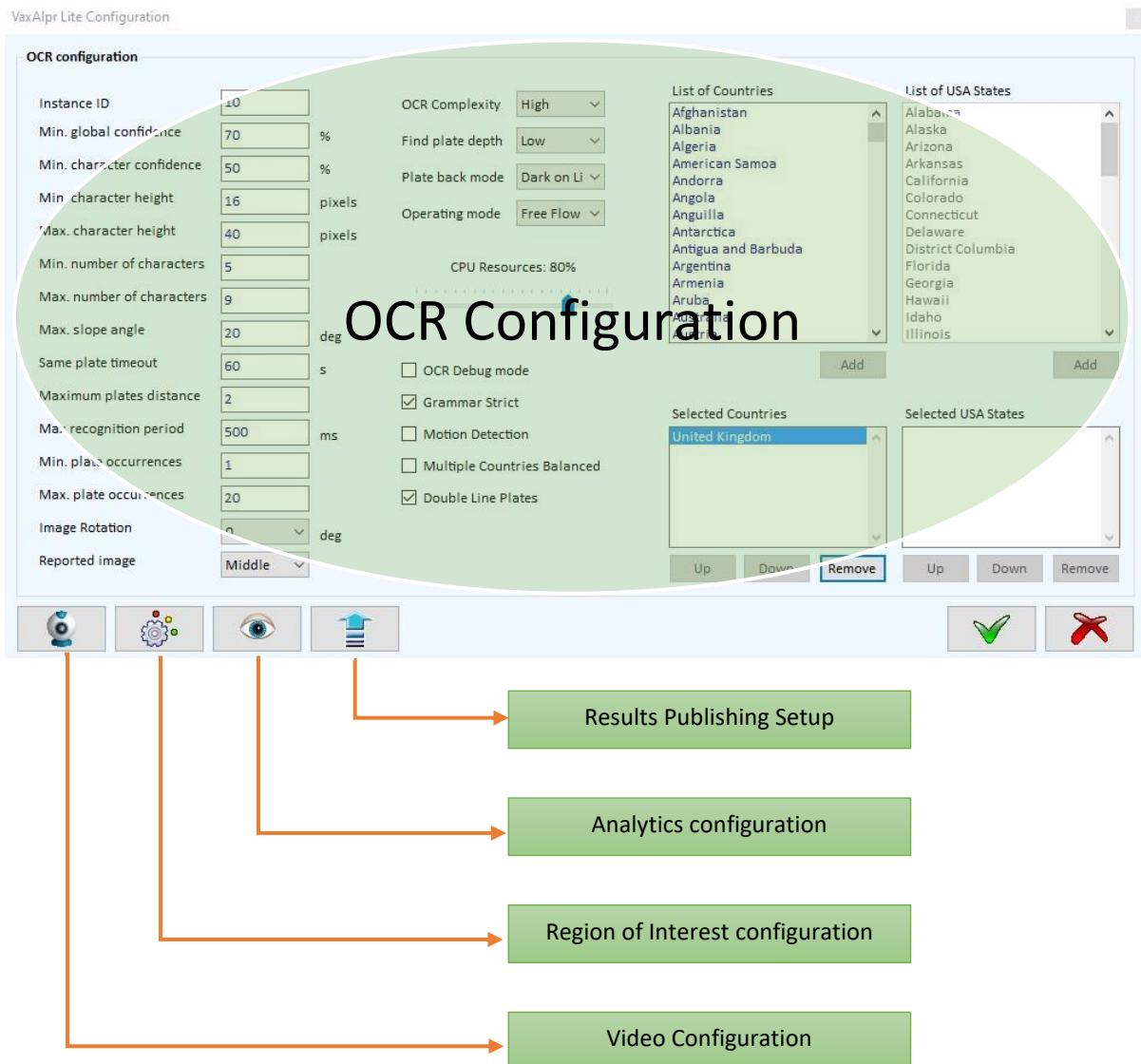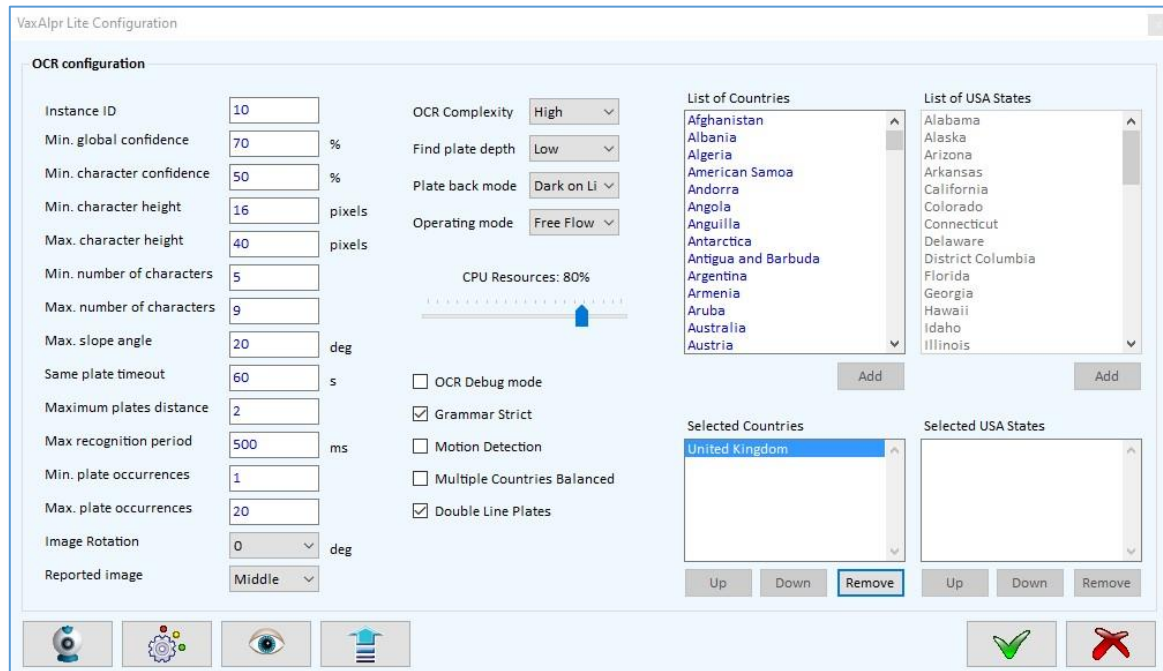*The confidence of each plate character or the plate as a whole is expressed as a percentage and is calculated using several factors such as the thickness of the character strokes, the character size, the plate contrast etc. so a large clear plate will produce a high confidence number when read.*

Minimum global confidence (percentage)

By setting this parameter you can determine the minimum confidence level the whole plate read must meet in order to be accepted.
The global confidence is the average of all individual characters' confidence.

Minimum character confidence (percentage)

This parameter is set to determine the minimum confidence level a character must meet to be accepted as the intended character.

Tip: In countries with open grammars such as the USA keep these values high, for example: 90-80 respectively. Higher values mean a lower probability of false positives but a lower probability of missing plates.

Minimum character height (pixels)

Range (14-70): This is the minimum license plate character height measured in pixels. It is the distance between the top pixel of the character and the bottom one. Take care with angled plates (see below).

Note that for small plates such as most Arabic plates - or plates with additional small characters such as Costa Rica, – then a minimum character pixel height of 30 pixels is recommended.

Maximum character height (pixels)

Range (14-70): This is the maximum license plate character height measured in pixels. It must be greater or equal to the minimum character height set previously.

Tips:

- *In license plates with difference character sizes such as some Middle East plates, the number applies to the largest character set appearing in the plate.*
- *Try to narrow the Min-Max interval to achieve better performance and less false positives. You can check with real images and add a margin of error. For example, if the license plate has a height of 25 pixels as it approaches the camera, you should set the min/max values to 18/32 respectively. This will ensure a few reads of a decent size to give a good result.*
- *The optimum character height is between 22 and 24 pixels.*
- *Small characters (below 18 pixels high) increase the probability of a misread because we start to lose details of the character shape especially if the image quality is not good: 'G' may become 'C', etc.*
- *Large characters above 55 pixels may require considerably more OCR processing time.*

Dealing with Angled Plates

Minimum number of characters

Range (4-12): This is the minimum number of characters that the license plate may have. (Each country or region has its own rules, some more formal than others. Note that by setting this to a very low number you are increasing the chance of producing a false positive especially in free-flow traffic. This will also increase the processing overhead by looking for more short plates.

Maximum number of characters

Range (4-12): This is the maximum number of characters the license plate may have. It must be equal or greater than the minimum number of characters.

Tips:

- *Set the minimum value one character below the expected minimum value and two above the expected maximum. So, for instance, if the vast majority of plates have 6 or 7 characters, set minimum to 5 and maximum to 9.*
- *Set high values of min/max confidences when dealing with short plates of 4-5 characters*

Maximum slope angle (degrees)

Range (0-30): This is the angle of the license plate to the horizontal

If you know that the plates will be skewed then by setting this parameter higher you can force the engine to look for plate shapes that are more skewed. You should setup your ALPR camera to keep plates as close to the horizontal as possible.

Same plate timeout (seconds)

This is the elapsed time between two reads of the same plate. For example, if we set this value to 10 seconds and there is a vehicle stopped in front of the camera with its plate readable, the ALPR will output a result for the same plate every 10 seconds.

Tip: This value is normally set above 60 seconds

Maximum plates distance

This parameter is used to determine what makes a plate different to the previous one read. (The Levenshtein distance). For two identical reads the Levenshtein distance is zero.

This parameter helps reduce the number of false positives when a license plate is read several times before the result is output and a partial read still represent a valid plate (valid by syntax), especially in countries where the plate doesn't have a fixed length.

Example: Real plate number is "AB-4567"

OCR read 1: AB-4567

OCR read 2: AB-456

If the maximum distance is set to "0" (exact match) the ALPR will report 2 plates, but if the distance is set to "1" (or higher), then the ALPR will report plate 1 but not plate 2.
This is because we are specifying that a plate with only one character different to the first read is considered as a read of the same plate. i.e. a probable mis-read occurred.

Tips:

- *Keep this value high when possible (2 by default) in countries where the minimum number of characters in the plate is more than 5*
- *In countries where you may have 5 or less characters length plates you may want to reduce this value to 1*

Maximum recognition period (milliseconds)

VaxALPR normally operates in free-flow. i.e. it continuously analyses video frames and reads and reports plates. It makes a final decision on the plate read after an interval of time - the maximum recognition period.

There is a dedicated time counter for every plate which starts counting after the first read. When it reaches the maximum recognition period it stops, checks the number of samples read of the same plate and returns the "best" result. The default value is set to 500ms (half a second).

We call the number of times the same license plate has been read within the maximum recognition period the **multiplate rate**. This value is one of the metrics displayed in the main screen after each plate is read and is very useful when tuning your system. Several reads of each plate are good and produce better results.
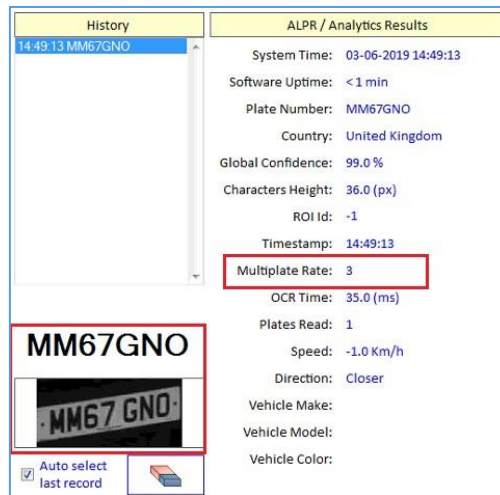
In this case the plate MM67GNO has been read 3 times before being reported

A good multi-plate rate is very important because:

- It increases the global accuracy
- It reduces the number of false positives
- It tells you a lot about the "quality" of your scenario configuration
- Low multiplate rates in good scenarios indicates low CPU performance

Tips:

- *Try to keep multiplate rates between 3 and 5*
- *If the multiplate is always 1 the risk of missing plates is high. Review your scenario configuration, camera setup, computing resources or the maximum recognition period set.*
- *If the multiplate rate is very high you may want to decrease the maximum recognition period and produce a result faster*
- *If the maximum recognition period is 0, you would be emulating a synchronous system, i.e. where each vehicle passing is set to trigger a read using an external relay. i.e. only take one read sample. This triggered method is often used in Tolling where vehicles stop. See 'Operating mode' below.*

Minimum plate occurrences

This is the minimum number of times the plate should be read within the maximum recognition period before reporting. i.e. report the result only if the minimum number of occurrences has been met. E.g. if set to 2, then only report the plate if two identical reads of the plate candidate have been made.

The default value is 1, but if the scenario is good, the speed of the vehicles is not too high and you are getting multiplate rates above 3 on average, - then by increasing this value to 2 may help reduce false positives.

Tips: Set this value to 2 when possible, especially in countries such as the USA to reduce false positives with custom plates

If you are getting high multiplate rate average then increase this minimum value.

Maximum plate occurrences

This is the maximum number of times the plate should be read within the maximum recognition period. If this value is reached before the maximum recognition period has elapsed, the ALPR will force the result to be output.

Example:

If the ALPR reads every 100ms *(10 times per second. This depends on the resolution of your camera, the quality of image (low noise) and the speed of the PC),* and say the maximum recognition period is set to 5000ms (5 seconds) and the maximum plate occurrences is set to 10, the result will be output after about 1 second because the maximum plate occurrences (10) was reached before the 5 second timeout.

Image rotation (degrees)

You may apply a specific 90° rotation to the input image. The default is 0 degrees. Other valid values are 90, 180 and 270 degrees. This can be used if a plate or marking is written vertically on an object or freight container and needs to be read).

Reported image

As described above, the ALPR Engine can read the same plate several times within the maximum recognition period. This means there will be several saved images of the plate or vehicle, one for each read.   We can set which one to report: the one associated with the first, middle or last read.

Tips:

- *If we're reading front plates on approaching traffic, the first image will be the furthest away.*
- *If we're reading rear plates on receding traffic, the first image will be the closest image of the plate or vehicle.*
- *We suggest that you select the middle to achieve a balance but feel free to experiment.*

ALPR Engine Operation in Stages

Understanding this helps you to setup the ALPR System correctly.   The Engine works in several stages before finally reporting a plate. The first stage is the Plate finder which searches each image for plate candidates before choosing one.
The Plate reading stage consist of de-skewing and rotating the plate image. A skewed or rotated plate is normalized (transformed into a standard size and rotation). This is followed by the actual OCR (Optical Character Recognition) of the plate and then syntax rules are applied to this plate (so an 0 may be corrected to a O for example).
The final stage is the repetition of this process (the plate trace) as a vehicle moves through the field of view until a final plate is output.

OCR complexity

This is the complexity of the analytics to be applied during the ALPR Engine's stage of plate reading (see above). The default value is "High"

Tips:

- *The higher complexity, the higher the OCR processing time.*
- *Depending on the images received, the difference between the lowest and the highest complexities may represent up to 10% difference in OCR accuracy. (The average is 3-5%).*
- *If the images are of high quality and the license plates have a good standard shape the difference between medium and high complexity is irrelevant. You may set "medium" complexity in order to process the plates faster.*
- *Low complexity is only recommended when we have complex scenarios and low computing power available and our preference is for vehicle detection rather than perfect reading.*
- *You are advised to use the appropriate CPU to allow a complexity of at least "medium".*

Find plate depth

This is the complexity of the analytics to be applied during the ALPR Engine's stage of plate finding (see above). The default value is "Medium".
The ALPR Engine has up to 12 different Plate Finding levels. It works as follows:

- Low: Apply up 3 levels but if any potential plate is found before reaching level 3, stop seeking

- Medium: Apply up to 8 levels. if after reaching level 4 we have a plate or plates, stop seeking, otherwise continue until level 8.

- High complexity: Always apply the 12 different levels and consider all candidates found across all levels.

Tips:

- *Always use MEDIUM level unless you're losing vehicles because lack of CPU capacity*
- *Level HIGH is not normally recommended. It uses a lot of processing time and does not really make much difference compared to MEDIUM. This level is very good however for container code recognition.*

Plate back mode

This indicates the contrast between the plate text color and its background (dark on light, light on dark, or both)

Example of dark text on a light background

Example of light text on dark background

Set "both" to read both types of plates (e.g. USA, Singapore etc.).

Most countries' plates normally are "dark text on a light background" so do not set "both" unnecessarily as this will decrease the OCR performance.

Operating mode

Free-flow: the ALPR continuously searches for plates without needing any external triggers.

Triggered (or Signaled): the ALPR requires an external trigger in order to read a plate. This can be generated from say a beam being broken or a pressure pad for example. It is often used at Toll booths or when being used with under-vehicle scanning or radiation detection where the external equipment knows when a vehicle is present and can instruct the Engine to attempt to read a plate at that point. Most users will always use free-flow.

When using signaled mode on a PC, the software listens to port 19000 by default (but this is configurable).

You should then open the socket connection, send a message (TCP/IP packet) with the reader ID you want to trigger and then close the socket.

When the socket is closed, the OCR takes the current frame from the video and scans it looking for a plate. If a plate is found then it is reported as normal and if no plate is present it reports 'NONE' as the plate.

Contact Vaxtor for more information on setting up a trigger.

CPU Resources (1-100% Default = 80%)

This parameter manages the behavior of the OCR analytics by controlling the amount of CPU utilization (processing power). It is important to set this value correctly in extreme scenarios or when running multiple VaxALPR instances (multiple ALPR cameras) on the same computer.

This parameter has effect in two different ways:

- *Performance capability:* Any PC has limited resources. When this value is set to 100% the ANPR analytics will use an entire virtual core to do its job, processing at the highest speed permitted by the CPU clock frequency. In high traffic speed scenarios or PCs with slower processors, we may need to increase this value as it directly affects the OCR processing speed.

- *Parallelization capability:* In many cases the processing speed is not a concern. We may have a fast CPU managing less demanding scenarios such as parking or access control but we need to operate many ALPR cameras from the same PC. By reducing the CPU Resources parameter, you will be able to increase the number of ALPR cameras in exchange for a reduced performance in terms of frame rate. The individual plate read OCR accuracy is unaffected.

So, the CPU Resources parameter controls the tradeoff between performance (OCR speed) and number of ALPR instances that can run concurrently on a PC.

It is also important to note that many ALPR systems run 24/7, so it is also important to set this parameter sensibly in order to avoid losing CPU cycles and having a high CPU load at all times.

The ALPR performance is determined by the CPU clock frequency, and the maximum of ALPR instances (cameras) is determined by the PC's number of virtual cores. The more we decrease the CPU Resources parameter the more ALPR instances we can run in parallel. However, if we run more ALPR cameras than there are virtual cores in the PC, we should decrease this parameter.

The key question you should ask yourself about a particular scenario is: ***How much time do I have to read the license plate***? If we have 2 seconds to read the plate it makes no sense to setup the OCR to process 10 times per second because we're wasting CPU cycles. In this case, setting an IP camera to output at 5 FPS and decreasing the CPU Resources parameter to 40%-50% will do the same job as 80%+ but much more efficiently and we will then be able to process more ALPR cameras on the same PC.

OCR debug mode

This is used for debugging purposes in case of any unexpected errors. Do not activate without supervision of the Vaxtor team.

Grammar

Often referred to as **Syntax**, these are the rules that many countries apply to their plates. For example in the UK the current format is AA99 AAA,   where A is an alphabetic character and 9 is a digit. Within this there are also other rules (like no letter Q in the first 2 characters etc.). This is very useful when trying to interpret a plate as say the plate OO1O OOO is read. It is actually OO10 OOO. The only way you would know that is to use the UK grammar or syntax rules.
Without these any of the following plates might be reported:

OO1O OOO, O0I0 000, 001O O00 etc. etc. etc. If fact 128 combinations as in many countries the letters 'O' and '0' and also '1' and 'I' are written in exactly the same way.

Grammar Strict

Default is ON.   If grammar strict is set to ON and the read plate grammar (or syntax) doesn't match any country defined in the countries list (see below), then the plate will **not** be reported. If it is set to OFF and it has an unknown plate syntax, then it **will** be reported and the country result will be set to 'UNKNOWN'.

Tips:

- *Setting this option to OFF may increase considerably the number of false positives in free-flow (asynchronous mode). To minimize the impact of this you should use a fast CPU to be able to set the minimum number of occurrences to values like 2 or 3.*
- *You can turn this OFF when working in Triggered mode.*

- *We recommend keep this option set to ON.*

Motion Detection

Default OFF. When set to ON the engine will only look for plates if motion is detected in the video stream. This can help reduce processor overhead.

Multiples Countries Balanced

Default OFF. This option only applies when more than one country is defined in the selected countries list. If the flag is OFF the OCR will select the first country matching the plate grammar, otherwise it will compare candidates with all the countries in the list selecting the best option according to its internal algorithms.

Keep this set to OFF unless there is a high probability of having plates from different countries in equal numbers.

Example: If you define FRANCE and SPAIN in the countries list, and the ALPR system is in Paris, the probability of having a French plate vs Spanish plate is much higher, so keep this option set to OFF. If however the ALPR system is operating near to the French-Spanish border, then the probability of having a plate from either France or Spain is equal, so set this parameter to ON.

Double Line Plates

Default ON. Some countries or regions do not have two or three-line plates. If this is the case then unticking this option will allow the engine to run faster by not having to search for them.

List of Countries

You may select up to 5 countries to apply the proper grammar rules. This is very important to differentiate between "O" and "0" and also "I" and "1".

Set the countries in order of preference or likelihood to be seen when plates are read. Normally the first country should be the one where the ALPR system is operating.   If the plate grammar does not match any specified country the plate may not be reported (see grammar strict option)

Tips:

- *Add the appropriate countries, if you're in UK do not add Singapore*
- *The OCR applies rules based on grammar structure and not font types or plate features*
- *Do not operate with no countries selected*

List of USA states

Set the Country to USA and then select up to 5 US states to apply the proper grammar rules. As in the countries list above, the order of preference should be set according to the likelihood of seeing plates from each State.

This option applies only when USA is defined in the list of countries. Setting a state of preference helps the OCR to narrow the search and manage probabilities more efficiently.
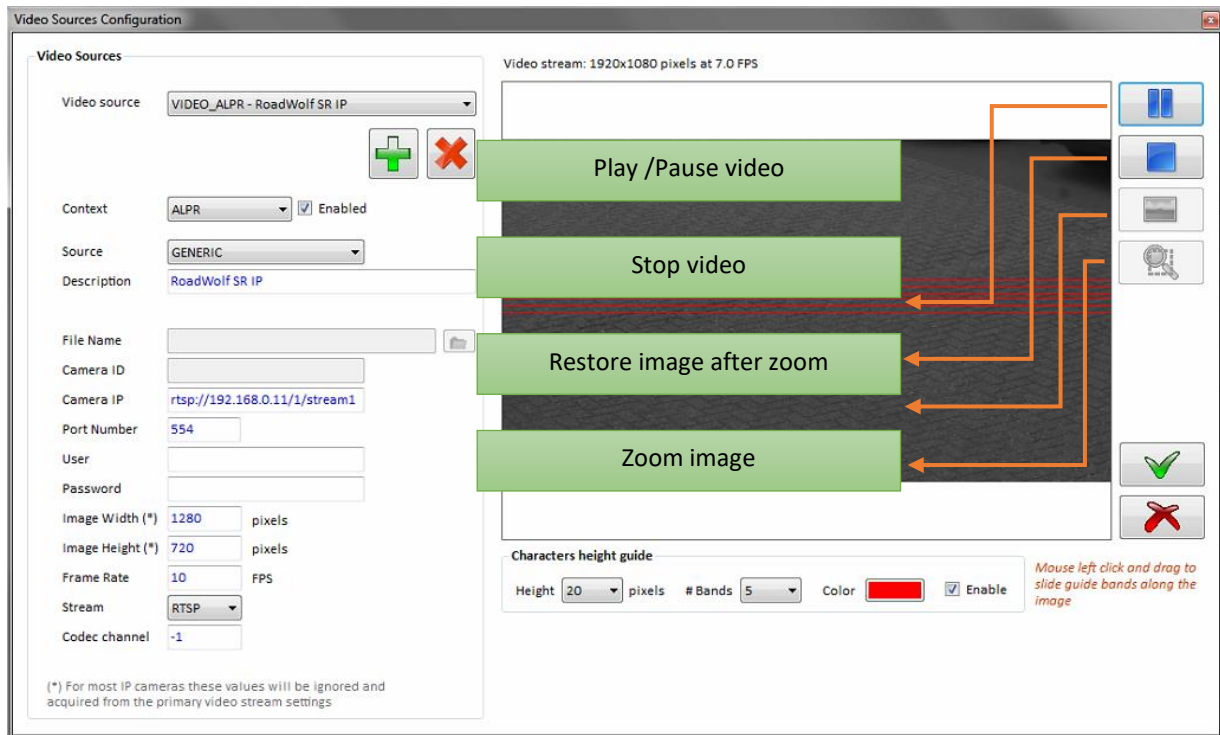
As opposed to the list of countries, if the plate grammar doesn't match the State rules the license plate result will be reported anyway.

Video Configuration

This is where the video source used by the OCR and optionally the video contextual source (or environment camera) linked to the ALPR sensor are added and setup for each lane.

Video Configuration Screen

Some cameras used for ALPR have only one lens and can be set to color, night-mode or auto switching between day (color) and night-mode. E.g. an Axis Q1700-LE. If, however you are using a professional ALPR camera it may have twin lenses: a monochrome one illuminated by IR (Infrared) and a second color contextual or Environment camera which is usually zoomed out a little to show the vehicle and hopefully the occupants contextually against a background. This can help to legally prove where a vehicle was when captured.

Alternatively, you can use a separate second color camera and configure it as the Environment camera for another unit that has been optimized to read plates.

Note that using two IP cameras like this on a network can sometimes produce unsatisfactory results as the video latency can cause the cameras to be slightly out of sync. Zooming out the color contextual camera helps mitigate this effect.

Video source

This drop-down menu displays a list of linked video sources that have been configured (see below).

Click the Add icon to add a video source to perform ALPR on.

Context

Select either **ALPR** or **ENVIRONMENT** according to what type of camera you are configuring.
*The first camera added should be an ALPR camera. If an associated color contextual camera is needed then follow this procedure by selecting **Context - ENVIRONMENT** and setup the Environment camera before saving the pair using the green tick.*

Note that it is possible to add multiple environment cameras to a single ALPR camera but this is only for use with some forthcoming Vaxtor products.

Source

This is where the Video source is actually selected. i.e. the camera that is being used for ALPR (or the Environment camera). It can be classified into different groups:

-   IP cameras: IP based cameras
-   USB or non-IP cameras
-   Video files: Media clips or Graph Studio files
-   Generic RTSP streams

You will see a list of well-known cameras.   Select the appropriate camera if shown.

If the camera you are using is not in this list then select **GENERIC** and enter the IP address of the camera's RTSP stream, port number, user name and password (if used) for your camera.

For example, for a global shutter RoadWolf IP camera enter:

Camera IP	rtsp://192.168.0.10:554/cam0_0 (i.e. the correct IP address)
Port	554
User	root or whatever has been set.
Password	root or whatever has been set.

Select **VIDEO_FILE** if you wish to process a recorded video clip and attempt to read the plates seen.

Depending on the type of video camera selected, some of the following text boxes will be enabled or disabled.

Description

Enter a description for your camera. E.g. Front Entrance

File name

If a recoded file of traffic is to be processed select the file here. The video source can be a media clip.

If an older analogue camera is being used with a video frame grabber then enter the Video Graph File (.grf) generated by Graph Studio that uses the DirectShow filters of a frame grabber (video analog acquisition)

Camera ID

Non-IP cameras by certain manufacturers such as IDS or Basler

Camera IP

When selecting an IP camera from video source you should set the camera's IP address

In case of using a GENERIC video source you should enter an RTSP or ONVIF connection string as follows:

RTSP, RTMP, HTTP, TCP, UDP, MSSH Protocols

- [protocol]://[user:password]@[IP address or host name]/[URL params]
- Example: rtsp://root:admin@192.168.1.30/axis-media/media.amp?videocodec=h264&audio=0 (or see example above)

ONVIF RTSP streams

- RTSP stream of the first Onvif media profile (default)
  - onvif://[onvifuser]:[onvifpassword]@[IP address or host name]:[onvif HTTP port]
  - Example: onvif://user:pass@192.168.2.55:8080
- RTSP stream selected by the index of the Onvif media profile
  - The index of the media profile must be in the 0..n-1 range
  - onvif://[onvifuser]:[onvifpassword]@[IP address or host name]:[onvif HTTP port]/[index of the onvif profile]
  - Example: onvif://user:pass@192.168.2.55:8080/1
- RTSP stream selected by the name of the Onvif media profile
  - This is the name of the media profile as it has been configured in the IP camera settings
  - onvif://[onvifuser]:[onvifpassword]@[IP address or host name]:[onvif HTTP port]/[name of the onvif media profile]
  - Example: supposing the name of the profile is "high quality" it would be onvif://user:pass@192.168.2.55:8080/high quality

Non-managed IP camera parameters

Port number, user, password, image width, image width and height.

Most of the IP cameras will ignore these values and the settings from the camera's primary stream will be used. (When using most Axis cameras then the resolution CAN be changed here)

Frame Rate -   The maximum frame rate to be used.

<u>IMPORTANT</u>: The camera will normally allow you to set up a target frame rate to output images. E.g. 20.   If the Frame rate is set here to a lower value, then OCR engine will take this value as its maximum operational frame rate.

Example: If the camera is operating at 20 FPS and the OCR engine can operate at 10 FPS (100ms frame analysis period – depending on processor power) and we set this parameter to 5 FPS, the OCR engine will operate 5 FPS maximum.

This value will represent the maximum frequency of our OCR analytics cycle.

Stream

Can be either MJPEG or RTSP. Not all IP cameras will have MJPEG available so it is recommended to use RTSP by default.

Codec channel

This Indicates the stream channel to acquire the video from.   Most IP cameras have 2 or 3 streams which can be set to different resolutions. You might use one stream to send to a remote VMS system and another for the ALPR processing.

For most IP cameras this value can be set to 1, 2 or 3. (It actually adds these numbers to the RTSP parameters).   The default value is set to -1 – which selects the default stream from the camera – i.e. stream 1.

After setting up and previewing this camera, if you have an associated Environment camera then select ENVIRONMENT in the Context box and repeat the setup.
Remember to tick 'Enabled' next to the Context box.

To complete our example for a generic camera with two lenses (IR & color overview):

For example, for a rolling shutter RoadWolf color IP camera enter:

Camera IP   rtsp://192.168.0.11/1/stream1
Port   554
User   admin
Password   admin1357 or whatever has been set.

Press the Play icon to test and if working correctly click the green tick (bottom right) to save the settings configured so far. In the main menu save again using the green tick noting the Instance ID.

Select the 'Save As' icon on the left to save your configuration to the VaxALPR cfg directory using a meaningful name.

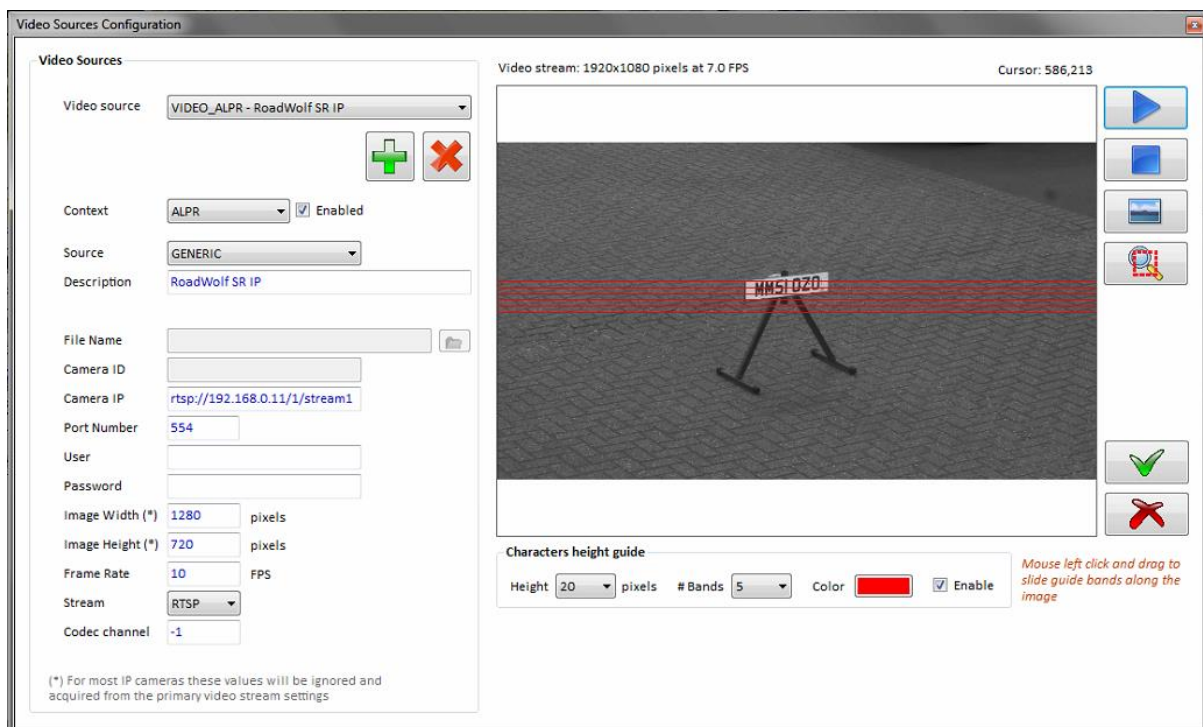# Calculation of the average license plate characters height

One of the key tasks during ALPR configuration is to estimate the average license plate character height in pixels to set up a valid range for the OCR to work on. The correct range will help to achieve better performance and higher accuracy.

Sometimes it is hard to estimate this height just by watching the live video screen, furthermore, it's even harder to verify that the character height is optimal,- not too small, not too big.

The program fortunately contains a visual tool that will help the user to quickly and easily get a good estimate of the height range of the plates seen in the live video. The tool is essentially a tape measure.

In the "Characters height guide" we can configure the spacing of the calibration stripes:

- Height: The gap between any 2 lines, in pixels
- Bands: The number of lines to display. (this just helps you estimate more accurately)
- Color: The color of the lines may be changed for clarity.
- Enable: Turn the calibration stripes on or off.


Calculation of the average height in pixels of the license plate characters

1. Click the triangular Play icon to play the live video and press **PAUSE** when you have a vehicle in the frame with the license plate clearly visible.

Tip: if there is not much passing traffic or you cannot position a vehicle then use a license plate on a stand as shown to setup the system.

2. Move the mouse and hold the left button to slide the red horizontal lines up and down over the frame. The separation between any two stripes is equal to the height defined in the "Characters height guide" section at the bottom of the screen, in pixels.
(Here we have set the number on bands to 5 and the height between each band to 20)

3. Use the Zoom icon to define an area around the plate and zoom into that area.
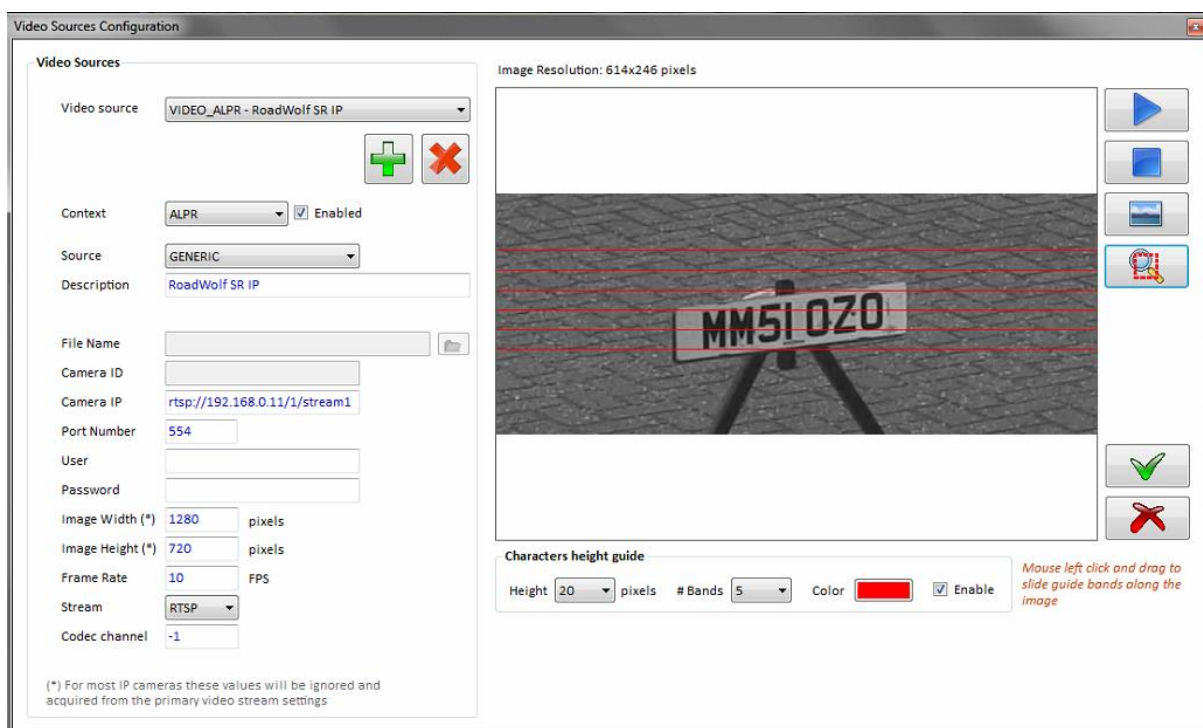
Using the red stripes to estimate the characters height of the target vehicle

4. We can now change the height (gap between the red bands) and/or the number of bands and then slide the bands up and down to accurately determine the height of each character. In this case, after zooming in we can clearly see that height of the characters takes up nearly two gaps separation - which would be around 38 pixels high. Optimum recognition occurs at a character height of between 20 & 30 pixels.   Less than 20 can affect recognition on small character details – but a bit more is fine. The only disadvantage of having larger plates is that it can take slightly more processing power to look for and analyze the plates.

Region of Interest Configuration

This functionality requires the video source to be setup and working.

The Region of Interest (ROI), sometimes known as the Crop Zone, is used to define an area within the video frame where the OCR analytics takes place.   The user can define a polygon and choose whether the area to look for plates in Inside or Outside this region.   The user can then set multiple regions, i.e. multiple ROIs, in complex situations although this is rare.

Using an ROI can decrease OCR processing time and also reduce false positives.
So, if the camera is looking across a large stretch of road as in the example below, the ROI can be used to limit the OCR to the area near to the camera thus reducing the processor load.

If a plate-shaped house window or road sign for example is within the camera's field of view and keeps getting mistaken for a license plate, then these false positives can be eliminated by creating a crop zone to exclude this part of the image.
Each ROI must be given a unique numeric Identifier. E.g. '1'.
Note that the whole license plate must be in or out the ROI to pass the test.
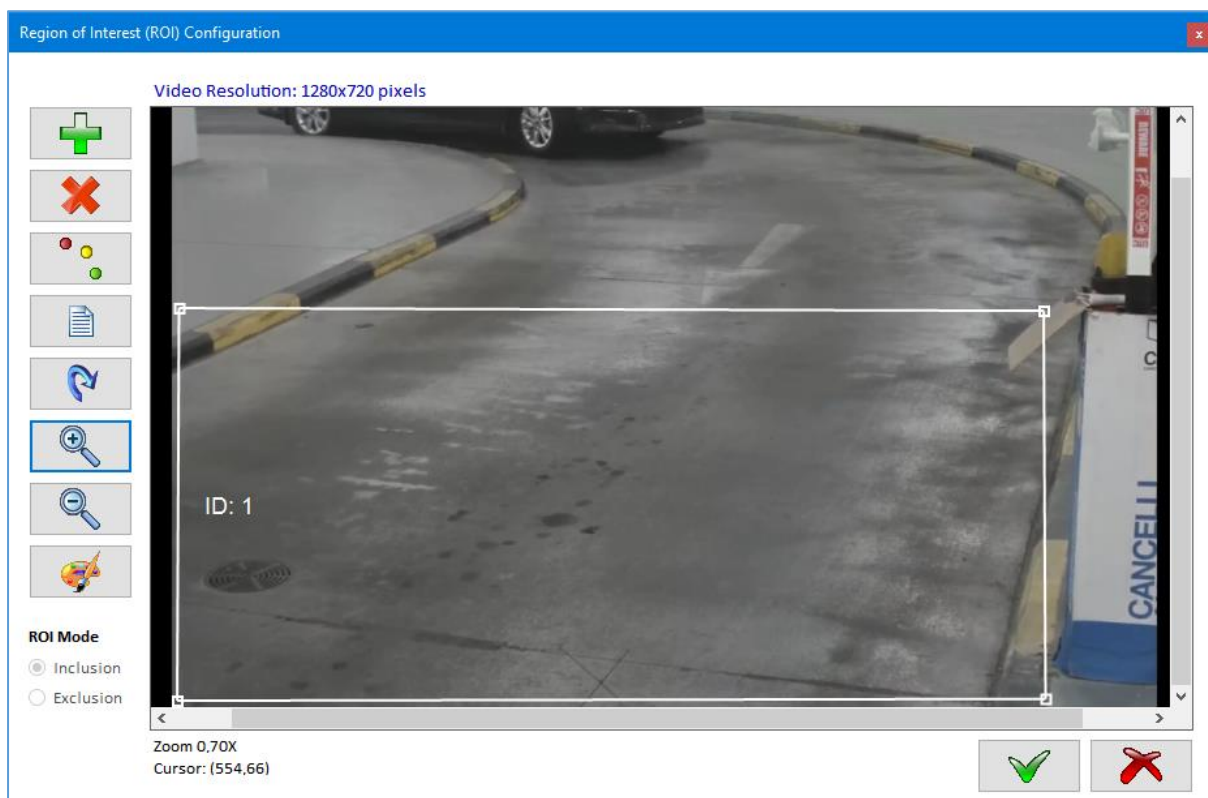
Region of Interest Configuration screen

The **ROI Mode** determines the behavior of the ROI, it can be set to either include or exclude the area around it. We cannot mix both types for logic reasons.

- Inclusion: The OCR will apply the analytics only inside the polygons defining the ROI
- Exclusion: The OCR will apply the analytics only outside the polygon defining the ROI

The icons to perform the ROI functions are:

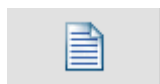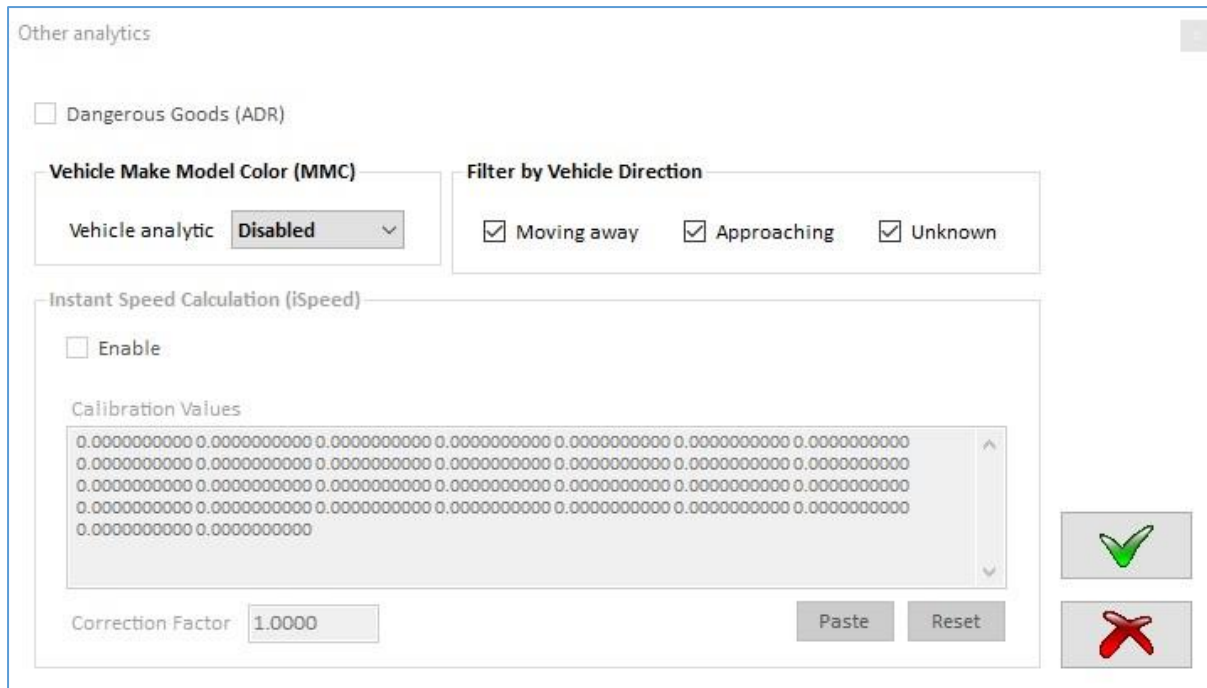|			
	Add a new region of interest and save a region ID (numeric)		Remove all ROIs
	Remove an existing region of interest		Zoom In to edit the ROI
	Move ROI polygons points i.e. change the polygon shape		Zoom Out
	Edit the ROI ID number		Change the polygon color

The functions are self-explanatory.

 Other analytics configuration

VaxALPR includes some additional analytics in addition to the OCR.

Additional Analytics Configuration screen

The Vehicle Direction Filter is part of the OCR package and can be enabled here.

Filter by vehicle direction causes the ALPR Engine to report only the license plates from vehicles matching the direction of travel defined by the filter. By default, this filter is inactive.
If all options are selected, then the Engine will report all plates)

Note that the other analytics shown including **Vehicle Make Model Color (MMC)**, **Dangerous Goods Plates (ADR) or Vehicle Instant Speed Calculation** require additional licenses in order to activate. Contact Vaxtor support for more information.

The Vehicle Instant Speed Calculation analytic requires the ALPR software to be calibrated by specialist staff.
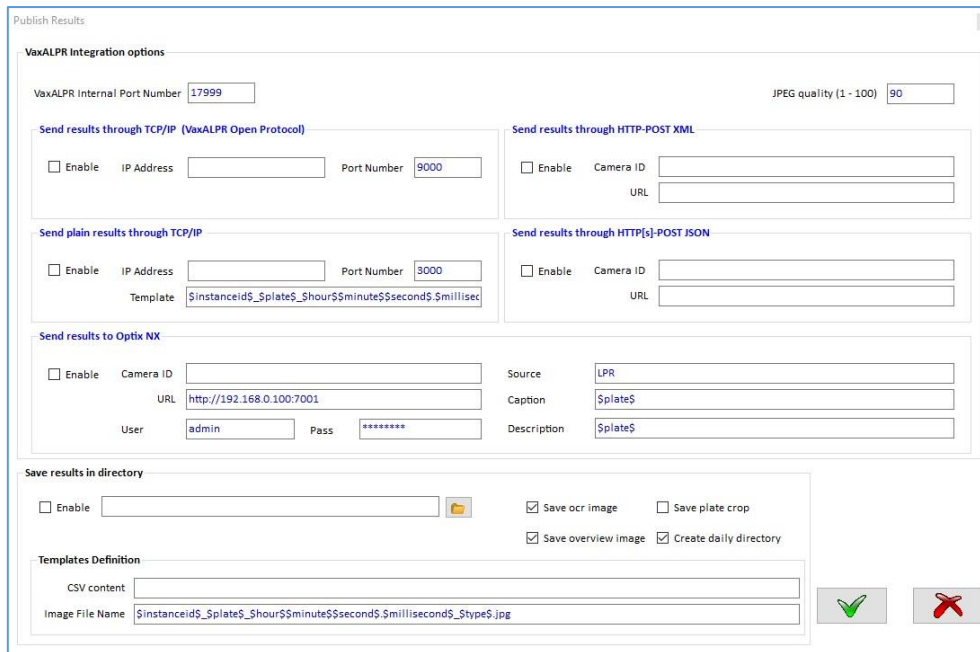
The Make Model Color analytic is not available in all countries where VaxALPR can operate, please contact us for further information

Results Publishing Configuration Screen

This menu allows the user to configure the software to publish the plate reads in real time, saving or sending the reads to other software or locations.   This should be done for each lane setup.

Results Publishing Configuration Screen

Results Publishing

Sending reads to Helix

If Helix (the Vaxtor Back Office or BOF) is running on the same PC as VaxALPR then there is no need to configure any of these outputs. However, if Helix is running on another PC on your network then you should enable TCP/IP, enter the IP address of the PC where Helix is running and **use Port 9100**.

Other Destinations

VaxALPR provides several mechanisms to allow third party integration and allows external programs to receive results in real time.   Since this software is an application and not an SDK, VaxALPR can publish results as follows:

- **TCP/IP Sockets**: Each result is encoded and sent to the server **Port Number** as specified here.
- **Plain TCP/IP Sockets**: As above – but a template may be defined for which fields to send.
- **HTTP-POST XML**: Each result is formatted in XML and sent to the specified URL.
- **HTTP(s)-POST JSON**. Each result is formatted in JSON and sent to the specified URL.
- **Send results to Optix NX:** Sends data to the Network Optix n^x Witness VMS as Events & Bookmarks using http. (Note that the latest Optix NX enforces https)

See the ALPR Results Integration section later in this manual for more details on configuring these outputs and a list of reserved words for the plain TCP/IP output.

Saving plate read results to a directory

In addition to transmitting plates remotely you can enable '**Save results in directory'** to record all of the plate reads and associated images. Select a directory using the Folder icon. This can be useful if you want to perform some testing using VaxALPR Lite and verify the results later.

You can choose to save any of the following images:

The OCR image (the full image that was used to read the plate)

The Plate crop – or Plate Patch. (This is the small extracted image of the actual plate.)

The Overview image
If an associated color contextual camera is used then this image is saved also

Finally, you can choose whether to write everything in to the target directory or alternatively create a daily folder which contains all of the selected data.

The **Templates Definition** section is where you can configure exactly what information is written to the .csv file and define the name of the images. In addition, you can configure what information is written into the .csv file such as Confidence, Plate Height, Country etc.

CSV Content

The default file structure produces a record as follows:

1   12:45:33.245   23/10/2019   DS06BXL   99.00   26   18   8   GBR   -1 D(99.00) S(99.00) 0(99.00) 6(99.00) B(99.00) X(99.00) L(99.00)

This includes the Instance ID, time and date, the plate read, the global confidence, the plate height, OCR time in ms, the multiplate rate and the confidence for the individual plate characters.

However, you can use certain reserved words here to customise the data fields.
The available reserved words are:

$instanceid$: ID configured (00001, 00002, ….) will pad with zeros up to 5 chars.
$hour$: 2 digit hour (localtime).
$minute$: 2 digit minutes (localtime).
$second$: 2 digit seconds (localtime).
$millisecond$: 3 digit milliseconds (localtime).
day : 2 digit day
$month$: 2 digit month
$year$: 4 digit year
$plate$: Plate number
$charheight$: Average height in pixels of the characters in the plate number.
$left$,top,$right$,$bottom$: Pixel coordinates of the top left corner and the bottom right corner of the license plate in the image.
$confidence$: Confidence with 2 decimals, separator is a "." Always.
$processingtime$: In milliseconds
$country$: Country
$roiid$: Region of Interest Id where the plate was detected (-1 if none).

$direction$: 0, 1, 2: Unknown, Getting closer, Getting farther.
$imagefile$: Full path to the OCR image (full frame).
$plateimagefile$: Full path to the Plate image (crop).
$envimagefile$: Full path to the Overview image.

Image File Name

The default image file name is:

$instanceid$_$plate$_$hour$$minute$$second$.$millisecond$_$type$.jpg

Which produces files such as:

00001_ABC123_170816.949_ocr_img   and
00001_ABC123_170816.949_ocr_crop

Internal port number

Set a port number to allow VaxALPR intercommunication i.e. between each lane and the main VaxALPR Viewer.

JPEG quality (1-100)

Set the required compression ratio for the saved images. The lower the number, the higher the compression ratio but the quality of images will be lower. The default is 90 which produces vary acceptable images.

Saving the VaxALPR Configuration

After setting all of the parameters for a camera, you must save them as an .xml file in the \cfg folder using the **Save-As** icon as shown below. Once saved, you can continue editing and re-save to the same file name using just the Save icon.

*e.g. **C:\Program Files\Vaxtor Technologies\VaxALPR 4.0\cfg***

Choose an appropriate file name such as 'Camera 1' or 'Front Gate'.
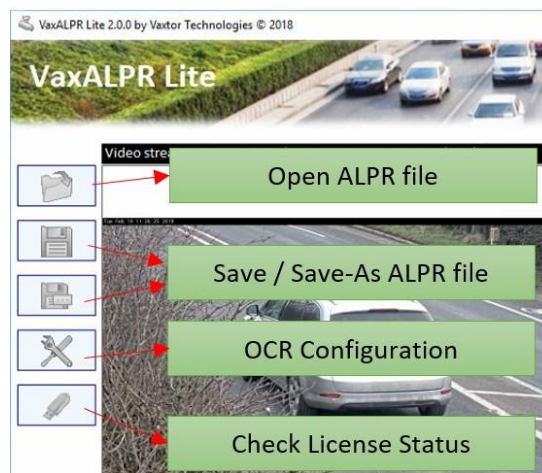
Repeat this configuration process for every camera you wish to add to your ALPR system.

Once all of the cameras are setup and their respective configuration files saved, exit the program and load the **VaxALPR** program (the VaxALPR Viewer) to link all the cameras together to create our ALPR system by loading these files one by one.
See next section.

Note that in older versions the configuration files were saved as .alpr or .txt files.

The open icon will open these older file formats in addition to the newer .xml versions.

Once opened and edited these will now be re-saved as .xml files when the Save-As icons is used.

VaxALPR Viewer

VaxALPR, also known as the VaxALPR Viewer, is the software that brings together and runs one or more ALPR cameras (or lanes) that have been configured by VaxALPR Setup. The application operates unattended and requires no user interaction other than the initial setup which is basically where you select which ALPR files to run.
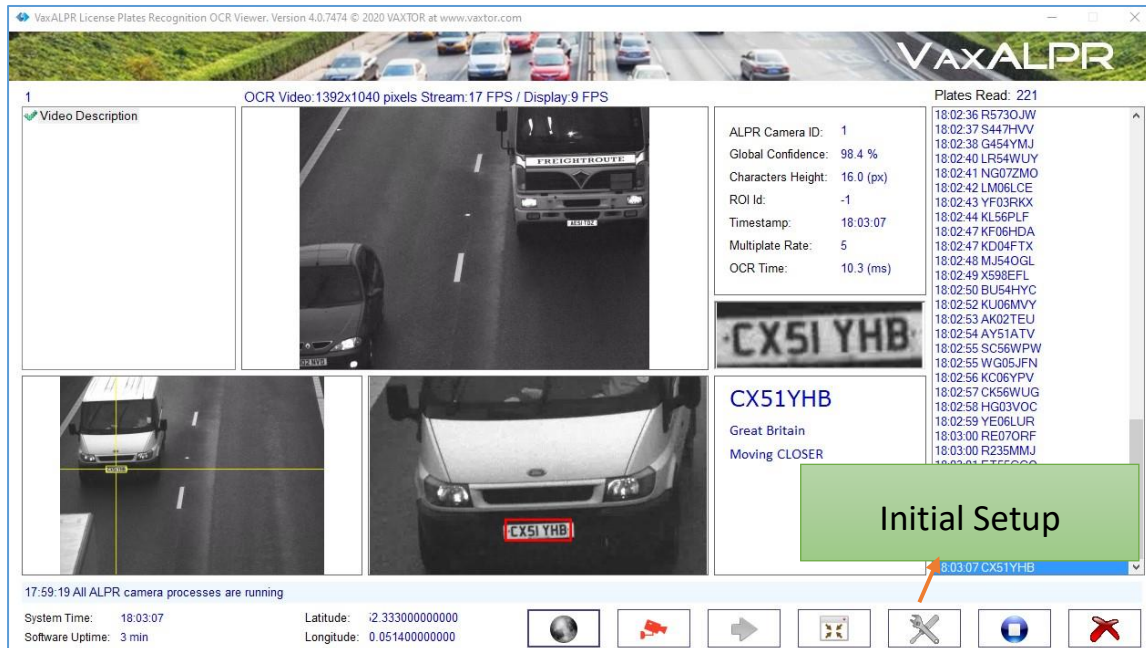
VaxALPR Main Screen in Light Color Scheme
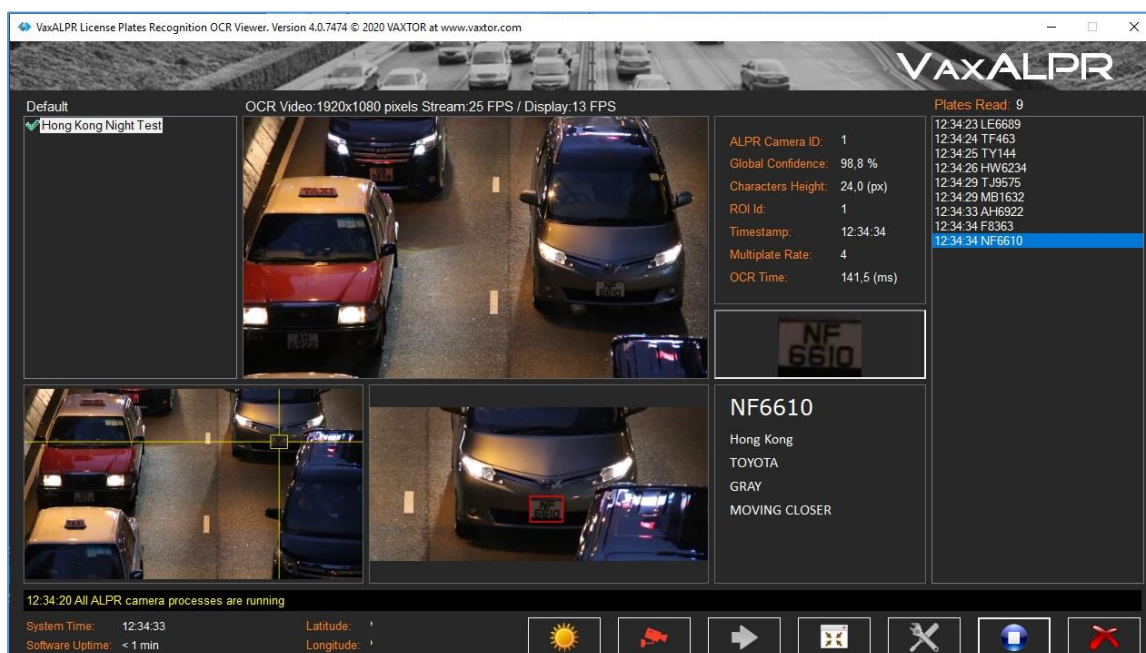
VaxALPR Main Screen in Dark Color Scheme

Initial setup

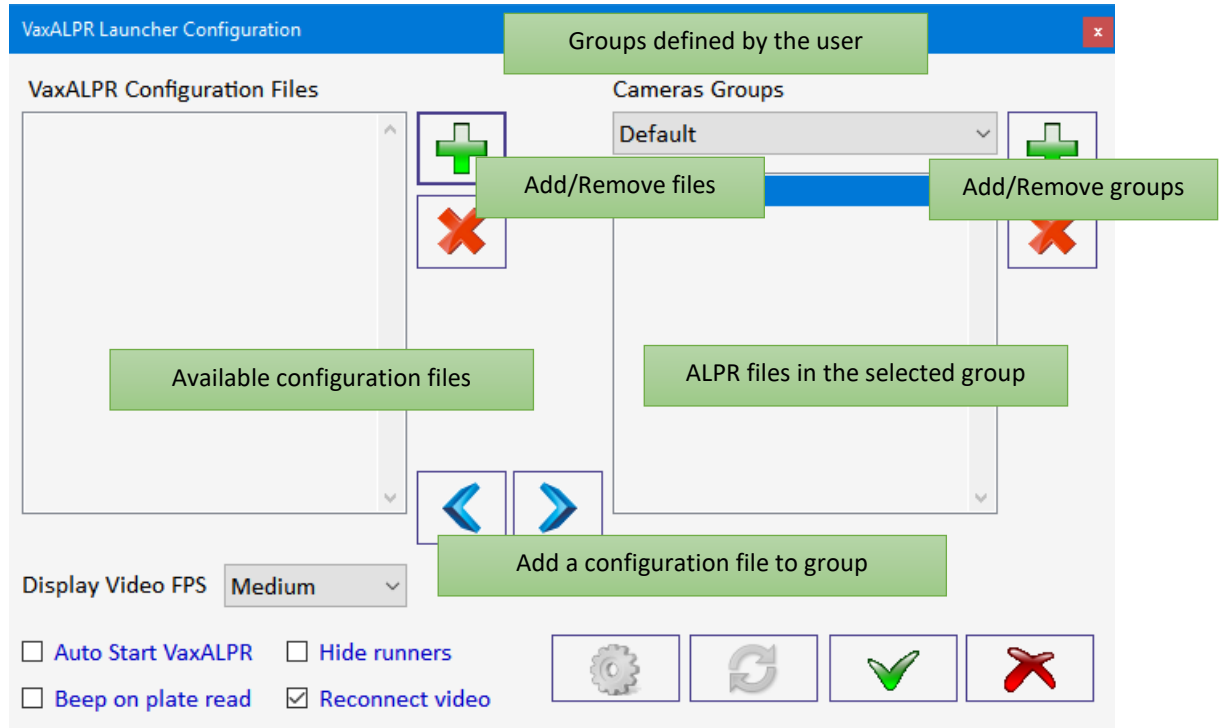Initial setup normally takes place just once and here we select the one or more VaxALPR Configuration files (.xml) configured by VaxALPR Lite that will become our ALPR system.

Configuration Screen for VaxALPR Configuration File Selection

VaxALPR Configuration files

This is the location where all ALPR files defined by VaxALPR Lite are located, which corresponds with the "cfg" folder inside VaxALPR installation directory.

Note that the fact of being listed here does not mean that they are going to be processed by VaxALPR Viewer. We must choose which files should be included in the process manually.

Camera Groups

The way VaxALPR Viewer manages the cameras is by groups. A group is a list of Configuration files and only one group can run at a time so only the configuration files of the group run simultaneously. Thus, VaxALPR Viewer manages a list of groups each one containing a list of VaxALPR Configuration files.

Usually we will have only one group containing all of our VaxALPR Configuration files. However, the group structure is useful in some scenarios such as ALPR Onboard in vehicles where sometimes you may want to switch between cameras.

For example, you can have 4 ALPR cameras but only run 2 simultaneously and then switch to the other 2. The multiple groups help you do this quite easily; the main screen provides a button (Yellow Right Arrow icon) to cycle and switch between camera groups automatically.

How it works step by step

Use the **Plus** Icon on the left to load the configuration files created by VaxALPR Lite located in the "cfg" folder in the VaxALPR installation directory. The red Cross Icon removes them.
Repeat for all the cameras you want to integrate.
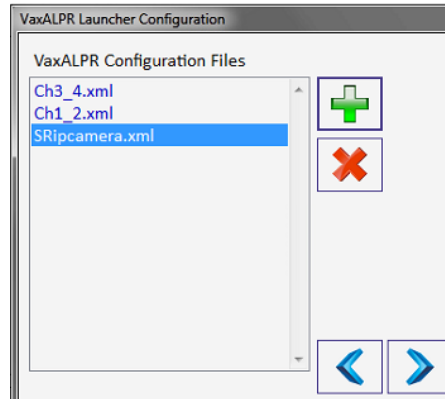
If you do not need to create more than one group you can press the button to create a default group and automatically add all your files, otherwise you'll have to manually create the groups and add the files using the blue arrow buttons.
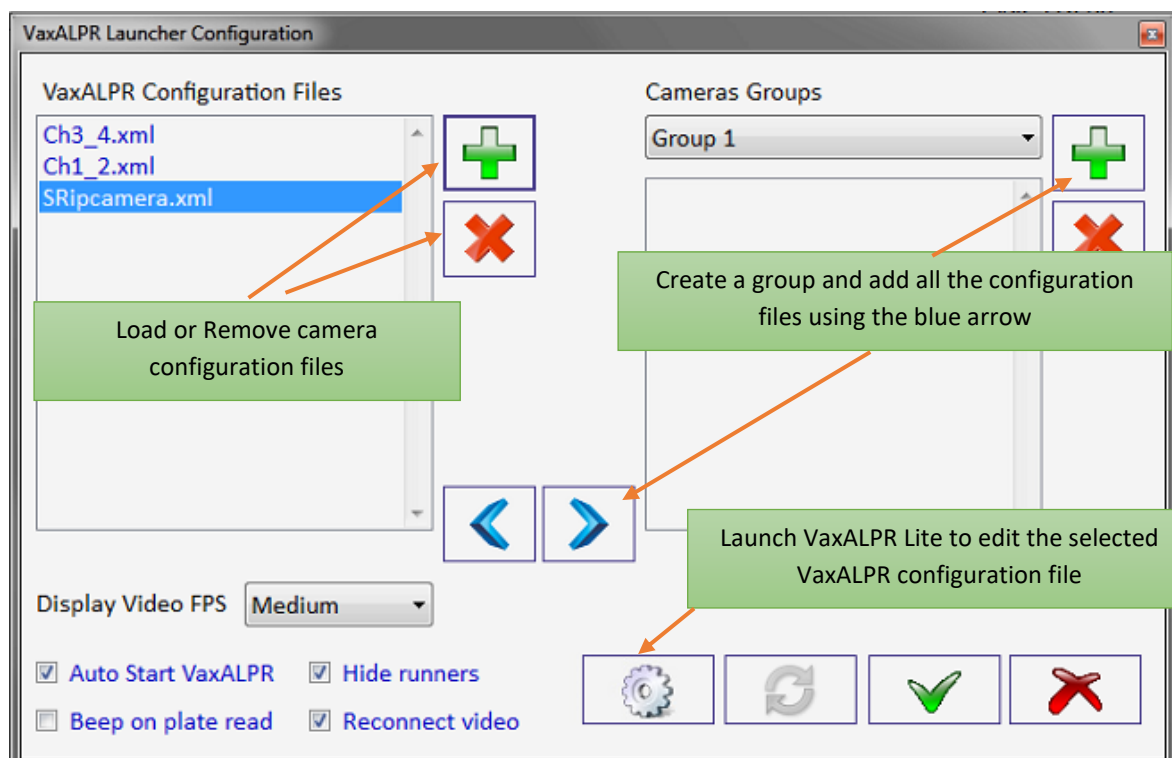
All groups must contain at least one VaxALPR Configuration File and all files loaded (in the left window) must be allocated to a group before exiting. If some are not needed, remove them with the red cross icon, – they will not be deleted.

Other options

- **Display Video FPS**: This sets the frame rate at which to display the live video on the PC screen. This feature does not affect the ALPR operating frame rate, it is more of a visual or cosmetic feature. Refreshing video frames consumes processor resources and so we recommend setting this to Low.

- **Beep on plate read**: The software will play a beep sound every time the OCR reads a plate.

- **Auto Start VaxALPR:** The software will automatically load your configuration at start up and will automatically launch the OCR processes. Note that this option does not launch VaxALPR after rebooting the computer, it just restarts the selected VaxALPR Configuration files after starting the application. *To auto start VaxALPR, add the program to the Windows Startup folder.*

- **Hide runners**: Show or hide the console windows in the task bar running the OCR processes.

- **Reconnect video**: Activate or deactivate automatic video reconnection in case of losing the camera connectivity. If this option is disabled the OCR will stop running if connectivity is lost. If enabled then once the connectivity is recovered, VaxALPR will continue running automatically. This option is normally enabled unless the system is configured to process video files (instead of live cameras) and we don't want the ALPR to reload the media clip after finishing.

Main Screen

After setting up the ALPR files groups we're ready to launch VaxALPR from the main screen.

**VaxALPR Viewer Main Screen Components**

Main Screen Components

- **ALPR Cameras running**: This window displays the list of the connected ALPR in the active group, the name corresponds with the camera description we setup in VaxALPR Lite.

- **Live Video Display**: This window shows the live video stream from either the ALPR or environment camera selected from the ALPR cameras list on the left. You can see the display frame rate from the VaxALPR Lite configuration screen described in the previous sections. Use the camera icon at the bottom to switch between ALPR and Environment cameras (if available).

- **History of Plates Read**: This shows the 100 most recent plates and timestamps read by the currently selected camera.

- **Last Plate Read Details:** This is the OCR result of the plate that has just been read. The country of origin is displayed (if known) and the direction of travel.

- **Last Plate Patch:** This is the cropped plate from the image - the Plate Patch.

- **VaxALPR Metrics**: The program displays various metrics from the ALPR Engine from the last plate read. These include data such as the confidence of the last plate read and the average height of the characters in the plate. Note that some metrics will not be available without the corresponding analytics plug-in such as vehicle make-model-color which is separately available. Others may require additional hardware to operate such as a GPS receiver to report the

longitude and latitude of each camera, and others may be country dependent such as "plate category" available mainly in Middle Eastern countries.

- **Last Plate Read Complete Image**: This is the complete video frame containing the last plate that was read. Note that the image displayed corresponds to the one defined by the **Reported Image** parameter. See the OCR Configuration section previously.

- **Last Plate Cropped Image:** This is an extract from the complete image of the last read plate showing more detail of the vehicle and plate and less background.

- **Action Buttons**: The main Action Buttons along the bottom of the display to the following:

Action buttons

●	Toggle between Day/Night view (lighter or darker screen theme)
➦	Toggle display between the ALPR and corresponding Environment camera (if available)
➡	Stops the running ALPR camera group and switches to next one (if multiple groups have been setup)
✕	Minimizes the main screen into a very small window with very little info display. This also saves processor overhead.
✕	VaxALPR Viewer Configuration. The cameras should be stopped first.
▣	Start/Stop VaxALPR. This stops the OCR process so that you can edit parameters.
✖	Exit the program.

VaxALPR Results Integration
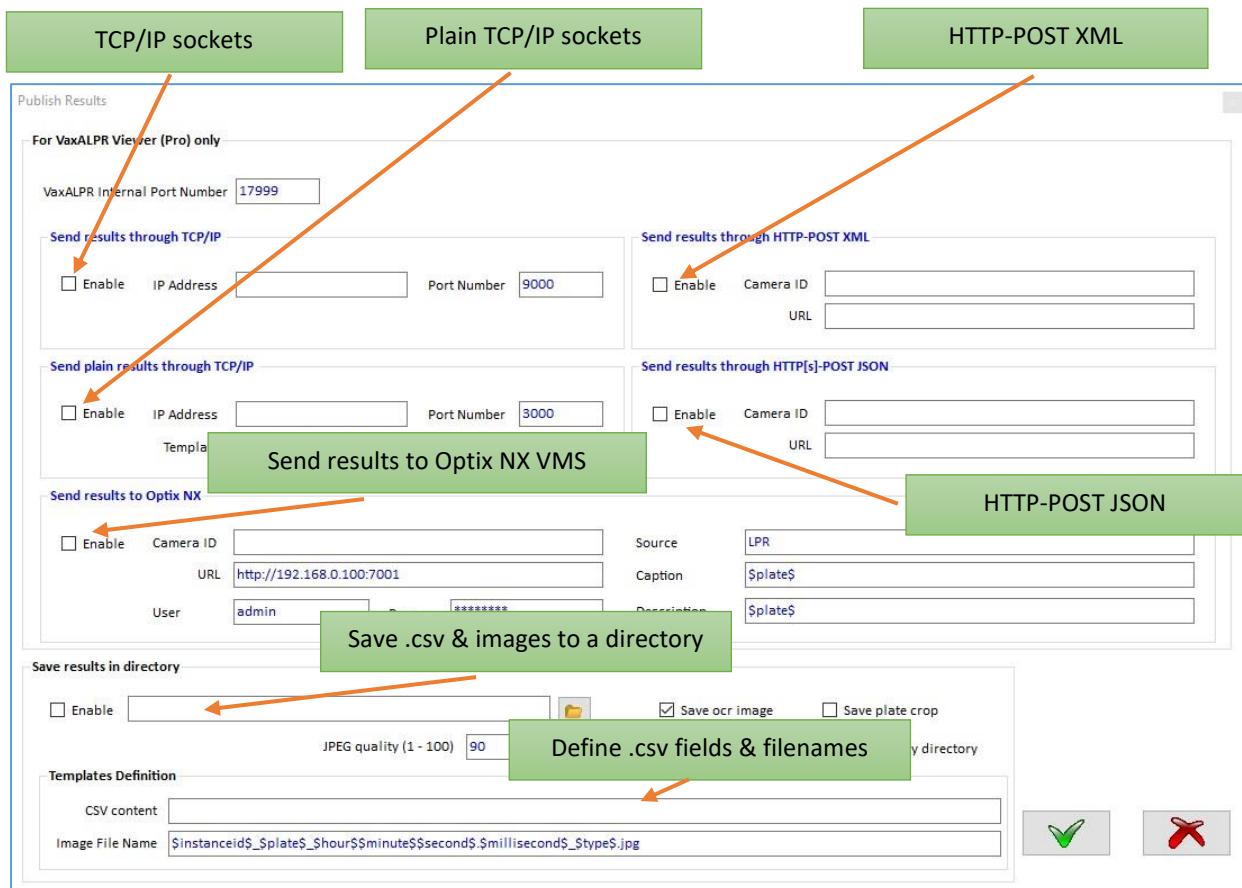
VaxALPR can publish real time results in various ways:

- TCP/IP Sockets
- Plain TCP/IP Sockets
- HTTP-POST XML
- HTTP-POST JSON
- Optix NX VMS System - Sends results via http (in the latest versions https)

VaxALPR publishes a result every time it reads a license plate. In order to receive results from VaxALPR you will have to enable the appropriate method.

All mechanisms are:

- Multiplatform independent
- Programming language independent
- Support local or remote integration

Configuration screen to setup the appropriate results publishing method

TCP/IP sockets

Enter the IP address of the host machine receiving the results and enter the port number. You will have to "listen" to the same port number.

IMPORTANT: Multiple ALPR instances (cameras) can publish to the same port number. The message (results) includes the camera ID to identify the message sender (or ALPR source). i.e. the camera.

From a software development perspective, you'll have open a "listener" on the port number and wait for results. VaxALPR opens a connection for every new message, transmits the information and closes the connection.

.NET integration

In case of using a .NET platform Vaxtor provides a Class Library (Assembly) named **VaxAlprRemotePlateParser.dll** that can do this job for you and it is very easy to use.

This is automatically installed into your VaxALPR main directory:

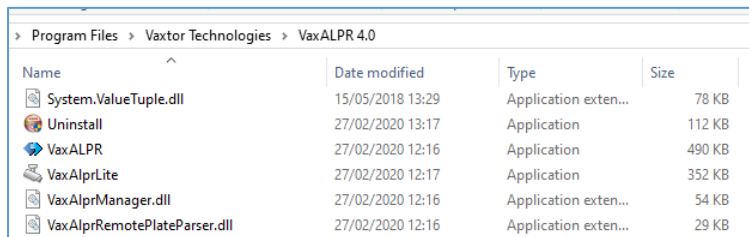| Name	Date modified	Type	Size
System.ValueTuple.dll	15/05/2018 13:29	Application exten...	78 KB
Uninstall	27/02/2020 13:17	Application	112 KB
VaxALPR	27/02/2020 12:16	Application	490 KB
VaxAlprLite	27/02/2020 12:17	Application	352 KB
VaxAlprManager.dll	27/02/2020 12:16	Application exten...	54 KB
VaxAlprRemotePlateParser.dll	27/02/2020 12:16	Application exten...	29 KB

Program Files > Vaxtor Technologies > VaxALPR 4.0

Visual Basic .NET example

1. Declare the main class of the class library

Imports VaxAlprRemotePlateParser

Private _server As AlprResultsServer = Nothing

2. Instance the main class and provide 2 callbacks to receive plate results and any possible errors from the library. Next start the server and provide the same port number as defined in the VaxALPR Lite configuration.

_server = New AlprResultsServer(AddressOf Me.OnNewPlate, AddressOf Me.OnAlprServerError)

_server.Start(port_number)

3. Shutdown the server when you have finished

_server.Shutdown()

Functions callback definition

Public Sub OnNewPlate(ByVal alpr_plate As AlprPlateResult)

End Sub

Public Sub OnAlprServerError(ByVal err_msg As String)

  MsgBox(err_msg, MsgBoxStyle.Exclamation)

End Sub

Raw integration and other platforms

In case of not using .NET you will have to parse the results yourself. This is the format of the data you'll get from the socket every time VaxALPR publishes a result:

- 4 bytes, int32   => 0xCAFEBABE is the start message header identifier (fixed)
- 4 bytes, int32   => 0xBABE10 result message (fixed)
- 4 bytes, int32   => VaxALPR instance ID, matches the tag InstanceID from VaxALPR configuration file
- 8 bytes, int64   => Time Stamp, current date in milliseconds
- 4 bytes, int32   => NC1:number of ASCII characters of the plate number
- NC1 bytes, byte   => ASCII bytes array
- 4 bytes, int32   => NC2:number of ASCII characters of the plate origin
- NC2 bytes, byte   => ASCII bytes array
- 4 bytes, int32   => ROI ID containing the license plate (1…n). 0 value means plate out of any ROI
- 8 bytes, double   => Global confidence of plate recognition:]0...100]
- 8 bytes, double   => Characters height, in pixels
- NC1 bytes, float   => Per character recognition confidence]0…100]
- 8 bytes, double   => OCR processing time, in milliseconds
- 4 bytes, int32   => 'x0' coordinate of the plate left-top corner, in pixels
- 4 bytes, int32   => 'y0' coordinate of the plate left-top corner, in pixels
- 4 bytes, int32   => 'x1' coordinate of the plate right-bottom corner, in pixels
- 4 bytes, int32   => 'y1' coordinate of the plate right-bottom corner, in pixels
- 8 bytes, int64   => OCR image timestamp, in milliseconds
- 4 bytes, int32   => SF: size of the OCR image, in bytes
- SF bytes, byte   => OCR image data in JPEG format
- 4 bytes, int32   => R1: size of image reserverved data, in bytes
- R1 bytes, byte   => reserved data, R1 bytes
- 8 bytes, int64   => Environment image timestamp, in milliseconds
- 4 bytes, int32   => SF: size of the envirnoment image, in bytes
- SF bytes, byte   => Environment image data in JPEG format
- 4 bytes, int32   => R2: size of image reserverved data, in bytes
- R1 bytes, byte   => reserved data, R2 bytes
- 4 bytes, int32   => vehicle direction, if available: 0=>unknown, 1=>closer, 2=>farther
- 4 bytes, int32   => ALPR multiplate rate
- 4 bytes, int32   => 1: plate reported under SYNCHRO_SIGNALED mode, 0: SYNCHRO_FREE_FLOW mode
- **4 bytes, int32   => 0x42F83988 Header indicating optional data follows up**
- --
- **4 bytes, int32   => 0x50000001 Plate number in wide string format section**

–	4 bytes, int32	=> Number of plate characters
–	4 bytes, int32	=> NC3: Number of bytes taking the full plate string
–	NC3 bytes, byte	=> Array of bytes representing the string either in UTF8 or UNICODE format
–	**4 bytes, int32**	**=> 0x50000002 Hot-List section (*)**
–	4 bytes, int32	=> 1:white list. 2: black list
–	4 bytes, int32	=> NC4:number of ASCII characters in the message
–	NC4 bytes, byte	=> ASCII bytes array containing the message
–	**4 bytes, int32**	**=> 0x50000003 String code section (**)**
–	4 bytes, int32	=> String code = 1:plate country region, 2: vehicle color, 3: vehicle make, 4: vehicle model
–	4 bytes, int32	=> NC5: number of ASCII characters of the string
–	NC5 bytes, byte	=> ASCII bytes array containing the characters
–	**4 bytes, int32**	**=> 0x50000004 GPS section**
–	8 bytes, double	=> Latitude in decimal format
–	4 bytes, int32	=> 1:N, 2:S
–	8 bytes, double	=> Longitude in decimal format
–	4 bytes, int32	=> 1:W, 2:E
–	--	
–	4 bytes, int32	=> 0x42F87D89 is the end message header identifier (fixed)

(*) The hot list block can appear twice, one per list.

(**) The string code block can appear more than once, but each code only can appear once.

TCP/IP sockets – sending plain results

Enter the IP address of the host machine receiving the results and enter the port number as above.

In addition, you can specify a template by using certain reserved words customize the data fields. Examples of the available reserved words are:

$instanceid$	: ID configured (00001, 00002, ….) will pad with zeros up to 5 chars.
$plate$	: Plate Number
$hour$	: 2 digit hour (localtime).
$minute$	: 2 digit minutes (localtime).
$second$	: 2 digit seconds (localtime).
$milllisecond$	: 3 digit milliseconds (localtime).
day	: 2 digit day
$month$	: 2 digit month
$year$	: 4 digit year
$plate$	: Plate number
$confidence$	: Confidence with 2 decimals, separator is a ".". Always.
$processingtime$	: In milliseconds
$country$	: Country
$roiid$	: Region of Interest Id where the plate was detected (-1 if none).
$direction$	: 0, 1, 2: Unknown, Getting closer, Getting farther.
$imagefile$	: Full path to the OCR image (full frame).
$plateimagefile$	: Full path to the Plate image (crop).
$envimagefile$	: Full path to the Overview image.
etc.	

For a full list of reserved words see the section towards at the end of this manual here.

HTTP-POST XML or JSON

XML Connector:

VaxALPR will send a HTTP POST to the webserver configured each time that a plate is read. The message Content-type will be "application/xml" and the message body will be the XML object defined in the file "**event.xml**" that you can find in VaxALPR installation directory. This file can be edited by the user to define the desired XML structure.

JSON connector:

VaxALPR will send a HTTP POST or HTTPS POST to the webserver configured each time that a plate is read. The message Content-type will be "application/json" and the message body will be the JSON object defined in the file "**event.json**" in the VaxALPR installation directory. This file can be edited by the user to define the desired JSON object. The available reserved words are:

Reserved words you can play with in your 'event' configuration file

$timestamp$: Date and time of the read in local time. The string is formatted according to ISO8601 standard (yyyy-MM-ddTHH:mm:sszzz). In example: 2007-11-23T13:18:05-03:00

$plate$: Plate number

$country$: Country of the vehicle using ISO ALPHA-3 Code.

$cameraid$: Unique id for the reader. This id is setup by the user on the configuration.

$confidence$: Global confidence of the plate (0-100).

$processingtime$: Milliseconds that the OCR took to analyze this plate number.

$charheight$: Average height in pixels of the characters in the plate number.

$left$,top,$right$,$bottom$: Pixel coordinates of the top left corner and the bottom right corner of the license plate in the image.

$absoluteleft$,$absolutetop$,$absoluteright$$absolutebottom$: Absolute coordinates (0 .. 1) of the top left corner and the bottom right corner of the license plate in the image.

$width$: Width of the analyzed image.

$height$: Height of the analyzed image.

$region$: Plate region. Countries like UAE or USA will report here the internal region (Dubai, Bahrein, New York …)

$category$: Plate category. Available for Kuwait.

$make$: Vehicle maker.

$model$: Vehicle model.

$vehiclecolor$: Vehicle color.

$direction$: Vehicle direction (UNKNOWN, GETTING_CLOSER, GETTING_FARTHER)

$latitude$, $longitude$: Coordinate of the read formatted in decimal degrees.

$image$: JPEG image encoded in base64 format.

$sizeinbytes$: Size in bytes of the JPEG image once decoded.

For a full list of reserved words see the section towards at the end of this manual here.

Send Results to the Optix N^X VMS System

See separate guide "VaxALPR on Camera - Network Optix & NX VMS Integration"

1. Once enabled, enter the URL of the NX host server using port 7001: http://nxserver:7001
   e.g. http://192.168.0.41:7001   - Note that the latest Optix NX enforces https.
   (ensure that the IP addresses of the PC and NX server are on the same subnet)

2. Enter your Username & Password.

3. Enter a "Source" parameter.   This is used by the NX Server to reference the events received.
   E.g. 'LPR".   This will mark all NX events as "LPR" events.

4. Enter the Caption and Description templates. This data will be saved with each event.
   Modify the two messages as required. The message can use Dynamic text replacement such as in the Overlay reporting option.
   - **$image$**: Full JPEG image encoded in base64.
   - **$jpegsize$:** JPEG size in bytes.
   - **$date$**: Timestamp in ISO8601 format
   - **$plate$**: Plate number
   - **tag**: Unique hash for this plate number. Same plate number will always give the same tag. Format based on UTMC algorithm.
   - **$plateutf8$**: Plate number in utf8 format.
   - **$country$**: Full country of origin name.
   - **$countrycode$**: 3 letter country code.
   - **$state$**: Plate State for USA.
   - **$category$**: Plate category for countries that support it.
   - **$blacklist$**: Description on the blacklist linked to the plate number.
   - **$whitelist$**: Description on the whitelist linked to the plate number.
   - **$ifblacklist$ .... $ifblacklist$**: If the plate is on the blacklist, the text in the 'if clause' will be displayed.
   - **$ifwhitelist$ .... $ifwhitelist$**: If the plate is on the whitelist, the text in the 'if clause' will be displayed.
   - **$ifnolist$...$ifnolist$:** If the plate in not on a list, the test in the 'if clause' will be displayed.
   - **$confidence$**: Global confidence (0-100).
   - **$charheight$**: Average charheight (pixels).
   - **$processingtime$**: Processing time in milliseconds.
   - **$left$**: Left coordinate for the plate on the image (pixels).
   - **top**: Top coordinate for the plate on the image (pixels).
   - **$right$**: Right coordinate for the plate on the image (pixels).
   - **$bottom$**: Bottom coordinate for the plate on the image (pixels).
   - **$absoluteleft$**: Plate left position based on the total image width (0-1).
   - **$absolutetop$**: Plate top position based on the total image height (0-1).
   - **$absoluteright$**: Plate right position based on the total image width (0-1).
   - **$absolutebottom$**: Plate bottom position based on the total image height (0-1).
   - **$width$**: OCR image width.

- **$height$**: OCR image height.
- **ip**: Camera IP address.
- **$roiid$**: Roi ID where the plate number is found.
- **$speed$**: Vehicle speed (Km/h).
- **$multiplate$**: Amount of times that the plate has been read before reporting.
- **$signaled$**: True if the read has been done due to a trigger.
- **id**: Database ID for this read.
- **$direction$**: Enumerate with the vehicle direction (0: Unknown, 1: Towards, 2: Away, 3: Stopped)
- **$directionstr$**: String with the vehicle direction.
- **$safedate$**: Date in format %Y%m%d_%H%M%S in the camera time zone (Useful for filenames).
- **$localdate$**: Date in format %d/%m/%Y in the camera time zone
- **$localtime$**: Date in format %H:%M:%S in the camera time zone.
- **$imageid$**: Signal ID in case of a trigger read.
- **$plateimage$**: Plate crop JPEG image encoded in base64.
- **$platejpegsize$**: JPEG size in bytes.
- **$overviewimage$**: Overview JPEG image encoded in base64.
- **$overviewjpegsize$**: JPEG size in bytes.
- **$epoch$**: Unix epoch (seconds).
- **$utcdate$**: Will report the date at ISO8601 format but always in UTC. (2020-12-31T16:11:30.000Z)
- **etx**: End transmission character (03)
- **stx**: Start transmission character (02)

For a full list of reserved words see the section towards at the end of this manual here.

You can add your own parameters into the message, so if you want to add say a site ID, your message might look like this:
{ "plate":"$plate$", "date":"$date$", "ip":"ip", "country":"$country$", "sitecode": 12345}

5. Enter the Camera ID. This is the ID that has been setup in the NX VMS settings. This can be found in Camera Settings.

Dynamic Text Replacement Reserved Words

- **$image$**: Full JPEG image encoded in base64.
- **$jpegsize$:** JPEG size in bytes.
- **$date$**: Timestamp in ISO8601 format
- **$plate$**: Plate number
- **tag**: Unique hash for this plate number. Same plate number will always give the same tag. Format based on UTMC algorithm.
- **$plateutf8$**: Plate number in utf8 format.
- **$country$**: Full country of origin name.
- **$countrycode$**: 3 letter country code.
- **$state$**: Plate State for USA.
- **$category$**: Plate category for countries that support it. E.g. the small prefix on some UAE plates.
- **$blacklist$**: Description on the blacklist linked to the plate number.
- **$whitelist$**: Description on the whitelist linked to the plate number.
- **$ifblacklist$ .... $ifblacklist$**: If the plate is on the blacklist, the text in the 'if clause' will be displayed.
- **$ifwhitelist$ .... $ifwhitelist$**: If the plate is on the whitelist, the text in the 'if clause' will be displayed.
- **$ifnolist$**...**$ifnolist$:** If the plate is not on a list, the test in the 'if clause' will be displayed.
- **$confidence$**: Global confidence (0-100).
- **$charheight$**: Average charheight (pixels).
- **$processingtime$**: Processing time in milliseconds.
- **$left$**: Left coordinate for the plate on the image (pixels).
- **top**: Top coordinate for the plate on the image (pixels).
- **$right$**: Right coordinate for the plate on the image (pixels).
- **$bottom$**: Bottom coordinate for the plate on the image (pixels).
- **$absoluteleft$**: Plate left position based on the total image width (0-1).
- **$absolutetop$**: Plate top position based on the total image height (0-1).
- **$absoluteright$**: Plate right position based on the total image width (0-1).
- **$absolutebottom$**: Plate bottom position based on the total image height (0-1).
- **$width$**: OCR image width.
- **$height$**: OCR image height.
- **ip**: Camera IP address.
- **$roiid$**: Roi ID where the plate number is found.
- **$make$**: The vehicle make
- **$model$**: The vehicle model
- **$color$**: The vehicle color
- **$class$**: The vehicle classification (type – e.g. car, van etc)
- **$speed$**: Vehicle speed (Km/h).
- **$multiplate$**: Amount of times that the plate has been read before reporting.
- **$signaled$**: True if the read was caused by a trigger.
- **id**: Database ID for this read.
- **$direction$**: Enumerate with the vehicle direction (0: Unknown, 1: Towards, 2: Away, 3: Stopped)
- **$directionstr$**: String with the vehicle direction.
- **$safedate$**: Date in format %Y%m%d_%H%M%S in the camera time zone (Useful for filenames).
- **$localdate$**: Date in format %d/%m/%Y in the camera time zone
- **$localtime$**: Date in format %H:%M:%S in the camera time zone.
- **$imageid$**: Signal ID in case of a trigger read.
- **$plateimage$**: Plate crop JPEG image encoded in base64.
- **$platejpegsize$**: JPEG size in bytes.
- **$overviewimage$**: Overview JPEG image encoded in base64.
- **$overviewjpegsize$**: JPEG size in bytes.

- **$epoch$**: Unix epoch (seconds).
- **$utcdate$**: Will report the date at ISO8601 format but always in UTC. (2020-12-31T16:11:30.000Z)
- **etx**: End transmission character (03)
- **stx**: Start transmission character (02)
- **$vehicleaccess$:** Entry / Exit events (0: Unknown, 1: enter, 2: exit, 3: overstay)
- **$dwelltime$:** Time spent in monitored area in seconds
- **$year$:** Year
- **$month$:** Month number
- **day:** Day number
- **$hour$:** Hour
- **$minute$:** Minute
- **$second$:** Seconds

Ends.