

# iSYS-5220

## User Manual



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## HISTORY

| Document revision | Date       | Change log                                                                                                                                                                            | Author |
|-------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 1                 | 2019-11-27 | <ul style="list-style-type: none"> <li>First release</li> </ul>                                                                                                                       | JS     |
| 2                 | 2019-12-09 | <ul style="list-style-type: none"> <li>Added Udp Settings</li> </ul>                                                                                                                  | SW     |
| 3                 | 2020-06-05 | <ul style="list-style-type: none"> <li>Added output number in event messages</li> </ul>                                                                                               | JS     |
| 4                 | 2020-06-29 | <ul style="list-style-type: none"> <li>Added ObjectID in motion event messages</li> </ul>                                                                                             | SW     |
| 5                 | 2020-09-15 | <ul style="list-style-type: none"> <li>Added new Images</li> <li>Update User Manual to latest changes in Software</li> </ul>                                                          | SW     |
| 6                 | 2020-11-23 | <ul style="list-style-type: none"> <li>Approvals Update</li> </ul>                                                                                                                    | WH     |
| 7                 | 2021-01-11 | <ul style="list-style-type: none"> <li>Added ETA point</li> <li>Update images and descriptions</li> <li>Added ETA and BicycleAvailable in event messages</li> </ul>                   | SW     |
| 8                 | 2021-04-21 | <ul style="list-style-type: none"> <li>Added number of pedestrians/bikes, cars, small trucks, big trucks in event message. Removed BicycleAvailable flag in event messages</li> </ul> | SW     |

## DOCUMENTS

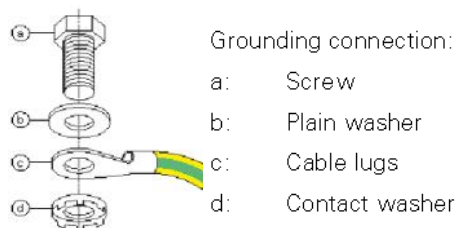
- [1] User Manual Mounting Bracket iSYS-5220.pdf
- [2] User Manual Ethernet Cable iSYS-5220.pdf
- [3] User Manual Power Supply Cable iSYS-5220.pdf
- [4] Quick Start Guide iSYS-5220.pdf
- [5] iSYS-5220\_RadarAPI\_readMe.pdf
- [6] UDP Message Viewer ReleaseNotes.pdf

# 1. SAFETY INSTRUCTIONS

- Only skilled and instructed persons shall install and connect the devices.
- Proper experience in working with mains voltage, electrical and electronic devices is required.
- Do not connect the devices directly to mains voltage, instead use the voltage given in the manual
- Do not wire any connections while power is applied to the device.
- Ground the devices carefully to prevent electrical shock.
- All connectors are pin-coded and fit in only one position.
- Mount the devices carefully to prevent them from shifting or dropping.



- The case must not be opened as this will void the warranty and cause incorrect calibration of the sensor.
- The Radome must not be painted, covered or glued over, as this will impair its function and cause incorrect calibration of the sensor.
- Ensure adequate ventilation during operation.
- The Breezer must not be covered.
- All connected plugs must be screwed mechanically stable in order to comply with protection class IP67.
- Unused connections should be covered with a sealing cap.
- Use a shielding for the sensor if needed to protect against environmental conditions (snow, rain, dust).



- Only use fully functional equipment (ladders, aerial work platform, ...) when working above ground.
- Staff shall be capable of working at heights.
- Use caution when installing the devices on or around active roadways. Pay attention to moving traffic.
- The devices must be mounted to a stiff and solid support.
- Vibration, oscillation or any kind of movement will reduce the sensor performance.
- Make sure that your installation methods are in accordance with local safety policy and procedures and company practices. The protective conductor connection must not be used for other purposes. It must have a permanent electrical continuity and mechanical strength.

## 2. SENSOR DESCRIPTION

The iSYS-5220 is a 24GHz 4D/UHD radar sensor designed and developed for multiple-lane, multiple-target tracking, intersection management and traffic monitoring applications.

The newest member of InnoSenT's radar fleet is designed for longrange and wide horizontal view to cover up to two slip roads to an intersection with multiple lanes.

### Measurements

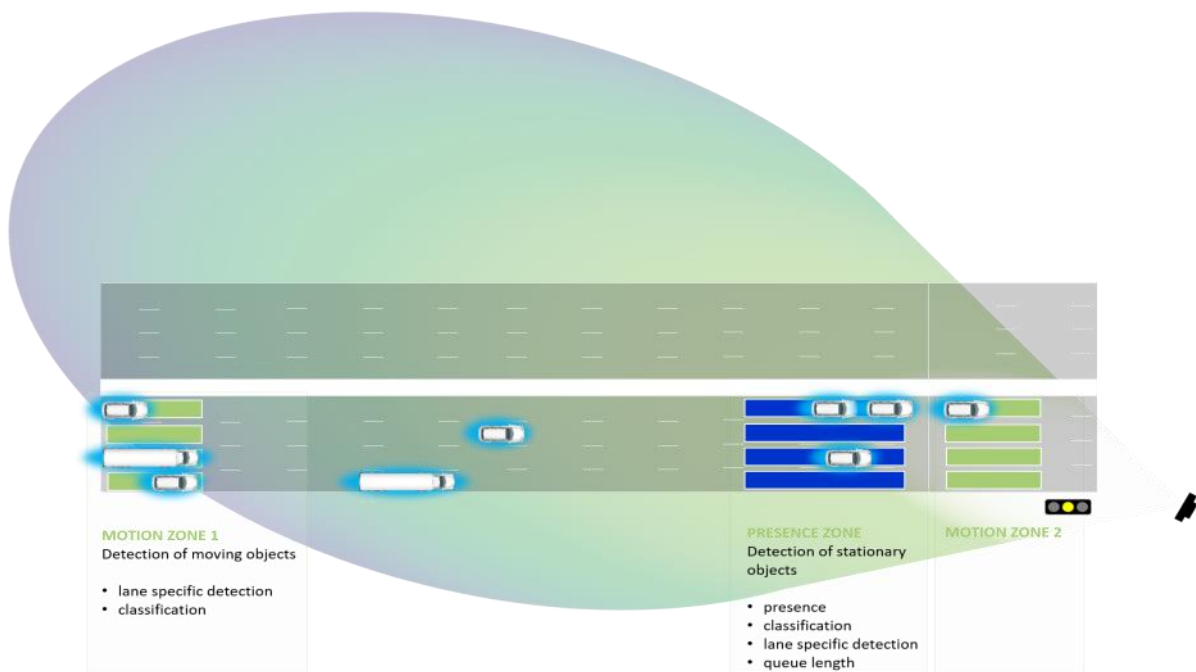
The sensor uses, with its Doppler based radial motion detection principle, innovative signal processing for optimal target detection. The measurements contain range, radial speed, azimuth and elevation angle, received signal strength and more parameters of the observed targets. This ensures a fast and efficient field of view coverage for excellent detection of moving targets, as well as stationary objects. Thanks to its high definition resolution the iSYS-5220 is capable of separating up to 512 detections on up to 8 lanes, enabling many different traffic monitoring applications in scenarios with many objects present.

### Tracking

After measuring the parameters of the detections, the iSYS-5220 uses modern multiple-target tracking algorithms to generate an object list in every update cycle of 50ms. This object list, consisting of up to 128 tracks, provides a variety of track parameters, such as position, velocity, direction, Object ID and many more.

### Applications

With its quick and easy configuration, the iSYS-5220 can be used for a variety of different applications. Thanks to our exclusive introduction of two brand new event zone types, challenging scenarios like Traffic Counting, Stop bar Detection, queue length measurements, and many more, can be solved comfortable.

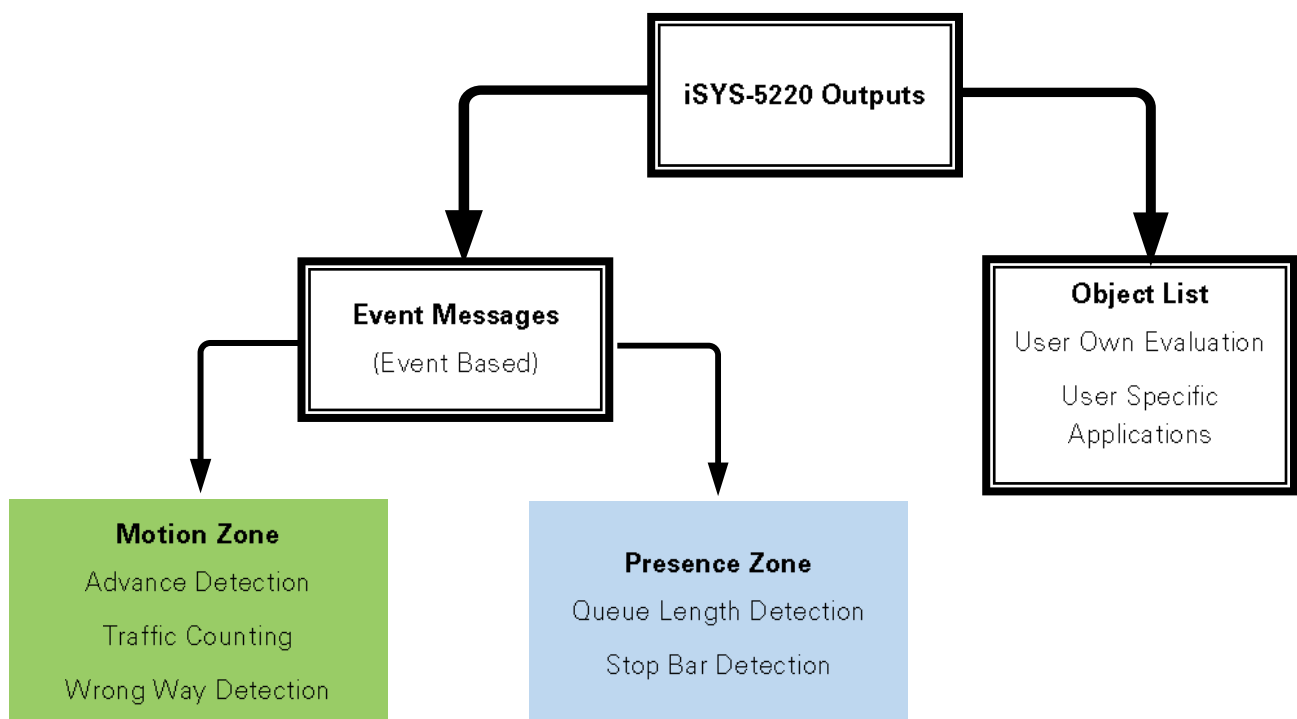


## 2.1 Traffic Applications with the iSYS-5220

The main feature of the iSYS-5220 are its two user friendly outputs:

- **Object list:** supplies the user with all object parameters, which are sent via Ethernet. This allows the user to implement his own desired applications.
- **Event Messages:** event based UDP or TCP/IP messages, which are sent via Ethernet or RS485. These messages enable quick and easy deployment for traffic applications.

These two outputs provide the user with all the necessary information needed to successfully monitor his applications. The two outputs are described in the following.



### 2.1.1 Object List

Object lists have to be requested by the Radar API. The update cycle of the object list is 50ms and a new request must be sent in order to retrieve the latest object list. The content of each object list, with the parameters of every track, is described in [\[11.2.1\]](#).

The use of object lists allows users to perform their own evaluations and implementations of specific applications.

## 2.1.2. Event Message

The iSYS-5220 sends the user UDP or TCP/IP event messages for two different types of Event Zones, which enable realization of many different traffic applications:

- Motion Zone: for detection of moving objects
- Presence Zone: for detection of stationary objects

Both Presence and Motion Zones can be used separately as well as in combination for detection within zones of interest. The two Event Zone types can be easily configured via InnoSenT's Traffic Manager or iSYS-5220 Radar API.

Depending on the Event Zone type a corresponding event message will be sent with the following information:

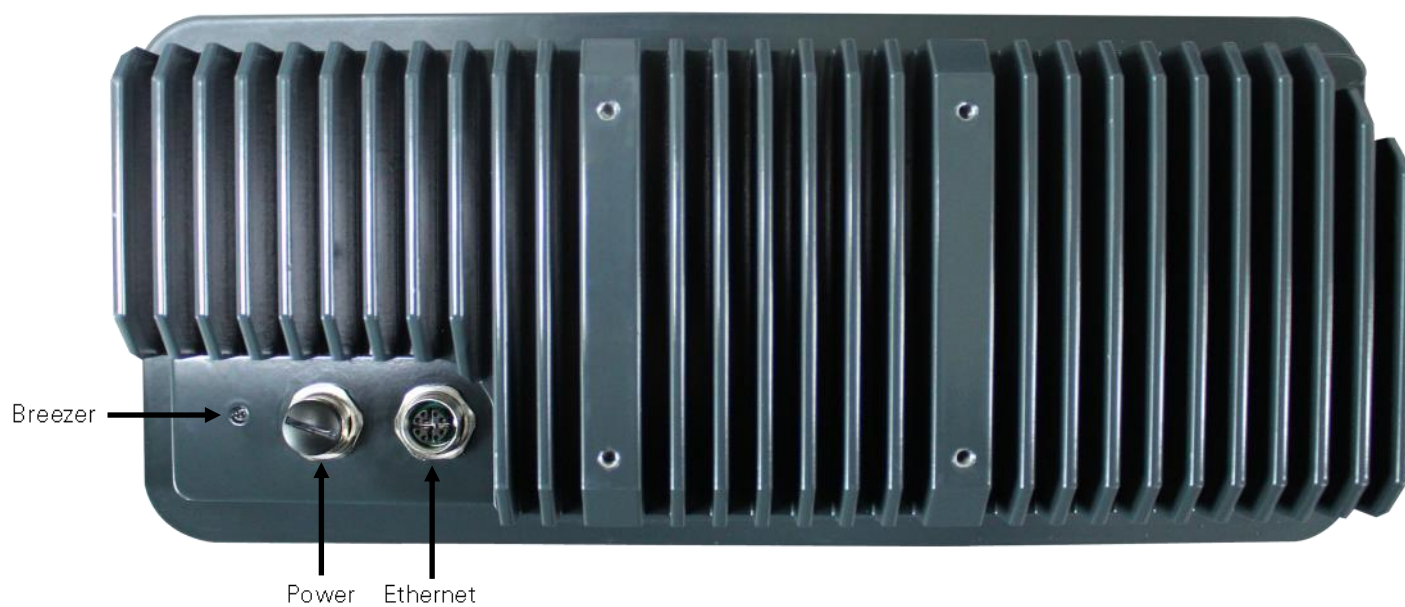
| Event Zone Type            | Motion                                    | Presence                                                                                  |
|----------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------|
| <b>Message Information</b> | Time stamp                                | Time stamp                                                                                |
|                            | Zone type                                 | Zone type                                                                                 |
|                            | Zone number                               | Zone number                                                                               |
|                            | Speed                                     | Queue                                                                                     |
|                            | Class                                     | Number of stationary objects                                                              |
|                            | Direction                                 | System state                                                                              |
|                            | System state                              | Output Number                                                                             |
|                            | Output Number                             | Phase Number                                                                              |
|                            | Phase Number                              | Number of pedestrians/bikes                                                               |
|                            | ObjectID                                  | Number of cars                                                                            |
|                            | Estimated time of arrival                 | Number of small trucks                                                                    |
|                            |                                           | Number of big trucks                                                                      |
|                            |                                           |                                                                                           |
| <b>Update</b>              | Each time an object enters the Event Zone | Each time there is a change in Queue Length or number of static objects in the Event Zone |

Thanks to these event messages the user gets a comfortable overview of complex situations. On how to set and configure event zones and what zone is most ideal for which application, please refer to sections [\[12.6.4\]](#) and [\[13\]](#).

### 3. SENSOR PHOTOGRAPH

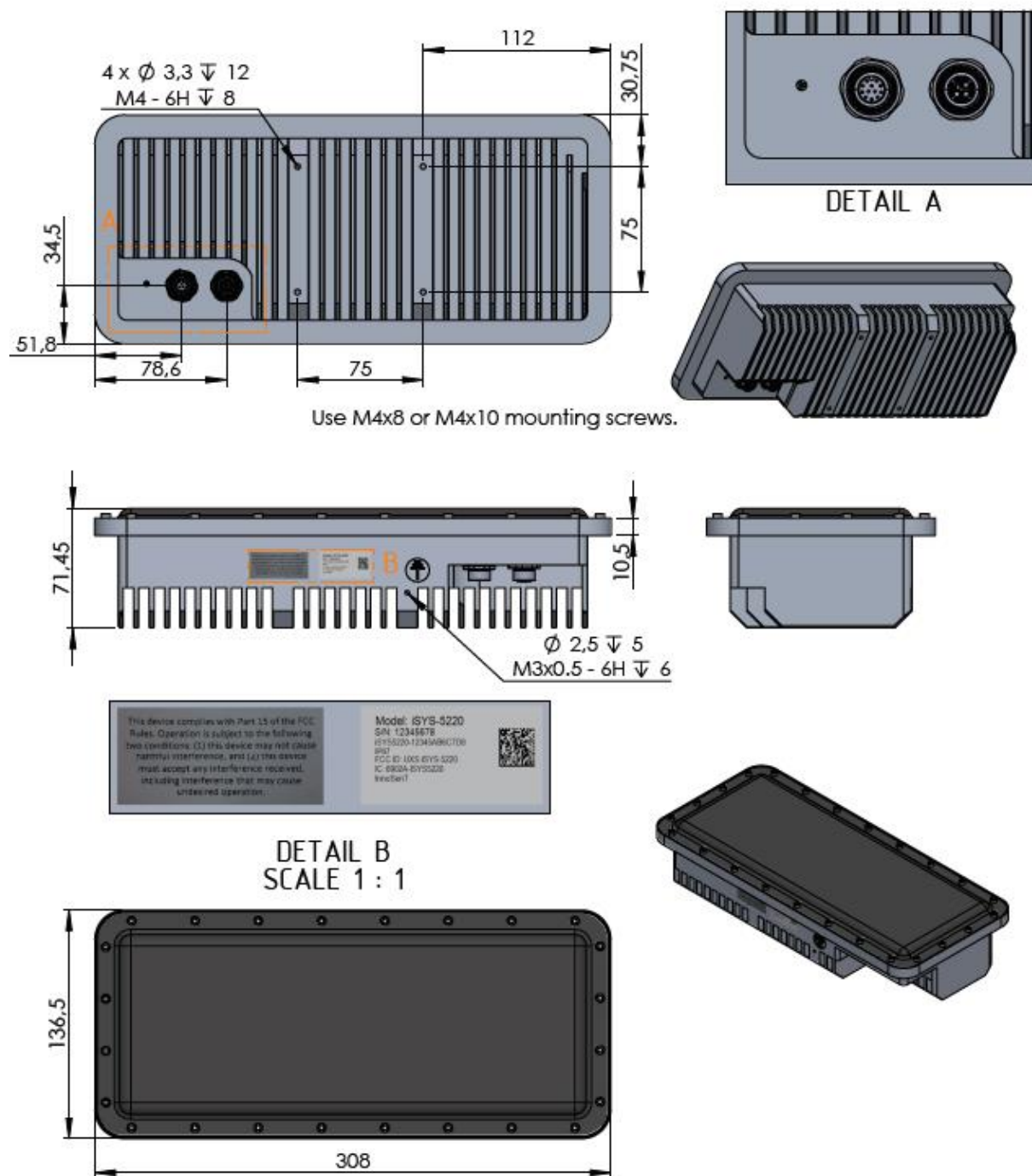


iSYS-5220 - front



iSYS-5220 - back

## 4. MECHANICAL DRAWING



All Dimensions in mm

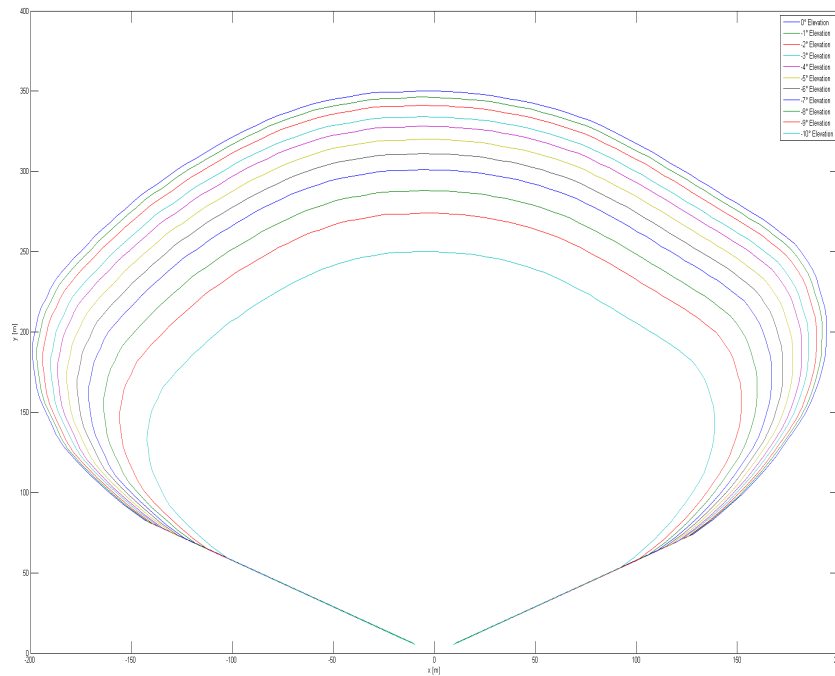
## 5. ACCESSORIES

| Accessory          | Ordering Number                                                                                                | Picture                                                                             | Description                                                                                                                                                                                                                                                                                                 | Documentation                                    |
|--------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Power Supply Cable | 29.00000284                                                                                                    |    | Connection with power supply<br>Connection with RS485 interface                                                                                                                                                                                                                                             | User Manual Power Supply Cable iSYS-5220.pdf [3] |
| Ethernet Cable     | 29.00000283                                                                                                    |    | Connection with Ethernet                                                                                                                                                                                                                                                                                    | User Manual Ethernet Cable iSYS-5220.pdf [2]     |
| Mounting Bracket   | 80.00000417                                                                                                    |    | attaches the iSYS-5220 to a mast, post, or pole                                                                                                                                                                                                                                                             | Data Sheet Mounting Bracket iSYS-5220.pdf [1]    |
| Software Package   | can be downloaded from InnoSenTs' download Server.<br><br>Link will be provided by your InnoSenT sales person. |  | <p>Software Package:</p> <ul style="list-style-type: none"> <li>• Traffic Manager</li> <li>• Radar API</li> <li>• Network Browser</li> <li>• Firmware Update</li> <li>• Intersection Manager</li> </ul> <p>Traffic Manager is used for configuring the iSYS-5220 and displays the radar data on screen.</p> |                                                  |

## 6. PRODUCT SPECIFICATION

|                                     |                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Functions &amp; Applications</b> | Intersection Management <ul style="list-style-type: none"> <li>• Stop bar detection</li> <li>• Queue length detection</li> <li>• Advance detection</li> <li>• Classification</li> <li>• Traffic light management</li> <li>• Junction monitoring</li> <li>• Wrong way</li> </ul> | Traffic Monitoring <ul style="list-style-type: none"> <li>• Traffic counting</li> <li>• Classification</li> <li>• Arterial management</li> <li>• Traffic statistics</li> </ul> |
| <b>Target separation capability</b> | Distance, Speed and Angle                                                                                                                                                                                                                                                       |                                                                                                                                                                                |
| <b>Field of view</b>                | Azimuth: 110 ° , Elevation: 30 °                                                                                                                                                                                                                                                |                                                                                                                                                                                |
| <b>Max. velocity</b>                | ±233 km/h                                                                                                                                                                                                                                                                       |                                                                                                                                                                                |
| <b>Maximum detection range</b>      | Up to 350m (depending on target RCS)                                                                                                                                                                                                                                            |                                                                                                                                                                                |
| <b>Measurement cycle time</b>       | 50 ms                                                                                                                                                                                                                                                                           |                                                                                                                                                                                |
| <b>Power up time</b>                | Depending on Ethernet connection <ul style="list-style-type: none"> <li>• 30 s using DHCP-Server</li> <li>• 95 s using Static IP-Address</li> </ul>                                                                                                                             |                                                                                                                                                                                |
| <b>Object list generation</b>       | <ul style="list-style-type: none"> <li>• Unique ID</li> <li>• Track quality</li> <li>• Class</li> <li>• Zone index (motion and presence)</li> <li>• Position (x, and y-direction)</li> <li>• Velocity</li> <li>• Object dimension (length, width)</li> </ul>                    |                                                                                                                                                                                |
| <b>Max. number of objects</b>       | 128                                                                                                                                                                                                                                                                             |                                                                                                                                                                                |
| <b>Max. number detections</b>       | 512                                                                                                                                                                                                                                                                             |                                                                                                                                                                                |
| <b>Interfaces</b>                   | <ul style="list-style-type: none"> <li>• Ethernet (1Gbit/s, 100Mbit/s)</li> <li>• RS-485 (full duplex)</li> </ul>                                                                                                                                                               |                                                                                                                                                                                |
| <b>Power consumption</b>            | Typ. 33 W @ 25°C (32W...38W over temperature range)                                                                                                                                                                                                                             |                                                                                                                                                                                |
| <b>Supply option</b>                | <ul style="list-style-type: none"> <li>• Power over Ethernet (Supply voltage: 48V DC (± 5 %))</li> </ul>                                                                                                                                                                        |                                                                                                                                                                                |
| <b>Frequency band</b>               | 24.05 to 24.25 GHz                                                                                                                                                                                                                                                              |                                                                                                                                                                                |
| <b>Max. transmit power (EIRP)</b>   | < 20 dBm PK / <108dBµV/m AVG                                                                                                                                                                                                                                                    |                                                                                                                                                                                |
| <b>Dimensions</b>                   | <ul style="list-style-type: none"> <li>• Length: 308 mm</li> <li>• Width: 136,5 mm</li> <li>• Depth: 71,45 mm</li> </ul>                                                                                                                                                        |                                                                                                                                                                                |
| <b>Weight</b>                       | 2520g                                                                                                                                                                                                                                                                           |                                                                                                                                                                                |
| <b>Temperature Range</b>            | -40°C to +74°C                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |
| <b>Protection Standard</b>          | IP67                                                                                                                                                                                                                                                                            |                                                                                                                                                                                |
| <b>Additional Features</b>          | <ul style="list-style-type: none"> <li>• GPS</li> <li>• Inclination sensor for easier configuration</li> <li>• up to 4 sensors without interference (Synchronization after 2...7 min)</li> <li>• Build in self-test function</li> </ul>                                         |                                                                                                                                                                                |

## 6.1 RADAR BEAM



The plot shows the iSYS-5220 radar beam for the elevation angles  $0^\circ \dots -10^\circ$ . The best performance is achieved in bore sight. With its wide angular view, a full coverage of the desired scenario can be achieved. In the table below the detection range dependent on the elevation angle is shown. The range is specified for cars and trucks. The initialization of tracks takes about 1 second after the target is detected within the RADAR beam. Take in mind that target detection and track initialization is dependent on the target's radar-cross section.

| Elevation Angle [°] | Min Range [m] | Max Range [m] |
|---------------------|---------------|---------------|
| -10                 | 11            | 250           |
| -9                  | 11            | 274           |
| -8                  | 12            | 288           |
| -7                  | 12            | 301           |
| -6                  | 13            | 311           |
| -5                  | 14            | 320           |
| -4                  | 15            | 328           |
| -3                  | 15            | 334           |
| -2                  | 16            | 341           |
| -1                  | 17            | 346           |
| 0                   | 19            | 350           |

## 7. INSTALLATION & MOUNTING

Easy installation—one of the smart features of the iSYS-5220. The Traffic Manager Software enables a quick configuration of all necessary parameters (see Section '[Configuration using Traffic Manager](#)' for further information.)

### 7.1. Mounting Bracket

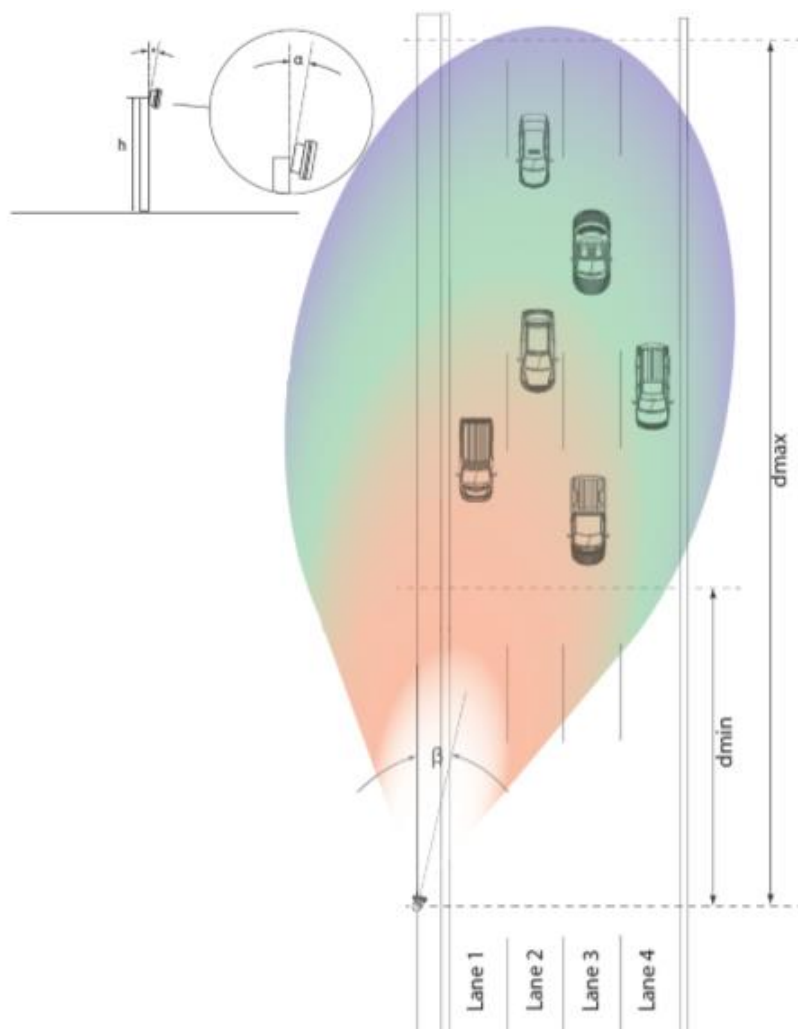
A mounting bracket for easy assembly on a pole (round shape) is available from InnoSenT. Information about the mounting bracket is provided in Document [\[1\]](#).

Please address your InnoSenT sales contact for further information.



## 7.2. Installation

This sketch shows a typical left side installation. The iSYS-5220 can also be configured to gantry or right side installation. Take care that the area of interest from the road fits into the FOV of the device. The iSYS-5220 is designed to track the oncoming traffic. Installations outside the recommended specification tend to result in performance drops. Occlusions need to be considered. It must be understood that neither the detection probability may be 100%, nor the false alarm rate 0%.



| installation     | symbol   | min.  | typ. | max.    | unit |
|------------------|----------|-------|------|---------|------|
| height           | $h$      | 4/13  | 6/19 | 8/26    | m/ft |
| elevation angle* | $\alpha$ | -10   | -7   | 0       | °    |
| angle to lane**  | $\beta$  | -60   | 6    | 60      | °    |
| motion zone      | $d$      | 30/98 |      | 200/656 | m/ft |
| presence zone    | $d$      | 20/65 |      | 80/262  | m/ft |

\* referenced to road gradient angle

the above range pertains to a horizontal road, i.e. elevation has to be adjusted to the individual scene

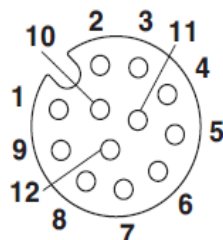
\*\* driving direction of the traffic can be within  $\pm 60^\circ$  to radar sensor boresight, take care that the road is well located within the radar beam within  $110^\circ$  FOV.

For further information, please refer to Section [\[16\]](#).

## 8. CONNECTORS

### 8.1 Power Supply Connector

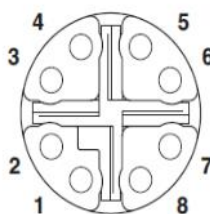
Type: Phoenix Contact SACC-CI-M12FS-12CON-SH TOR 32 (1457704)



| Pin | Description    |
|-----|----------------|
| 1   | GND            |
| 2   | GND            |
| 3   | RS485_FD.A     |
| 4   | RS485_FD.B     |
| 5   | RS485_FD.Z     |
| 6   | RS485_FD.Y     |
| 7   | VCC            |
| 8   | VCC            |
| 9   | Do not connect |
| 10  | Do not connect |
| 11  | Do not connect |
| 12  | Do not connect |

### 8.2 Ethernet Connector

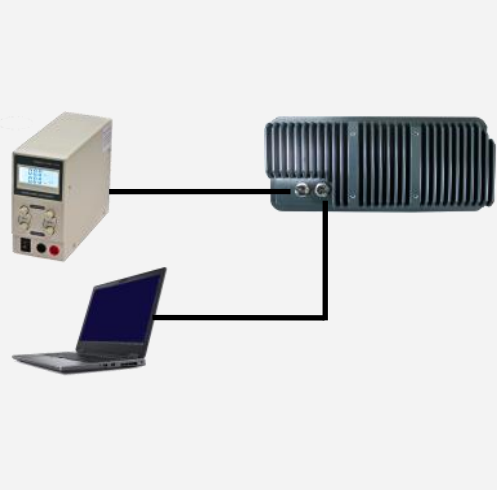
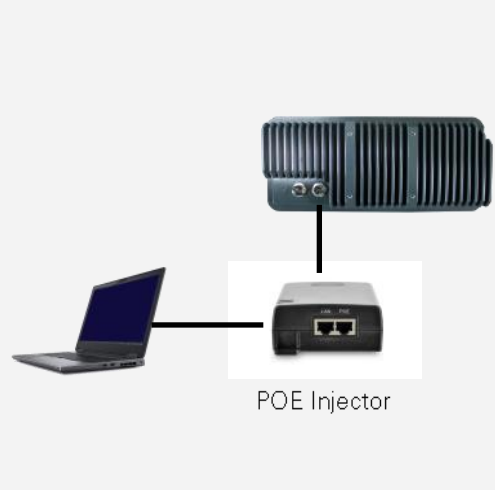
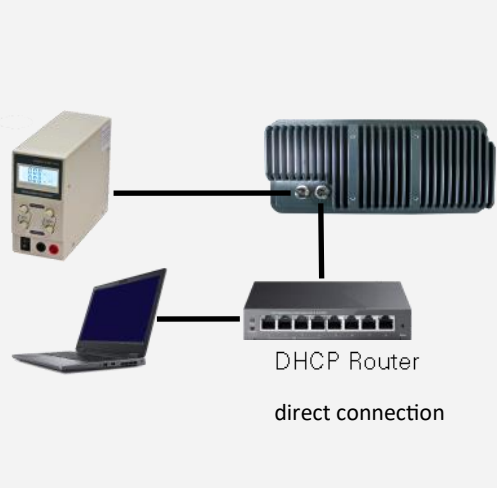
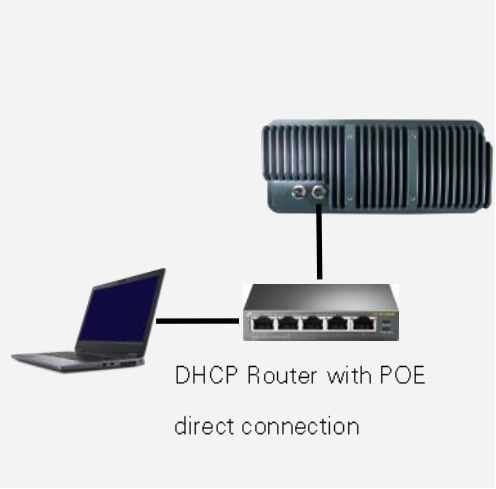
Type: Phoenix Contact SACC-CI-M12FS-8CON-L-180-10 (1402457)



| Pin | Strand Colour | Signal ID |
|-----|---------------|-----------|
| 1   | orange-white  | DA+       |
| 2   | orange        | DA-       |
| 3   | green-white   | DB+       |
| 4   | green         | DB-       |
| 5   | brown-white   | DD+       |
| 6   | brown         | DD-       |
| 7   | blue-white    | DC+       |
| 8   | blue          | DC-       |

9. CONNECTION

Prepare the Ethernet and power supply connection using one of the following options:

| Option   |                            | Power Supply                                                                                                            |                                                                                                                                   |
|----------|----------------------------|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
|          |                            | External power supply (24 VDC)                                                                                          | Power over Ethernet (one cable solution)                                                                                          |
| Ethernet | Direct (fixed IP-address)  |                                       | <br>POE Injector                               |
|          | Over Network (DHCP Server) | <br>DHCP Router<br>direct connection | <br>DHCP Router with POE<br>direct connection |

If both power supplies (24 VDC + POE) are connected, the system uses 24 VDC. If the system runs with POE and 24 VDC is connected, it switches to 24 VDC and reboots the system.

Power supply cable and Ethernet cable are available from InnoSenT. Information is provided in Documents [\[2\]](#) and [\[3\]](#). Please contact your InnoSenT sales person for further information.

## 9.1 PoE power supply standard

The PoE power supply standard that is needed to power the iSYS-5220:

| Property                                                  | 802.3bt Type 3 „4PPoE“                                                                 |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------|
| Power available at powered device (PD)                    | 51 W                                                                                   |
| Maximum power delivered by power sourcing equipment (PSE) | 60 W                                                                                   |
| Voltage range (at PSE)                                    | 50.0—57.0 V                                                                            |
| Voltage range (at PD)                                     | 42.5—57.0 V                                                                            |
| Maximum current I <sub>max</sub>                          | 600 mA per pair                                                                        |
| Maximum cable resistance per pairset                      | 12.5 Ω                                                                                 |
| Power management                                          | Six power class levels (1-6) negotiated by signature or 0.1 W steps negotiated by LLDP |
| Derating of maximum cable ambient operating temperature   | 10 °C (20 °F) with more than half of bundled cables pairs at I <sub>max</sub>          |
| Supported cabling                                         | Category 5                                                                             |
| Supported modes                                           | Mode A, mode B, 4-pair mode                                                            |

## 10. NETWORK CONFIGURATION

During boot up, the iSYS-5220 checks if there is a DHCP server available.

### 10.1. Connection using DHCP

If there is a DHCP server available, the iSYS-5220 requests the IP address from the DHCP server.

Make sure that the Ethernet is connected before power up if an IP from a DHCP server shall be used.

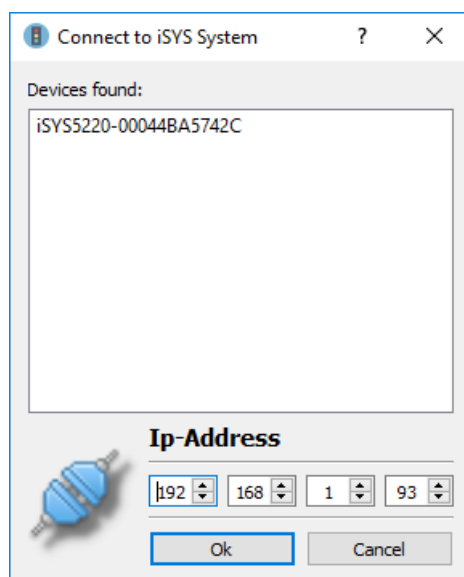
The boot process with DHCP Server takes about 30 Seconds.

There is no cyclical request for DHCP server available. If connecting a DHCP server after boot up, please restart the system.

When using more than one iSYS-5220 in a network the different devices can be determined by their unique host-name which is printed on the device label. This hostname consists of the string "iSYS-5220-XXXXXXXXXXXX", where X refers to the MAC address without hyphens.

To find and list all devices in your network and read the assigned IP addresses you can use InnoSenT's Traffic Manager or Network Browser.

If you cannot find the device, please check the assigned IP Address in the router.



## 10.2. Connection using fixed IP-address

If there is no DHCP server available during boot up the iSYS-5220 falls back to the fixed static IP address (192.168.178.253).

In this case the connection sequence does not matter. It is the default delivery state of all devices.

The boot process with fixed IP-address takes about 95 Seconds.

Connect only one device when using the static IP address.

If more than one system is connected, take in mind that you have to set different static IP addresses.

To restore the network defaults please use Traffic Manager Menu "Extras -> restore network defaults over RS485".

iSYS network settings

☐ Use DHCP

☒ Use static IP

IP-Address: 192 . 168 . 178 . 253

subnet mask: 255 . 255 . 255 . 0

standard gateway: 0 . 0 . 0 . 0

Ok Cancel

## 10.3. Changing TCP-IP setting

The IP configuration can be changed between DHCP and a fixed IP address using InnoSenT's iSYS-5220 Radar API (included in the software package) or Traffic Manager software (-> options -> network settings).

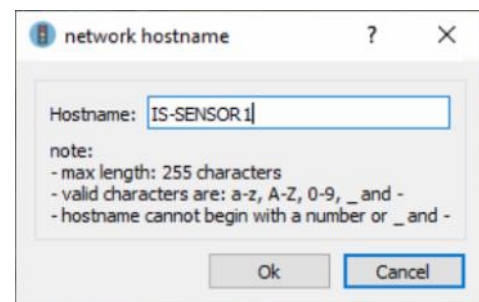
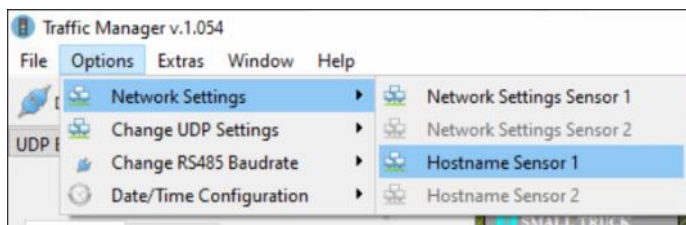
Note: The ports used by the iSYS-5220 can be secured by windows firewall or other firewalls. Check the settings of the firewall if you have connection problems.

## 10.4. Network Hostname

When using more than one iSYS-5220 in a network, every device can be determined by their unique hostname which is printed on the device label. This hostname consists of the string "iSYS-5220-XXXXXXXXXXXX", where X refers to the MAC address without hyphens.

If preferred, you are able to change the Hostname. Please observe the following rules:

- Maximum length: 255 characters (we recommend a short, descriptive name)
- Valid characters (related to RFC 952) are: a-z, A-Z, 0-9, \_ and -
- Hostname cannot begin with a number or \_ and -



After changing the hostname, a system reboot is needed for the change to take effect.

**NOTE: It can take a while until the new hostname is recognized by the router or DNS service.**

If your new hostname is not pingable, you can try to rebuild your DNS cache.

Example for Windows: Type "ipconfig /flushdns" in your command line window (cmd.exe).

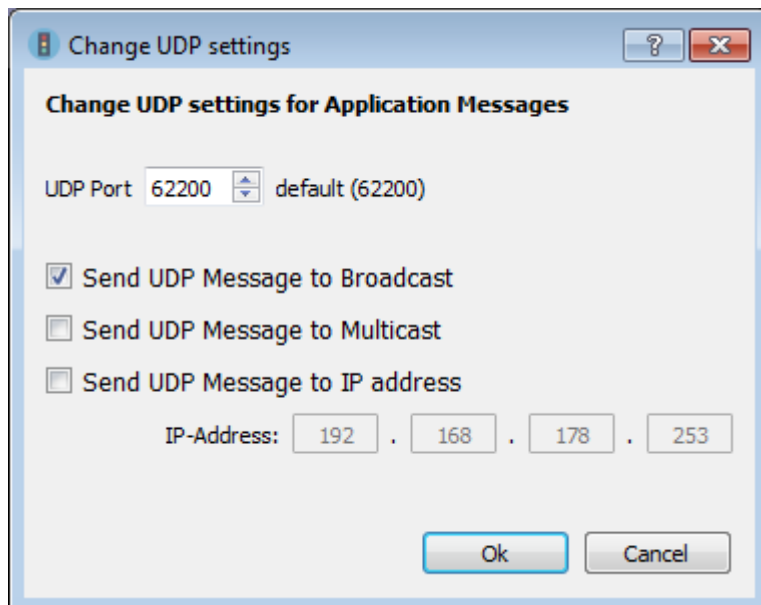
## 10.5. UDP Settings

The UDP settings can be changed between three options. Further the UDP port 62200 can be changed to a customized port. **Please be careful not to use reserved ports like 80, 21, ...**

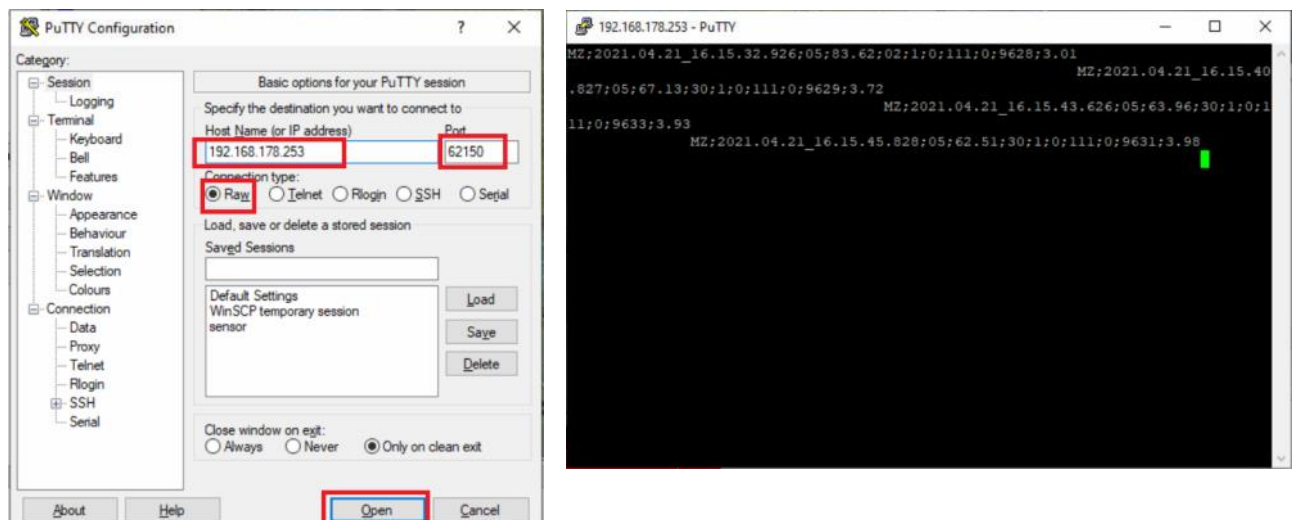
Send UDP Message to Broadcast (default setting) sends all event messages to the broadcast address. Every PC in the same network will receive the messages.

Send UDP Message to Multicast sends all event messages to the multicast address. Every PC in the same network joining the multicast group will receive the messages.

Send UDP Message to IP address sends all event messages to a specific IP address. Only the specific IP will receive udp messages.

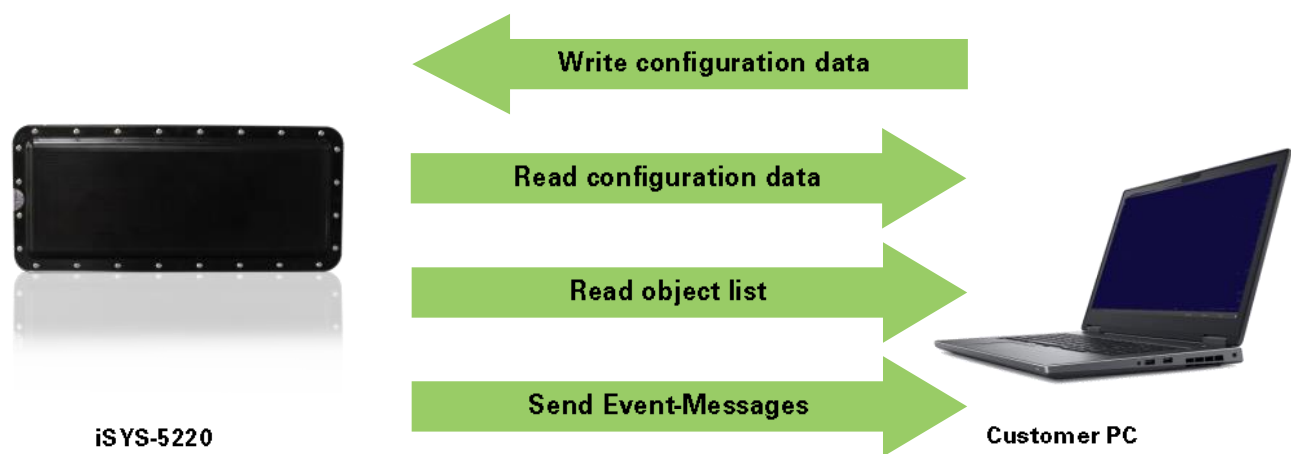


**NOTE:** Since firmware version v.1.010 you can also connect via TCP/IP on port 62150, to receive event messages. (max. 5 Clients). For example with putty (<https://www.putty.org>)



# 11. COMMUNICATION

The iSYS-5220 communicates over TCP/IP, UDP and RS-485.



| Ethernet (TCP/IP or UDP)                                                                                                                                                                           | RS-485                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>iSYS-5220 Event Messages</li><li>Read and write configuration data Requesting object list</li></ul>                                                          | <ul style="list-style-type: none"><li>iSYS-5220 Event Messages</li></ul> |
| General used TCP/IP Ports:<br>60000—62200 (both directions)<br><br>Used TCP/IP-Ports for event messages:<br>62150<br><br>Used UDP-Ports for event messages:<br>62200 (default, changeable by user) | Baudrates:<br>115200 8N1 (default)<br>230400 8N1                         |

To build your own application, there is an example project available in the software package. It includes configuring a system and requesting object lists.

## 11.1. Read/Write Configuration

For a proper signal processing, the configuration must be set carefully:

- Sensor position and height
- Event Zones and Ignore Zones

It is recommended to configure the system with InnoSenT's Traffic Manager software. This way configuration data can easily be written to the system. The configuration is explained in section [11.2](#) and a working example is provided in section [13.6](#).

The configuration data can also be manually set by using iSYS-5220 Radar API. This library includes all functions for communication with InnoSenT systems.

## 11.2. Object List

Object lists are sent when requested by Radar API. InnoSent's Traffic Manager software provides an easy way of displaying the received object lists. For further information on track parameters and how they are defined and calculated, please refer to Section [\[16\]](#).

### Object list information:

- Object ID: Unique ID the Tracker assigns to a Track
- AgeCount: Number of frames the Track is alive after being released.
- StaticCount: If an object gets static the static counter will be loaded with the maximum number of frames a track is allowed to be static before being deleted. Decrements every frame a Track is static. Tracks can only become static in Presence Zones.
- Track Quality: The Quality of the Track. Depends on different attributes of the assigned target. Track needs at least 50.0% Quality to be released and visible. The Quality is equitable with the reliability of the Track.
- Object Type Class (02 = others, 10 = non-motorized, 30 = car, 60 = small truck, 70 = big truck): Assigned Class of the Track. **Note: Objects of the class 'Others' will be displayed in the Traffic Manager as 'Cars'.**
- Event Zone Index: Index of the Event Zone the Track is currently occupying. If the Track is in no Zone, the Index is negative. (-2 if Track is outside of Zone or -1 if Zone is inactive). Active Zones start with index Zero.
- Distance x (m): Distance the Track has to the sensor in X direction (Cartesian coordinates), measured in meters. For further information, see Section [\[16\]](#).
- Distance y (m): Distance the Track has to the sensor in Y direction (Cartesian coordinates), measured in meters. For further information, see Section [\[16\]](#).
- Velocity x (mps): Velocity the Track has in X direction (Cartesian coordinates), measured in meter per second. For further information, see Section [\[16\]](#).
- Velocity y (mps): Velocity the Track has in Y direction (Cartesian coordinates), measured in meter per second. For further information, see Section [\[16\]](#).
- Velocity in direction (mps): Velocity the Track has in its direction, measured in meter per second. For further information, see Section [\[16\]](#).
- Direction x: Direction the Track has in X direction (Cartesian coordinates), normalized to one. For further information, see Section [\[16\]](#).
- Direction y: Direction the Track has in Y direction (Cartesian coordinates), normalized to one. For further information, see Section [\[16\]](#).
- Distance to front (m): Distance the Centroid of Track has to front of Track, measured in meters. For further information, see Section [\[16\]](#).
- Distance to back (m): Distance the Centroid of Track has to back of Track, measured in meters. For further information, see Section [\[16\]](#).
- Length of object (m): Length of object, measured in meters. For further information, see Section [\[16\]](#).
- Width of object (m): Width of object, measured in meters. For further information, see Section [\[16\]](#).

## 11.3. Event Messages

Event messages are generated when an object enters a motion zone or an object gets static in a presence zone. Look up the corresponding [section](#) for information on how to set event zones.

Event messages are sent via Ethernet (UDP packets) and via RS-485.

The UDP messages are sent 'multicast' to all hosts in the subnet. Therefore, the host PC needs to open the specified port (see sec. [Network Configuration](#)) and listen to the message. The messages are specific ASCII strings dependent on the type and function of the event.

**You can also connect via TCP/IP on port 62150 to receive the event messages (max. 5 Clients).**

### 11.3.1. Zone Type Motion

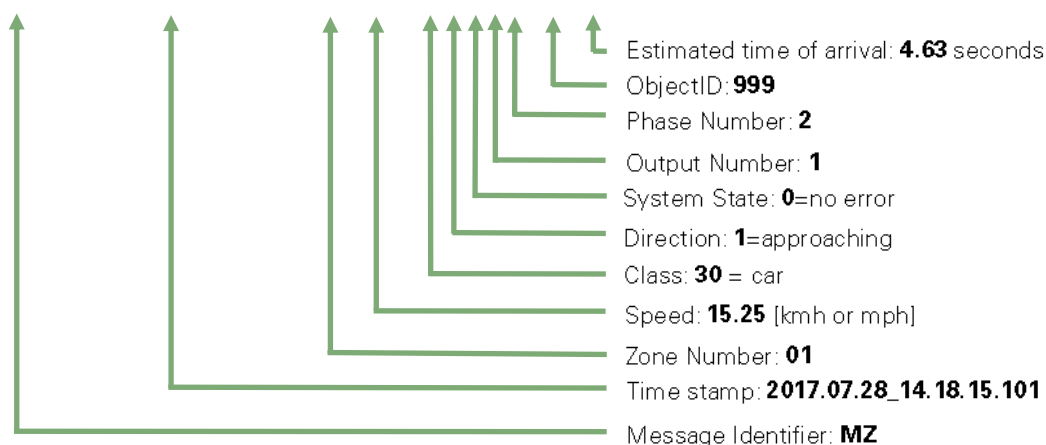
This message will be sent each time an object enters an Event Zone of the type Motion Zone and one or more conditions are true.

Message information:

- Message Identifier (MZ)
- Time stamp (Timestamp: yyyy.MM.dd\_hh.mm.ss.ms)
- Zone Number
- Speed [kmh/mph] (Speed: 4 digit >> 2 digit + 2 digit behind decimal point), measured in kmh or mph
- Class (Class: 2 digit >> 02 = others, 10 = pedestrian/bike, 30 = car, 60 = small truck, 70 = big truck)
- Direction (0=Not assigned; 1=approaching; 2=receding)
- System State (0=no error; 1=error)
- Custom configurable output number (0-255)
- Custom configurable phase number (0-255)
- ObjectID
- Estimated time of arrival (in seconds), if ETA point is set. Otherwise the value is 0.

Example message:

MZ;2017.07.28\_14.18.15.101;01;15.25;30;1;0;1;2;999;4.63\n



If a system state error is reported, you can check detailed information by self test function with the Radar API.

### 11.3.2. Zone Type Presence

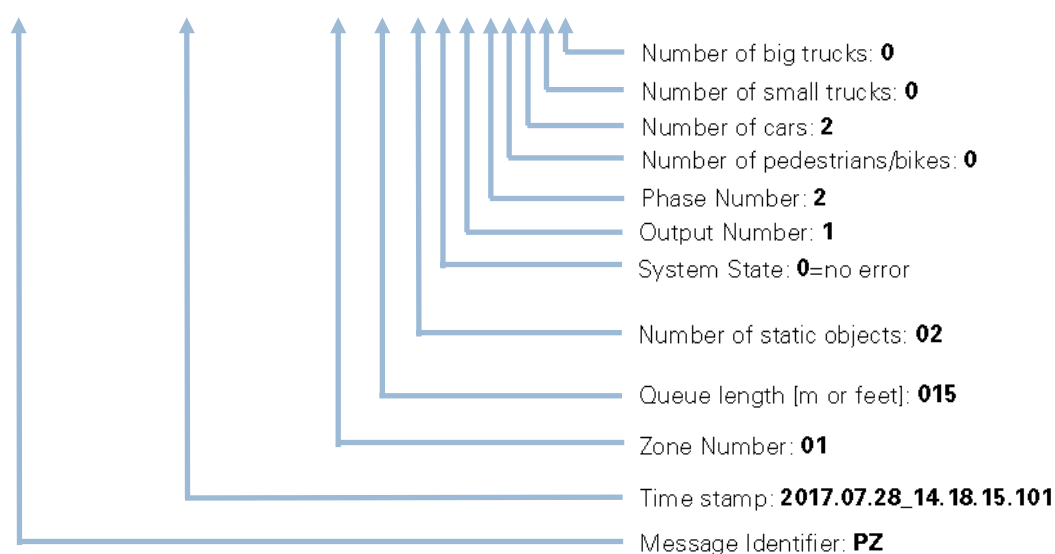
This message will be sent each time there is a change of static object is in the Event Zone of the type Presence Zone and one or more conditions are true.

#### Message information:

- Message Identifier (PZ)
- Time stamp (Timestamp: yyyy.MM.dd\_hh.mm.ss.ms)
- Zone Number
- Queue length [m or feet] (3 digit), measured in meter or feet
- Number of static objects (2 digit)
- System State (0=no error; 1=error)
- Custom configurable Output Number (0-255)
- Custom configurable Phase Number (0-255)
- Number of pedestrians/bikes
- Number of cars
- Number of small trucks
- Number of big trucks

#### Example message:

PZ;2017.07.28\_14.18.15.101;01;015;02;0;1;2;0;2;0;0\n



If a system state error is reported, you can check detailed information by self test function with the Radar API.

### 11.3.3. Rain Interference Level Message

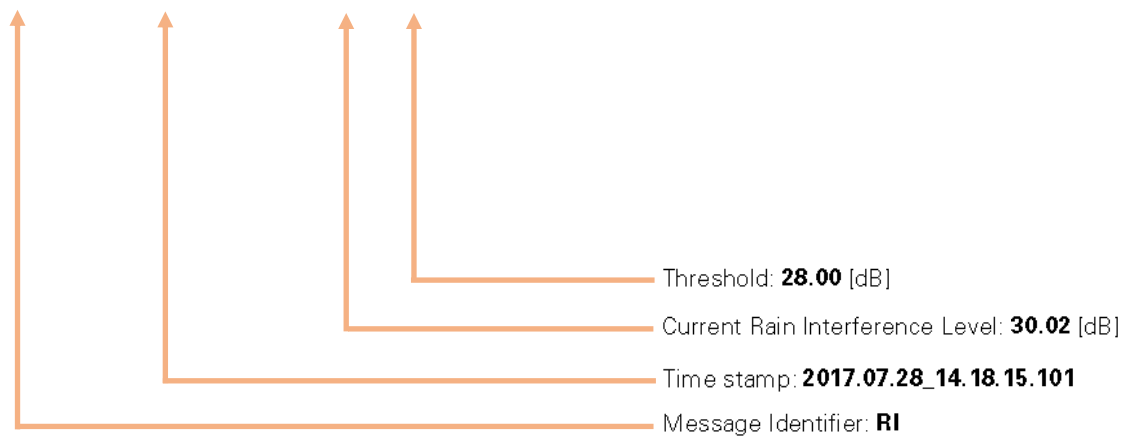
This message will be sent when the configured rain interference level threshold is exceeded.

#### Message information:

- Message Identifier (RI)
- Time stamp (Timestamp: yyyy.MM.dd\_hh.mm.ss.ms)
- Current Rain Interference Level [dB] (4 digit >> 2 digit + 2 digit behind decimal point)
- Threshold [dB] (4 digit >> 2 digit + 2 digit behind decimal point)

#### Example message:

RI;2017.07.28\_14.18.15.101;30.02;28.00\n



An exceeding of the threshold will result in performance drops, due to rain interference.

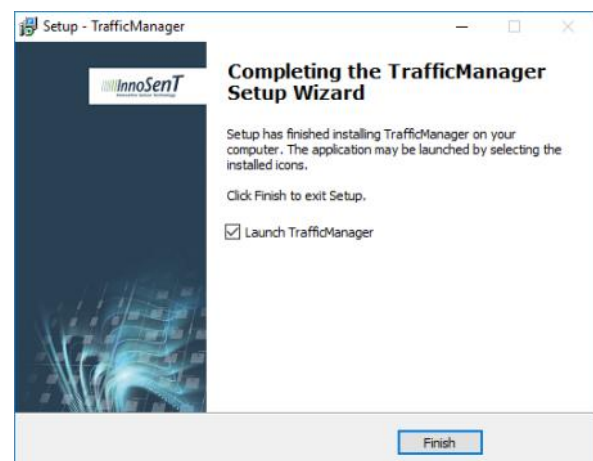
## 12. CONFIGURATION USING TRAFFIC MANAGER

The Traffic Manager is the primary software solution to configure the iSYS-5220 for use in the field.

### 12.1. Installation of Traffic Manager

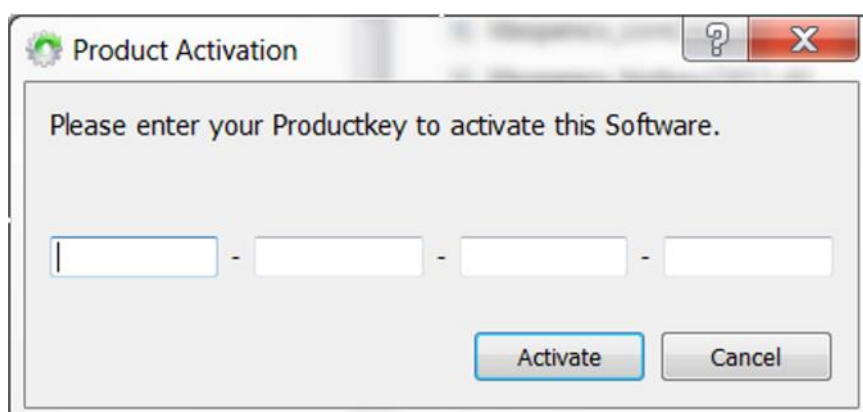
The Traffic Manager can only be installed on a Windows PC. The setup files can be found in the device's software package. Please ask your InnoSenT contact for information on how to receive the software package.

- Open the Traffic Manager folder in the software package and install Traffic Manager\_Vx\_xxx.exe (x\_xxx = software version).
- Follow the instructions on the screen.
- Click Finish to close setup and launch the Traffic Manager.



### 12.2. Launch Traffic Manager

- Click on the Traffic Manager icon to start the software
- When you start the Traffic Manager for the first time you need to enter the product key for activation of the software on your PC. The key is provided to you by your InnoSenT contact. You need an internet connection to activate your license.



## 12.3. Overview of Traffic Manager

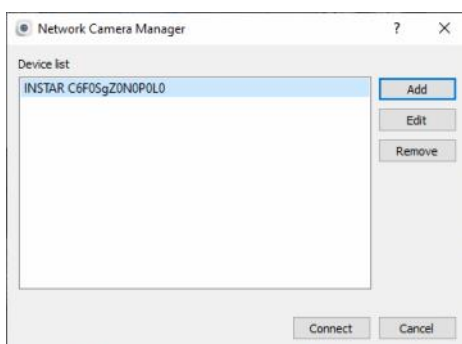
InnoSent's Traffic Manager is a software solution to configure your iSYS-5220 when installed in the field and visualize the data output from the system (i.e. object list and UDP event messages). The most important features of the Traffic Manager are highlighted below.

The screenshot shows the Traffic Manager v1.033 interface. Red callout boxes point to various features:

- Configuration wizard to configure iSYS-5220**: Points to the 'Configure' button in the top toolbar.
- Record & Play-back object list with video stream**: Points to the 'Record' and 'Play' buttons in the top toolbar.
- Read configuration from system**: Points to the 'Load Configuration from System' button in the top toolbar.
- Create & Remove Heatmap**: Points to the 'Create Heatmap' and 'Remove Heatmap' buttons in the top toolbar.
- Add network camera and display video stream**: Points to the 'Add Camera' button in the top toolbar.
- Connect or disconnect iSYS-5220**: Points to the 'Connect' and 'Disconnect' buttons in the top toolbar.
- Display UDP Event Messages caused by event triggers (e.g. trigger line)**: Points to the 'UDP Event Messages' button in the top toolbar.
- Event Message Results (e.g. counting and classification)**: Points to the 'Event Message Results' panel on the left, which displays a table of event data.
- Objectlist from iSYS-5220**: Points to the 'Objectlist' panel at the bottom, which displays a table of object data.
- Sensor information**: Points to the 'Sensor Information' panel on the right, which displays details about the connected sensor.
- Change view settings**: Points to the 'View Settings' panel on the right, which allows users to adjust the display of the main window.
- Display background image, event zones and tracked objects (main window)**: Points to the main radar display area, which shows a heatmap and tracked objects.

## 12.4. Connect to Network Camera (if available)

It is recommended to set up a network or usb camera together with the iSYS-5220. With the video from the camera a remote verification of the displayed radar data is much easier. In 'Record Mode' the video stream from the camera is stored together with the radar data on the hard disk. Therefore, it is possible to evaluate data offline.

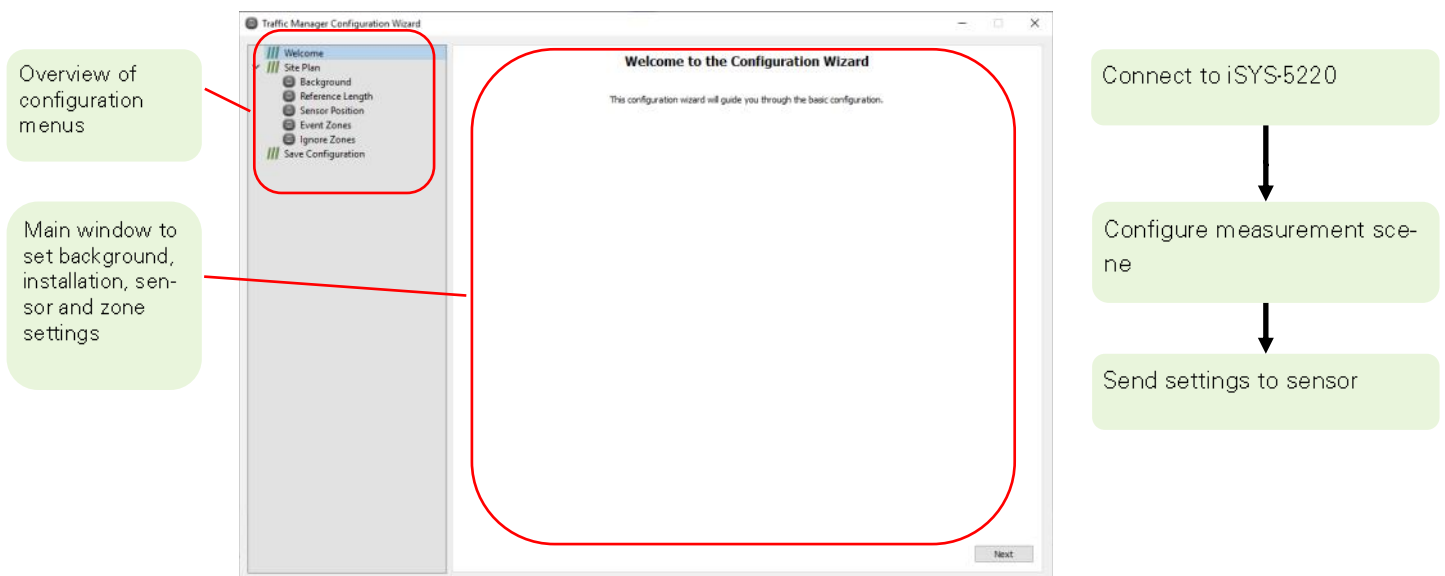


## 12.5. Connect to iSYS-5220

If the Traffic Manager is not already connected to the system, establish a connection by clicking on the 'Connect' button. For further information, recall section [11.0](#).

## 12.6. Configuration Wizard

The iSYS-5220 can be easily configured using the Traffic Manager. Open the configuration wizard by clicking on the 'Configuration' button. Here you will be guided through all steps necessary to configure the iSYS-5220 for your application. Below, the welcome screen and the overview of the configuration process are shown. With 'Next' you can navigate through the different configuration menus.

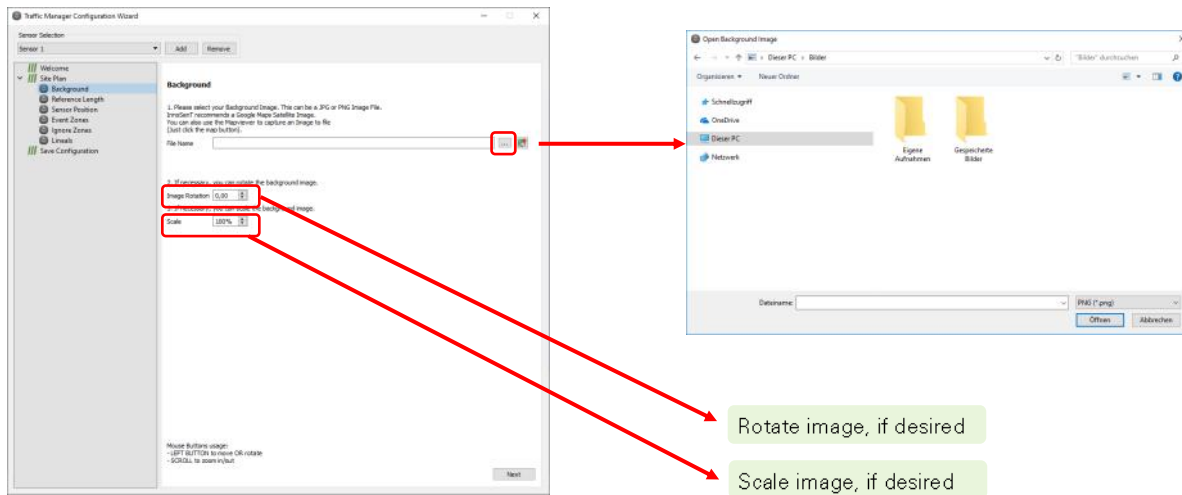


### 12.6.1. Background

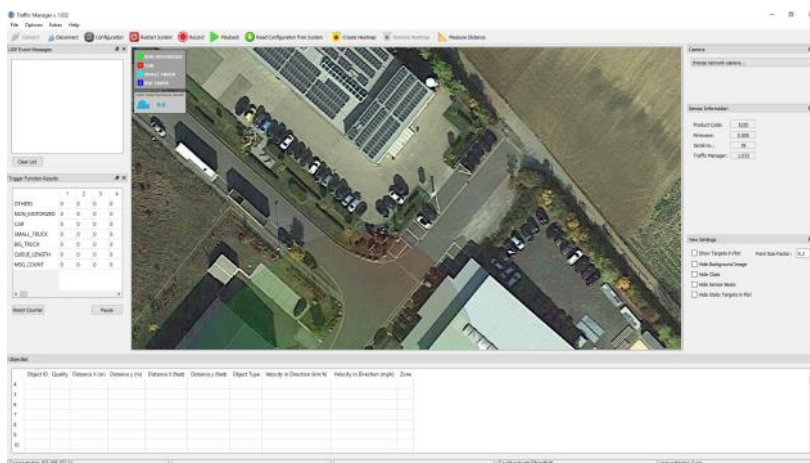
In the Background Menu an image of the measurement site can be loaded. This is the basis for positioning your sensor and defining the event zones for your application.

Option 1: Load a .jpg file or .png file from your hard drive.

Option 2: Open Google Maps with the builtin map viewer (just click the Map button) and take a screenshot from the measurement site.



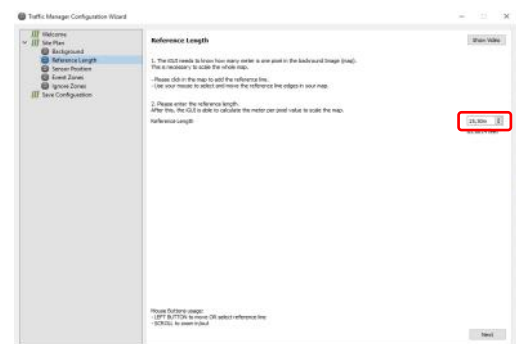
The background image is displayed in the main window.



## 12.6.2. Reference Length

The Traffic Manager needs a reference length in the background image. If the length is not set correctly, measured objects and radar coverage do not match to the image. As a consequence the set event zones will not work as expected. You can either measure the distance between two points by yourself or use google maps built in functionality.

Place the ends of the displayed red line where you measured the distance in the image and type in the appropriate length of the line.

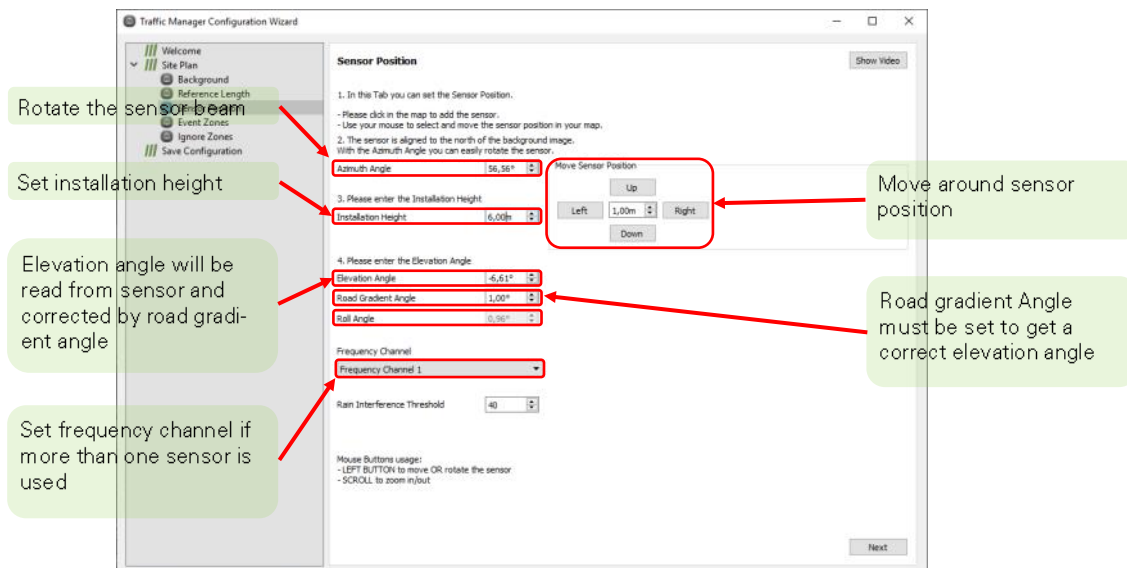


**Since Traffic Manager V.1.052: if you have imported the image via the built-in map viewer, the reference length is set automatically.**

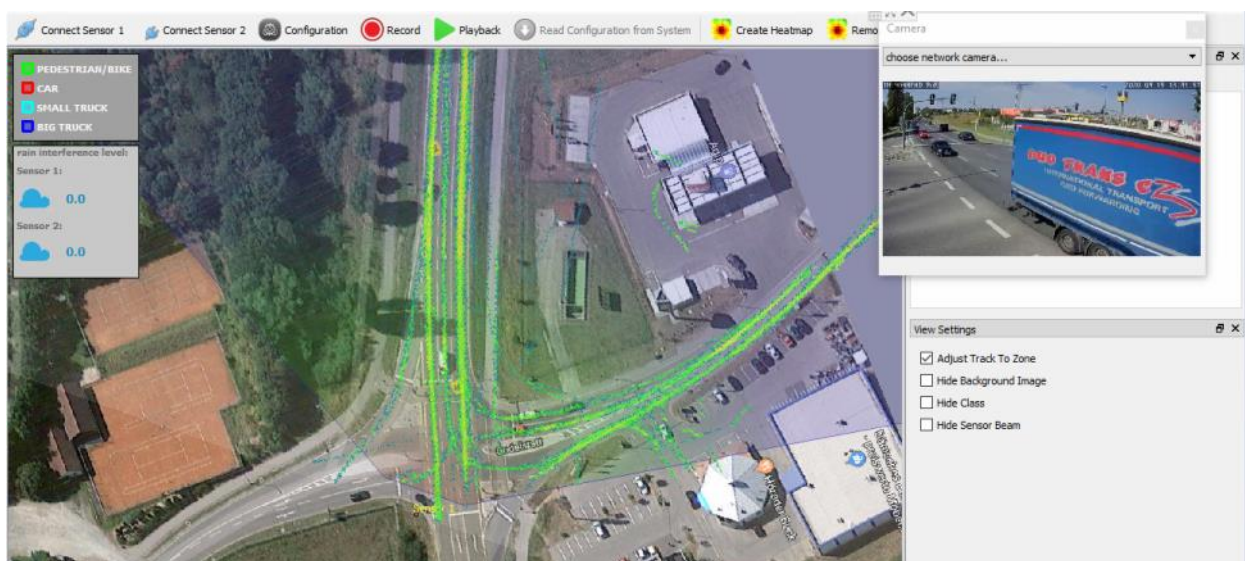
### 12.6.3. Sensor Position

Use Up/Down and Left/Right Buttons to place the sensor's virtual position (red point) in the background image to the exact location where the iSYS-5220 is installed (\*). Then set the installation height. The elevation angle will be read from the sensor and corrected by the road gradient angle.

(\*): It makes sense to first set a rough step size and then a fine one.



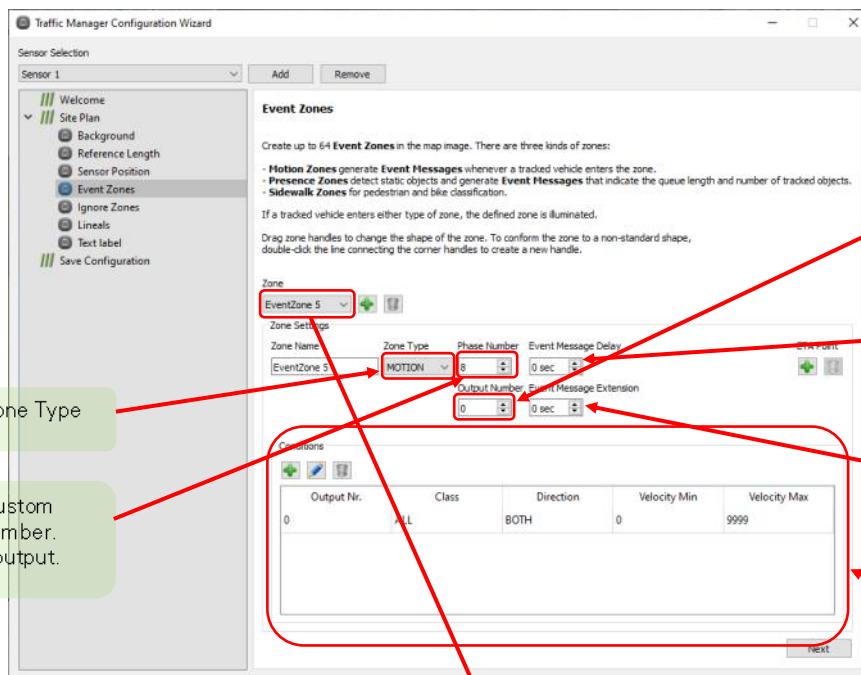
You can use the "Create Heatmap" function to display the object trajectories in the background image (green lines). Check whether the displayed objects match the real objects movement. Adjust the parameters sensor position, azimuth angle (to rotate the sensor beam) and reference length until they match each other.



If you use more than one sensor, each sensor has to be set on a different frequency channel.

## 12.6.4. Event Zones

Event Zones are defined to generate event messages when an object is located within this zone. Further, you can add conditions. This will help you to only get messages for the condition you want (Speed, Class, Direction...). Event Zones can be added in the Event Zone Menu. Afterwards, the desired zone type can be selected. Place the Event Zone in the background image. The shape of the Event Zone can be adjusted by adding some Points. Left mouse double click on the lines of the Event Zone to add more Points (max. 10 Points) or remove Points with right mouse click.



Define Zone Type

Define custom phase number. Just for output.

Define custom output number. Just for output.

Event message will be sent after a defined delay

Event message will be sent repeatedly every 50ms for a defined time

Add one or more conditions to create more or less event messages



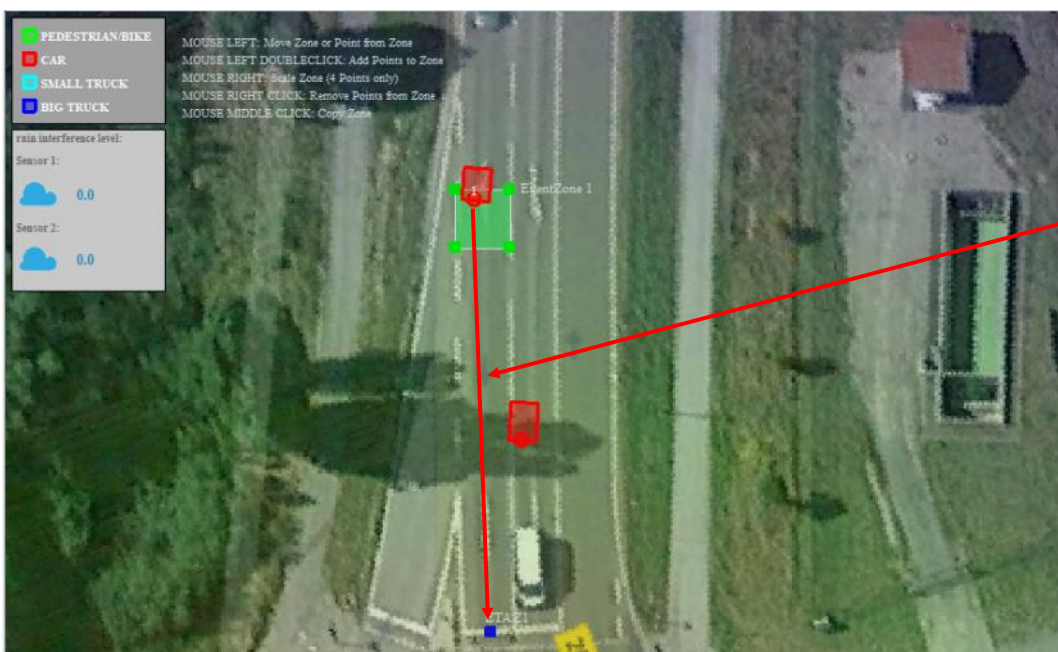
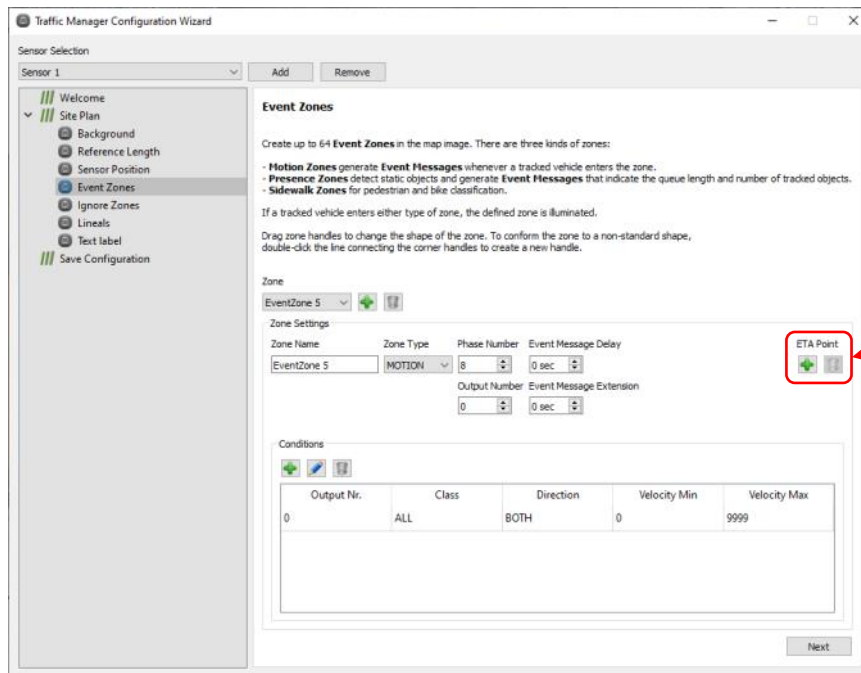
There are three types of zones:

- **Motion Zone:** A message will be sent each time an object enters an Event Zone and for every true condition defined for this zone.
- **Presence Zone:** A message will be sent each time at least one static object is in the Event Zone. Only in Presence Zones objects will become static. This zone is optimized for calculating a queue length.
- **Sidewalk Zone:** This Zone is for classification (Pedestrian/Bike) only and will not generate event messages. Use this zone type to define your sidewalks for a Pedestrian/Bike classification.

## ETA - Estimated time of arrival

To enable the ETA calculation, please add the ETA point for a motion zone.

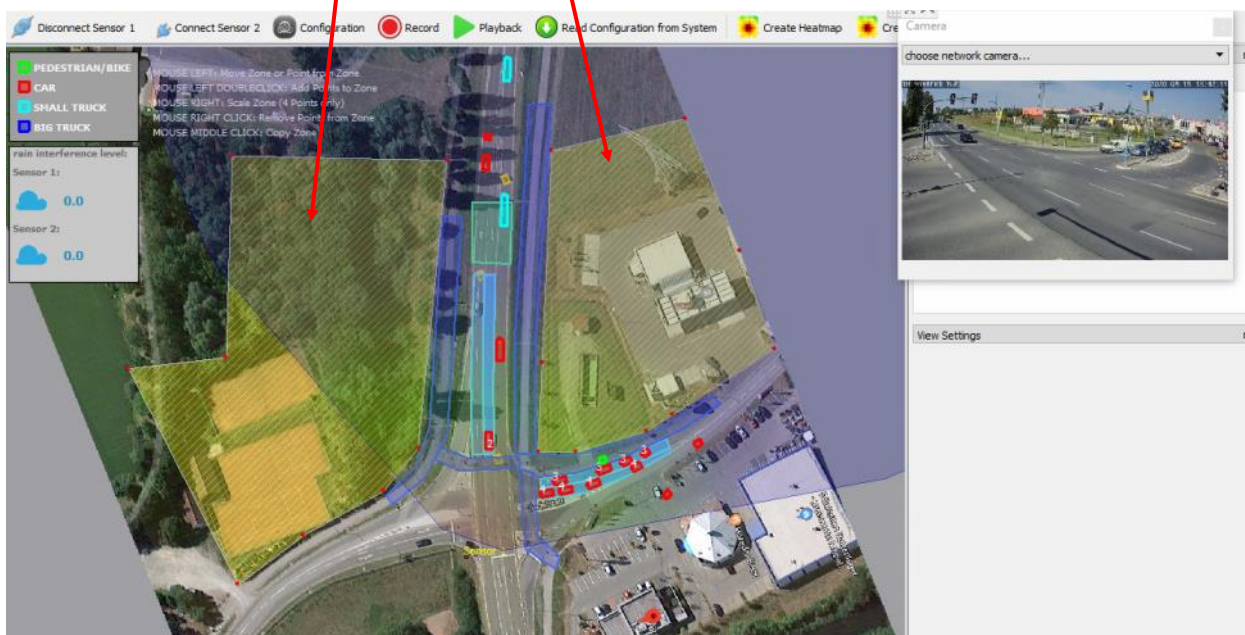
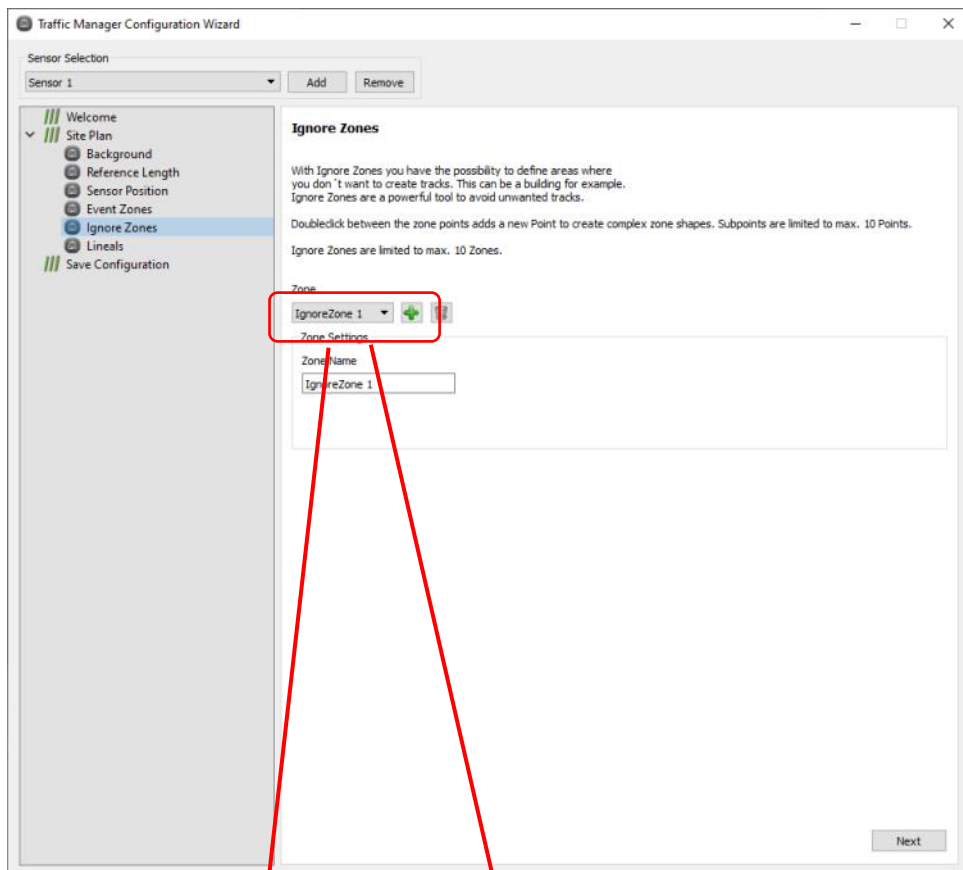
If a object enters the zone, the distance between the object and the ETA point will be calculated. With the help of the object speed, the arrival time can now be calculated in seconds. You will receive the output via the event message.



### 12.6.5. Ignore Zones

In the Ignore Zones Menu you can define regions where objects shall not initialize new tracks. Note: Already existing tracks can move through an Ignore Zone without being harmed.

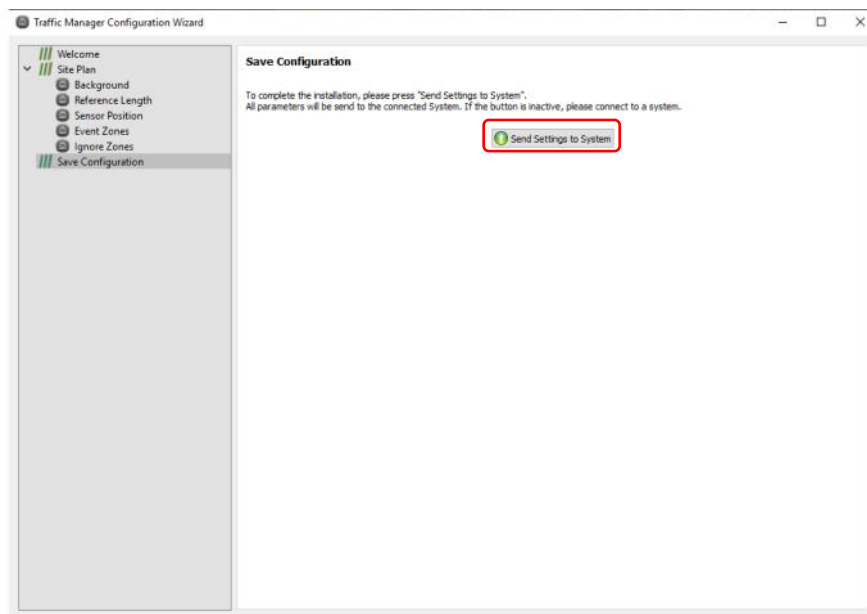
Place an Ignore Zone in the background image. The shape of the Ignore Zone can be adjusted adding some Points. Left mouse double click on the lines of the Event Zone to add more Points (max. 10 Points) or remove Points with right mouse click.



## 12.7. Save Configuration

In this menu, the parameters defined in the Configuration Wizard are sent to the sensor and measurement mode is started.

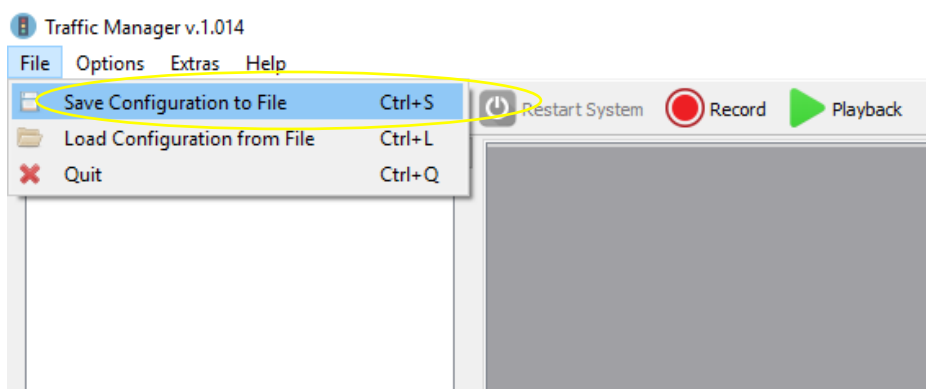
After the configuration is sent to the sensor, tracks from objects are displayed in the background image.



### Attention:

The above procedure sends the settings to the iSYS-5220. To change the current configuration in the future it is recommended to save the settings to a file on your PC. This can be done in the File Menu of the Traffic Manager.

The file stored is an .iprj File. For an offline evaluation of recorded data, this .iprj file needs to be loaded first. Thus, make sure to have an up-to-date .iprj file available for Playback



## 12.8. View Settings

The View Settings window comprises checkboxes for enabling or disabling various options which control the objects and tracks displayed in the background image.

In detail:

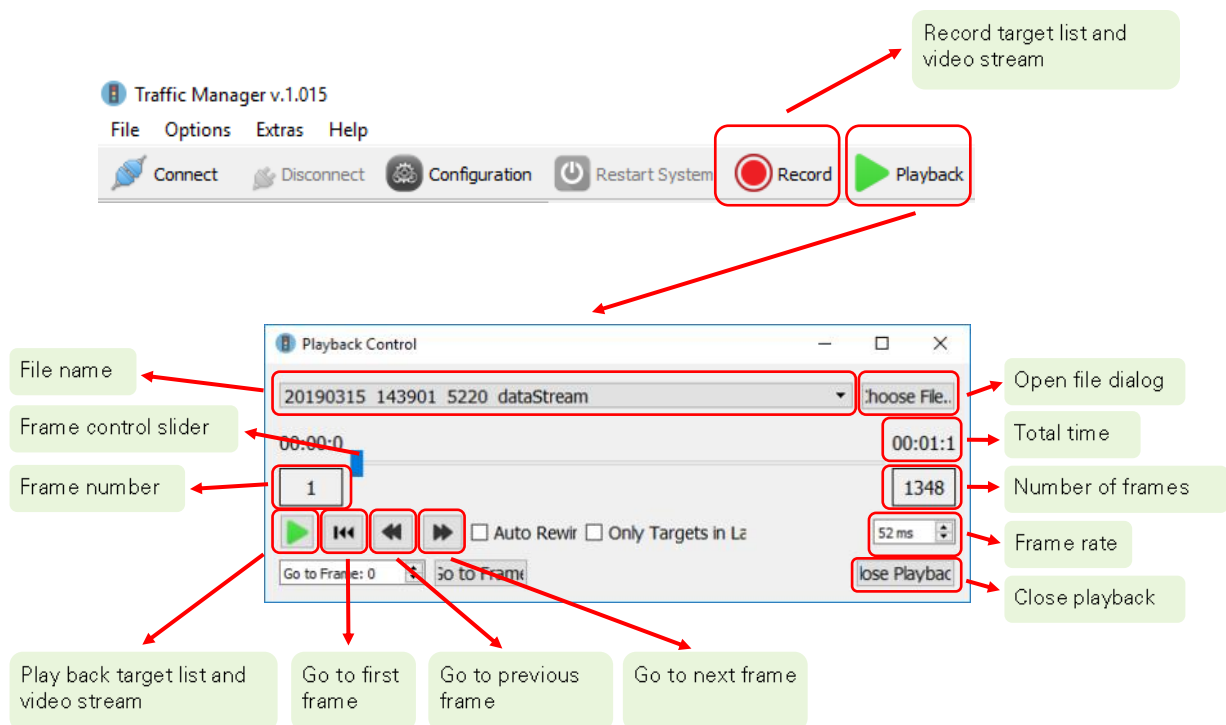
- **Adjust Track to Zone**  
Adjusts a track to the middle of a presence zone
- **Hide Background Image**  
If enabled: The background image is not shown.
- **Hide Class**  
If enabled: Hides the class of the track. Every track is displayed as class 30 = car.
- **Hide Sensor Beam**  
If enabled: The sensor beam is not shown.
- **Hide Rain Interference Level**  
If enabled: Hides the Rain Interference Level Label

## 12.9. Record / Playback

When the Traffic Manager is connected to the sensor, you can record target lists and video stream. Click the 'Record' button to start recording and click it again to save recorded target lists and video stream to a file. While recording is active, the ongoing tracks, objects and video stream can not be observed.

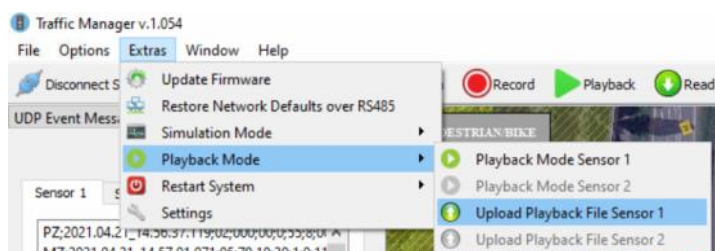
To play back recorded data, click the 'Playback' button and select the appropriate data file.

Attention: After loading recorded data from a file, matching configuration settings must be sent (please see sec. [Save Configuration](#)).



## Playback on System

The iSYS-5220 provides you to upload a recorded playback file to the system (max. size 3GB).

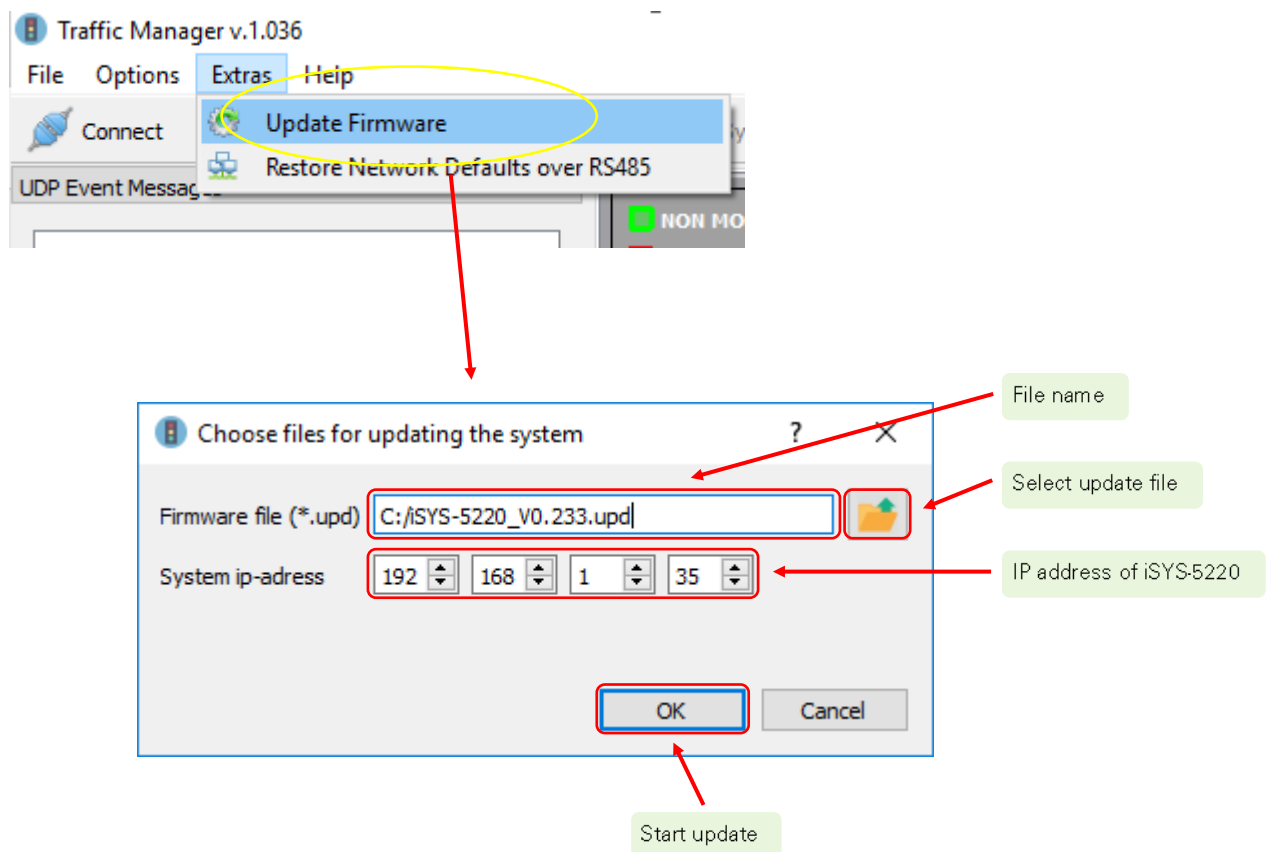


After uploading, you are able to activate the playback. Your playback file will be played in a loop on the system.



## 12.10. Update Firmware

It is possible to update the firmware of the iSYS-5220. In order to do this, click the Update Firmware button in the Extras Menu. Select a firmware update (if available), set the sensor's IP address and click the OK button to start the firm ware update.



With the 'Restore Network Defaults over RS485' you can reset your network to the default configuration.

## 12.11. Object List Traffic Manager

The Traffic Manager also provides an object list, but it does not contain as much information as the object list provided by the Radar API. Note: Green Tracks are receding, red Tracks are approaching and black Tracks are static.

| Objectlist           |           |         |                |                |             |                              |      |
|----------------------|-----------|---------|----------------|----------------|-------------|------------------------------|------|
| Sensor 1    Sensor 2 |           |         |                |                |             |                              |      |
|                      | Object ID | Quality | Distance X (m) | Distance y (m) | Object Type | Velocity in Direction (km/h) | Zone |
| 1                    | 31414     | 58,4371 | -5,92253       | 38,6496        | 30          | 0                            | 2    |
| 2                    | 31448     | 84,2461 | 38,497         | 46,131         | 30          | 31,5148                      | 3    |
| 3                    | 31440     | 52,9384 | 24,5629        | 31,6283        | 30          | 6,53817                      | 4    |
| 4                    | 31417     | 23,5478 | 19,4958        | 28,8874        | 30          | 0                            | 4    |
| 5                    | 31415     | 27,0422 | -4,1404        | 33,7672        | 30          | 0                            | 2    |
| 6                    | 31430     | 44,1608 | -11,2363       | 53,2295        | 30          | 0                            | 2    |
| 7                    | 31446     | 78,8675 | -18,6232       | 85,1621        | 30          | -41,5463                     |      |

## 13. TRAFFIC APPLICATION IMPLEMENTATIONS

The three different event zone types in combination with one or more conditions allow the user a quick and comfortable configuration of complex traffic situations.

By exploiting these three event zone types many different applications are possible to implement. An overview of typical traffic applications is given below:

| Applied Event        | Traffic Application | Obtainable Information from iSYS-5220                                                                                                                               | Practical Usage                                                                                                                                                                               |
|----------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Presence Zone</b> | Queue Length        | <ul style="list-style-type: none"> <li>Queue length of stationary objects in zone of interest</li> <li>Number of stationary objects in zone of interest</li> </ul>  | Traffic light management: <ul style="list-style-type: none"> <li>Dynamic control of green light duration</li> <li>Green light signal priorities</li> </ul> ⇒ <b>Optimize traffic flow</b>     |
|                      | Stop Bar Detection  | <ul style="list-style-type: none"> <li>True presence of stationary objects in zone of interest in front of Stop Bar</li> </ul>                                      | Traffic light management: <ul style="list-style-type: none"> <li>Trigger for calling green light</li> </ul> ⇒ <b>Optimize traffic flow</b>                                                    |
| <b>Motion Zone</b>   | Advance Detection   | <ul style="list-style-type: none"> <li>Speed of moving objects entering zone of interest</li> </ul> ⇒ Estimated Time of Arrival (ETA) to Stop Bar can be calculated | Traffic light management: <ul style="list-style-type: none"> <li>Dynamic control of yellow light duration at dilemma zones</li> </ul> ⇒ <b>Minimize risk of collision at dilemma zones</b>    |
|                      | Wrong Way Detection | <ul style="list-style-type: none"> <li>Moving direction and speed of objects entering zone of interest</li> </ul>                                                   | Wrong Way Detection: <ul style="list-style-type: none"> <li>Trigger alert by detection of moving objects in wrong way</li> </ul> ⇒ <b>Identify and minimize risk due to wrong way driving</b> |
|                      | Traffic Counting    | <ul style="list-style-type: none"> <li>Number, type and speed of moving objects entering zone of interest</li> </ul>                                                | Traffic statistics: <ul style="list-style-type: none"> <li>Counting and classifying objects on highway or arterial roads</li> </ul> ⇒ <b>Calculate traffic flows, traffic average speed</b>   |

On the following pages an example configuration is shown for each different Traffic Application.

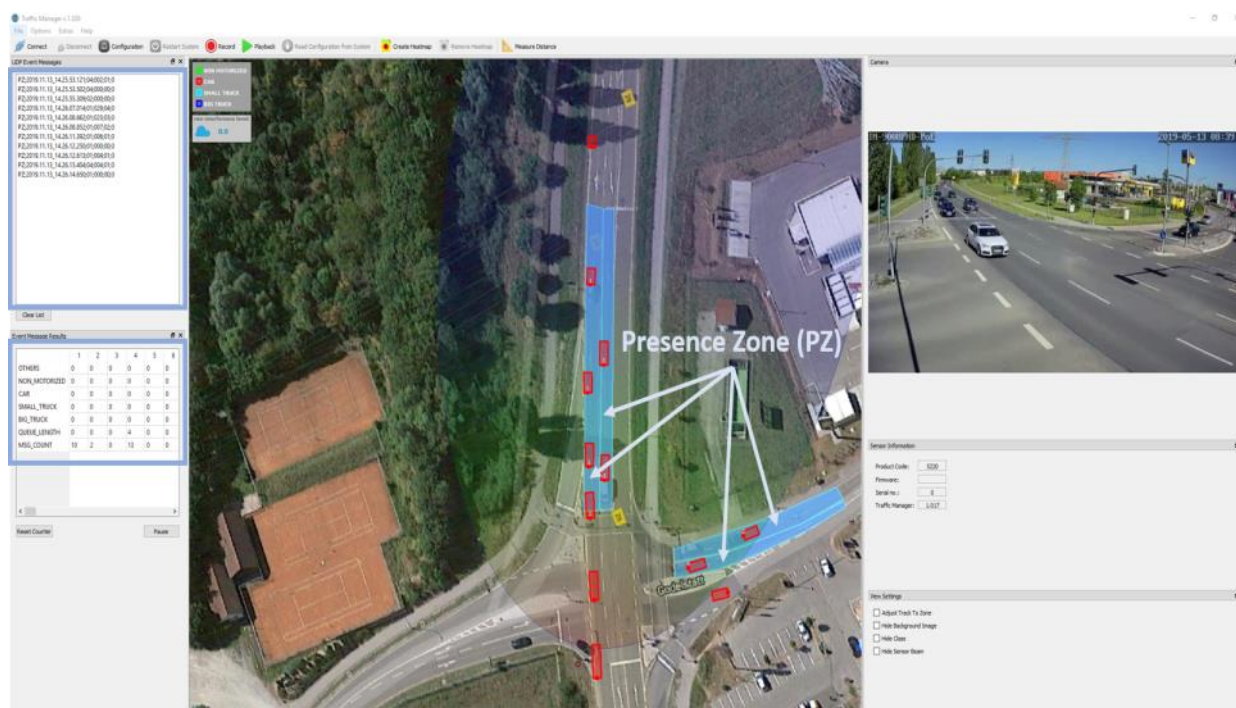
**Note: Two or more different applications can be easily solved by using a combination of different zone types. The zones are even allowed to overlap, for a full and easy coverage of all applications.**

## 13.1 Queue Length

The iSYS-5220 is capable of measuring queue length and number of stationary objects in the zones of interest at intersections for controlling traffic lights e.g. dynamic green light duration and optimizing traffic flow.

The application is realized by using iSYS-5220 Presence Zones. The fast and easy configuration of zones is shown in section [112.6.4](#). After having the presence zones set and sent to the system, the iSYS-5220 will send the user UDP event messages every time the presence zones are triggered. The messages are displayed in the UDP Event Messages Window (top left) and the corresponding queue length will be shown in the Event Message Results Window (middle left).

Note: It is important to make sure that each defined Presence Zone should only cover one single lane. For measuring queue lengths on multiple lanes multiple Presence Zones must be used. Queue Length works correctly only with oncoming traffic.



A combination of up to 4 sensors can be deployed to cover all approaches of an intersection. The deployed sensors can be set to operate at different frequency channels to avoid mutual interferences. This can be done by using InnoSent's Intersection Manager. For further information see Document [16](#).

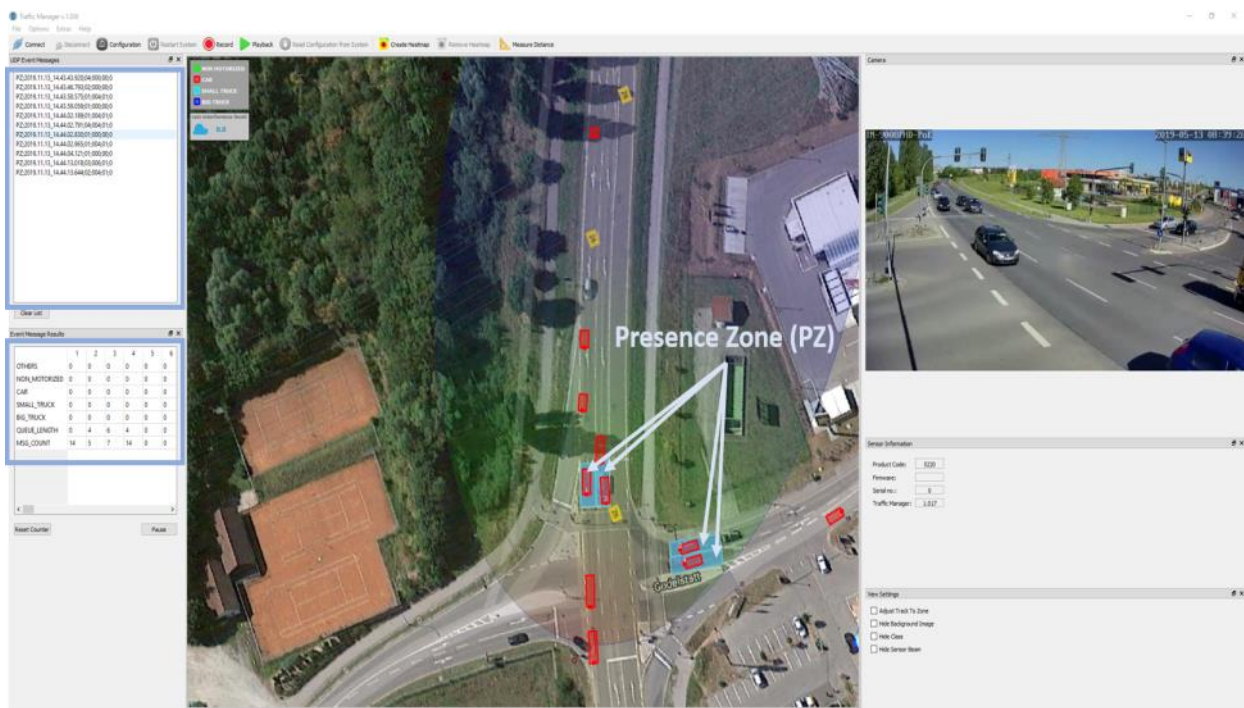
| Installation Parameter | min.  | typ.        | max.   | unit |
|------------------------|-------|-------------|--------|------|
| Traffic Direction      |       | approaching |        |      |
| height                 | 4/13  | 6/19        | 8/26   | m/ft |
| elevation angle        | -10   | -7          | 0      | °    |
| angle to lane          | -60   | 6           | 60     | °    |
| Queue Length           | 20/65 |             | 80/262 | m/ft |

## 13.2 Stop Bar Detection

The iSYS-5220 is capable of detecting the presence of stationary objects in call zones in front of stop bars. True presence of stationary objects can be tracked even if they are shadowed by cross traffics. The information can be used for controlling traffic lights e.g. to trigger a call for green light signal.

The application is realized by using iSYS-5220 Presence Zones. The fast and easy configuration of zones is shown in section [11.2.6.4](#). After having the presence zones set and sent to the system, the iSYS-5220 will send the user UDP event messages every time the presence zones are triggered. The messages are displayed in the UDP Event Messages Window (top left) and the corresponding queue length will be shown in the Event Message Results Window (middle left).

Note: It is important to make sure that each defined Presence Zone should only cover one single lane. For measuring queue lengths on multiple lanes multiple Presence Zones must be used. For Stop Bar Detection, the presence zone should be at least as big as a vehicle, but not bigger than two. Minimizing the presence zone to a trigger line, as well as enhancing it to a queue length presence zone, will lead to a poor performance. Stop Bar Detection and its true presence detection feature works correctly only with oncoming traffic.



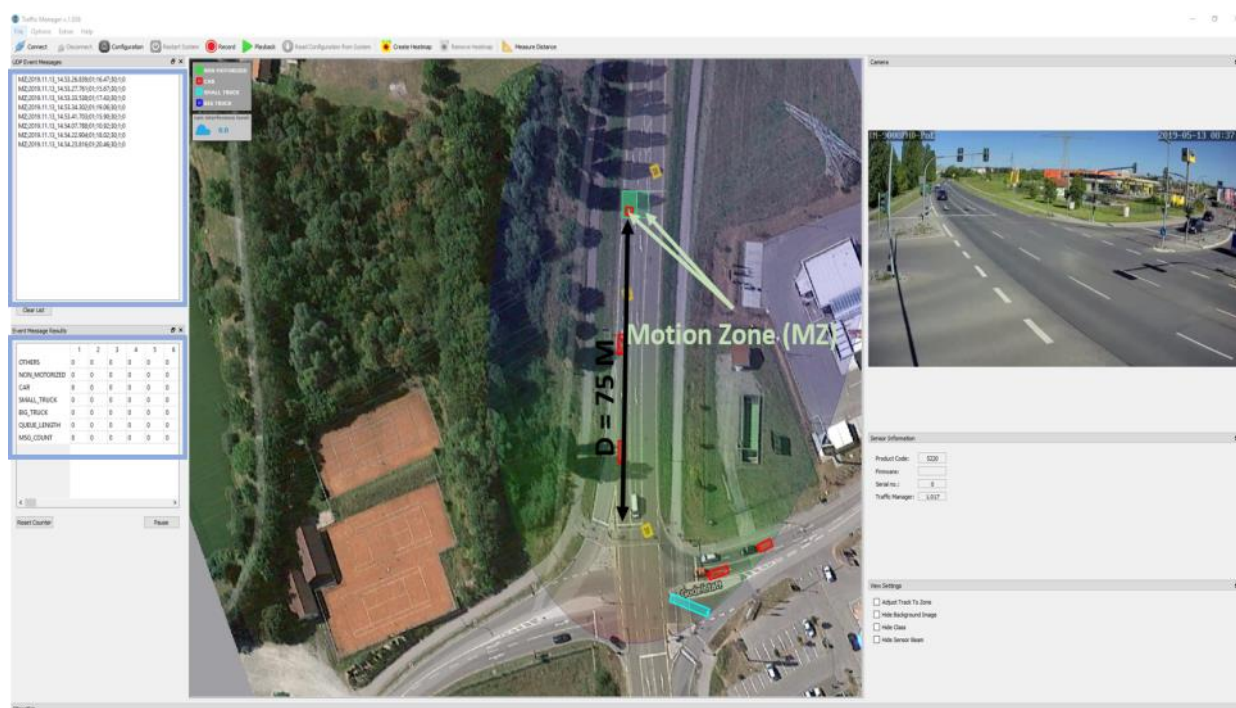
A combination of up to 4 sensors can be deployed to cover all approaches of an intersection. The deployed sensors can be set to operate at different frequency channels to avoid mutual interferences. This can be done by using InnoSenT's Intersection Manager. For further information see Document [16](#).

| Installation Parameter | min.  | typ.        | max.   | unit |
|------------------------|-------|-------------|--------|------|
| Traffic Direction      |       | approaching |        |      |
| height                 | 4/13  | 6/19        | 8/26   | m/ft |
| elevation angle        | -10   | -7          | 0      | °    |
| angle to lane          | -60   | 6           | 60     | °    |
| Stop Bar Detection     | 20/65 |             | 40/131 | m/ft |

### 13.3 Advance Detection

The iSYS-5220 is capable of measuring the speed of moving objects entering a defined zone located at a distance away from the stop bar. This information can be used to calculate the Estimated Time of Arrival (ETA) of moving objects at the stop bar. The ETA then can be used for controlling traffic lights e.g. dynamical yellow light duration to minimize risk of collision at dilemma zones.

The application is realized by using iSYS-5220 Motion Zones. The fast and easy configuration of zones is shown in section [12.6.4](#). After having the motion zones set and sent to the system, the iSYS-5220 will send the user UDP event messages every time the motion zones are triggered. The messages are displayed in the UDP Event Messages Window (top left) and the corresponding trigger count will be shown in the Event Message Results Window (middle left).



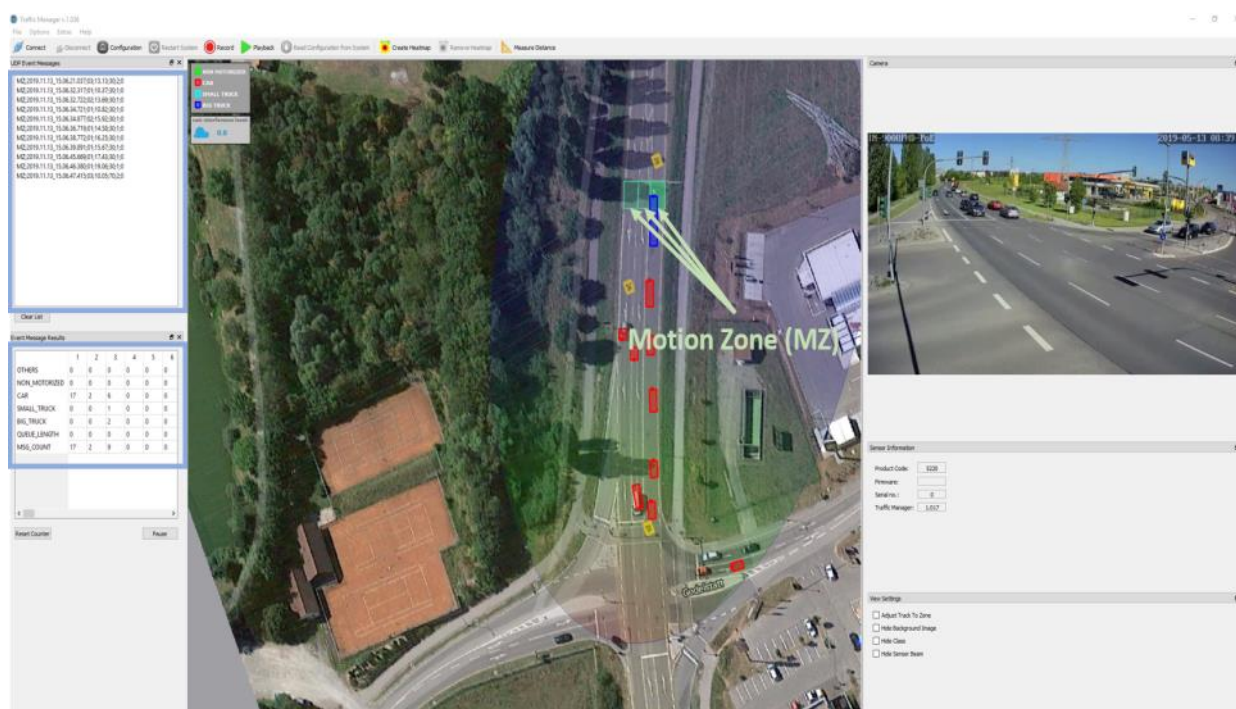
A combination of up to 4 sensors can be deployed to cover all approaches of an intersection. The deployed sensors can be set to operate at different frequency channels to avoid mutual interferences. This can be done by using InnoSent's Intersection Manager. For further information see Document [16](#).

| Installation Parameter | min.  | typ.        | max.    | unit |
|------------------------|-------|-------------|---------|------|
| Traffic Direction      |       | approaching |         |      |
| height                 | 4/13  | 6/19        | 8/26    | m/ft |
| elevation angle        | -10   | -7          | 0       | °    |
| angle to lane          | -60   | 6           | 60      | °    |
| Advance Detection      | 30/98 |             | 200/656 | m/ft |

## 13.4 Wrong Way Detection

The iSYS-5220 is capable of capturing the moving direction of objects entering a defined zone. This information can be used to detect wrong way drivers and minimize the risk of incidents e.g. on highway or arterial roads.

The application is realized by using iSYS-5220 Motion Zones. The fast and easy configuration of zones is shown in section [\[12.6.4\]](#). After having the motion zones set and sent to the system, the iSYS-5220 will send the user UDP event messages every time the motion zones are triggered. The messages are displayed in the UDP Event Messages Window (top left) and the corresponding trigger count will be shown in the Event Message Results Window (middle left).



A combination of up to 4 sensors can be deployed to cover all approaches of an intersection. The deployed sensors can be set to operate at different frequency channels to avoid mutual interferences. This can be done by using InnoSenT's Intersection Manager. For further information see Document [\[6\]](#).

| Installation Parameter | min.  | typ.        | max.    | unit |
|------------------------|-------|-------------|---------|------|
| Traffic Direction      |       | approaching |         |      |
| height                 | 4/13  | 6/19        | 8/26    | m/ft |
| elevation angle        | -10   | -7          | 0       | °    |
| angle to lane          | -60   | 6           | 60      | °    |
| Wrong Way Detection    | 30/98 |             | 200/656 | m/ft |

## 13.5 Traffic Counting

The iSYS-5220 is capable of counting and classifying moving objects entering a defined zone. This information can be used for traffic statistics e.g. monitoring traffic flows, average speed etc on arterial roads.

The application is realized by using iSYS-5220 Motion Zones. The fast and easy configuration of zones is shown in section [\[12.6.4\]](#). After having the motion zones set and sent to the system, the iSYS-5220 will send the user UDP event messages every time the motion zones are triggered. The messages are displayed in the UDP Event Messages Window (top left) and the corresponding trigger count will be shown in the Event Message Results Window (middle left).



A combination of up to 4 sensors can be deployed to cover all approaches of an intersection. The deployed sensors can be set to operate at different frequency channels to avoid mutual interferences. This can be done by using InnoSent's Intersection Manager. For further information see Document [\[6\]](#).

| Installation Parameter | min.  | typ.        | max.    | unit |
|------------------------|-------|-------------|---------|------|
| Traffic Direction      |       | approaching |         |      |
| height                 | 4/13  | 6/19        | 8/26    | m/ft |
| elevation angle        | -10   | -7          | 0       | °    |
| angle to lane          | -60   | 6           | 60      | °    |
| Traffic Counting       | 30/98 |             | 200/656 | m/ft |

## 13.6 Pedestrian/Bike Counting with Sidewalk Zones

If you easily want to classify Pedestrians and Bikes, just define your sidewalks with "sidewalk zones" (purple zones). Every Track which is created in this zone, will be classified as Pedestrian/Bike. If a track is moving inside a sidewalk zone for a couple of time, it will also be classified as Pedestrian/Bike. Sidewalk Zones enables you an easy classification option. In combination with a motion zone (condition Pedestrian only), you can easily count Pedestrians/Bikes in your intersection area.



## 13.7 Working Example — An overview

The iSYS-5220 can be configured in two separate ways. You can either configure it online while you are connected to the sensor, or you can configure it offline for data evaluation.

| Online configuration and its perks                                                                                                                                                                               | Offline configuration and its perks                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Write configuration to sensor</li> <li>• Read configuration from sensor</li> <li>• Online visual performance evaluation</li> <li>• Record and save scenarios</li> </ul> | <ul style="list-style-type: none"> <li>• Configure and adjust comfortable projectfiles in the office</li> <li>• Load and replay recordings for in-depth evaluation</li> </ul> |

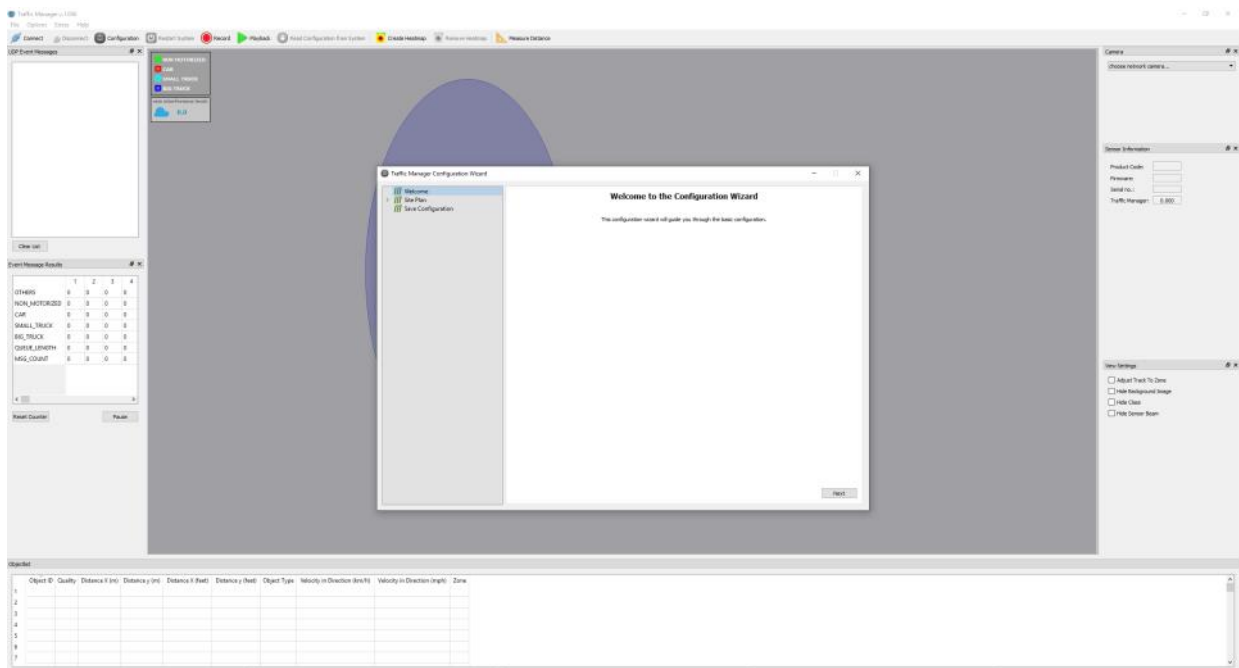
**Several working examples will be introduced on the following pages:**

- [Easy configuration in 10 steps](#)—no projectfile included.
- [Application Stop Bar Detection](#)—projectfile “User Manual iSYS-5220 Projectfile Stop Bar Working Example.iprj” included.
- [Application Traffic Counting](#)—projectfile “User Manual iSYS-5220 Projectfile Counting Working Example.iprj” included.
- [Application Queue Length](#)—projectfile “User Manual iSYS-5220 Projectfile Queue Length Working Example.iprj” included.

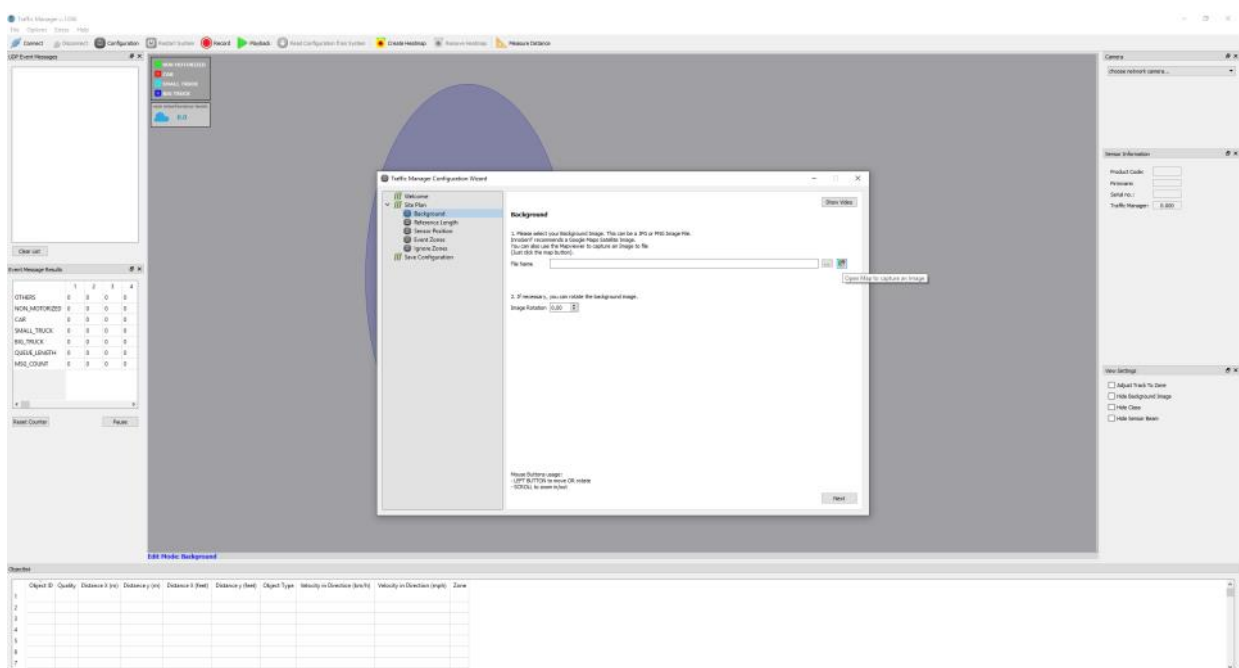
## 13.8 Working Example — In 10 easy steps to our own configuration

As a working example we want to measure the queue length from two oncoming streets in our hometown Hassfurt, Bavaria, where our iSYS-5220 has been installed. In just 10 easy steps we can configure our iSYS-5220 offline by using InnoSent's Traffic Manager. This example shows you how to configure your own projectfile. Working examples for different applications are given in the following sections.

Step 1: After installation, we open the Configuration Wizard by clicking on the "Configuration" Button



Step 2: We need our background image from our intersection in Hassfurt. Therefore, we need to go to Site Plan -> Background -> Open Map to capture an Image

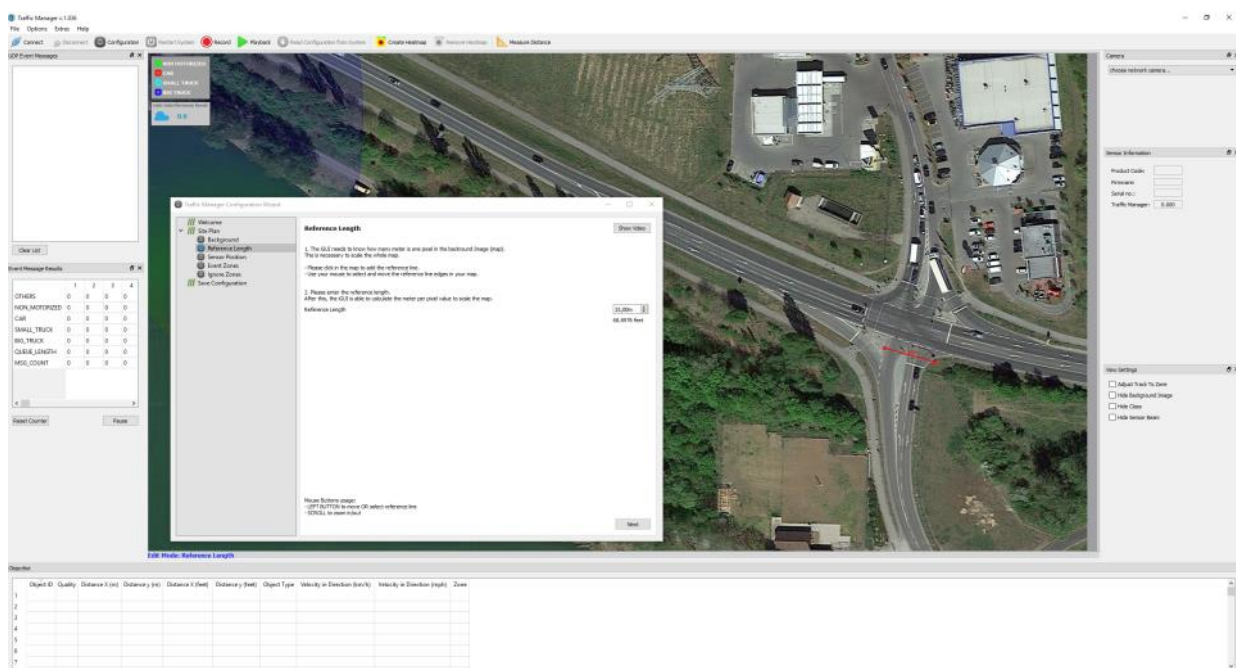


## 13.8 Working Example — In 10 easy steps to our own configuration

Step 3: We want the Google Maps Image where our iSYS-5220 is located. We maneuver to our location easily by using the built in Mapviewer. After having adjusted the image we save it by clicking the 'Capture Image' button in the top right corner.

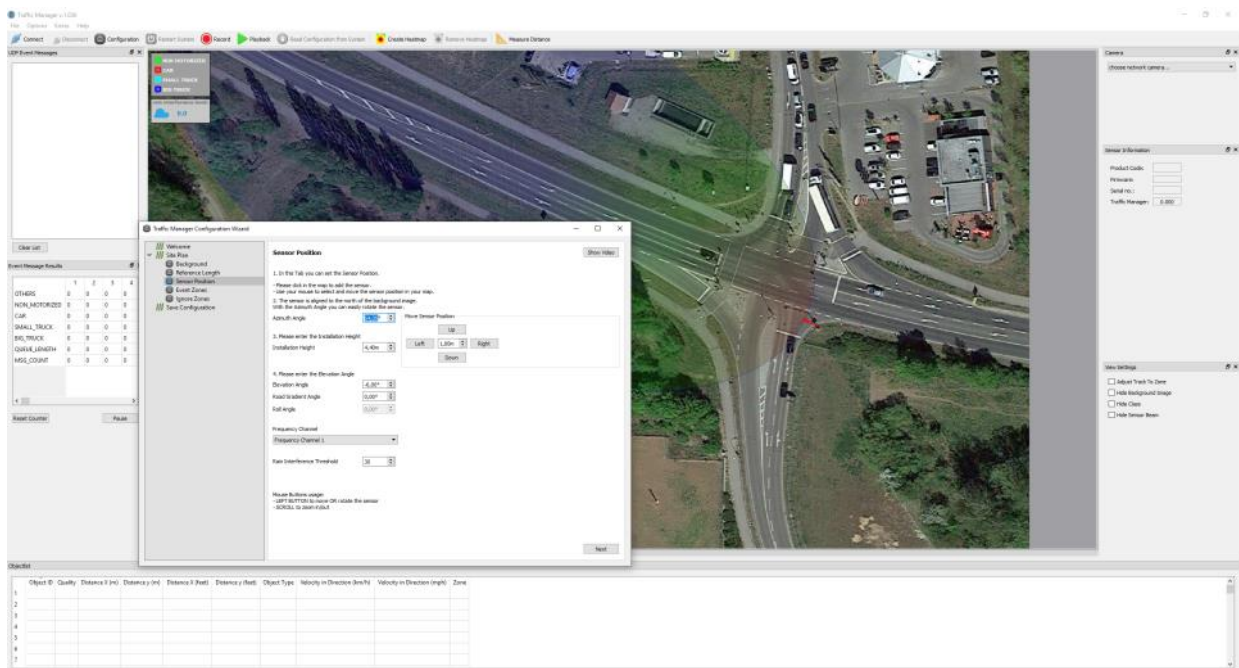


Step 4: After capturing the image, we need the [reference length](#) in order for the event zones to work correctly. The easiest way to do this is by opening Google Maps separately in your browser and use its measurement function.

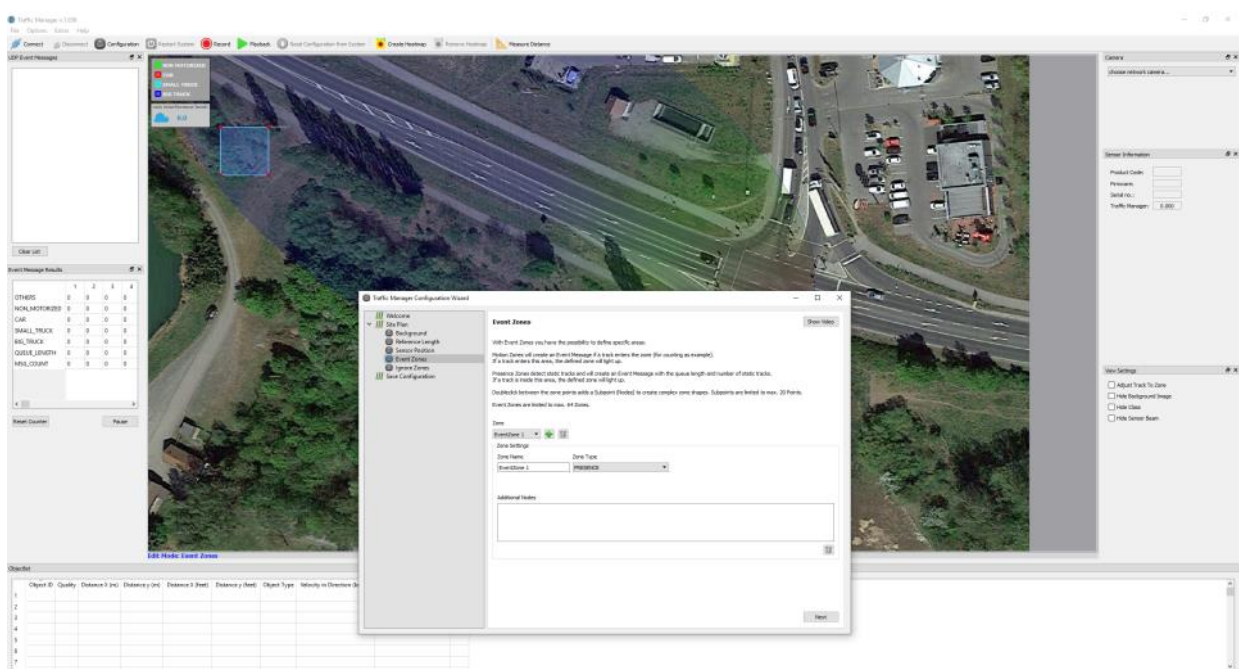


## 13.8 Working Example — In 10 easy steps to our own configuration

Step 5: After having set the correct reference length, we need to move our sensor to the precise position it's installed. Afterwards, we have to adjust the sensor beam and installation height, in order for the tracks to be displayed correctly.

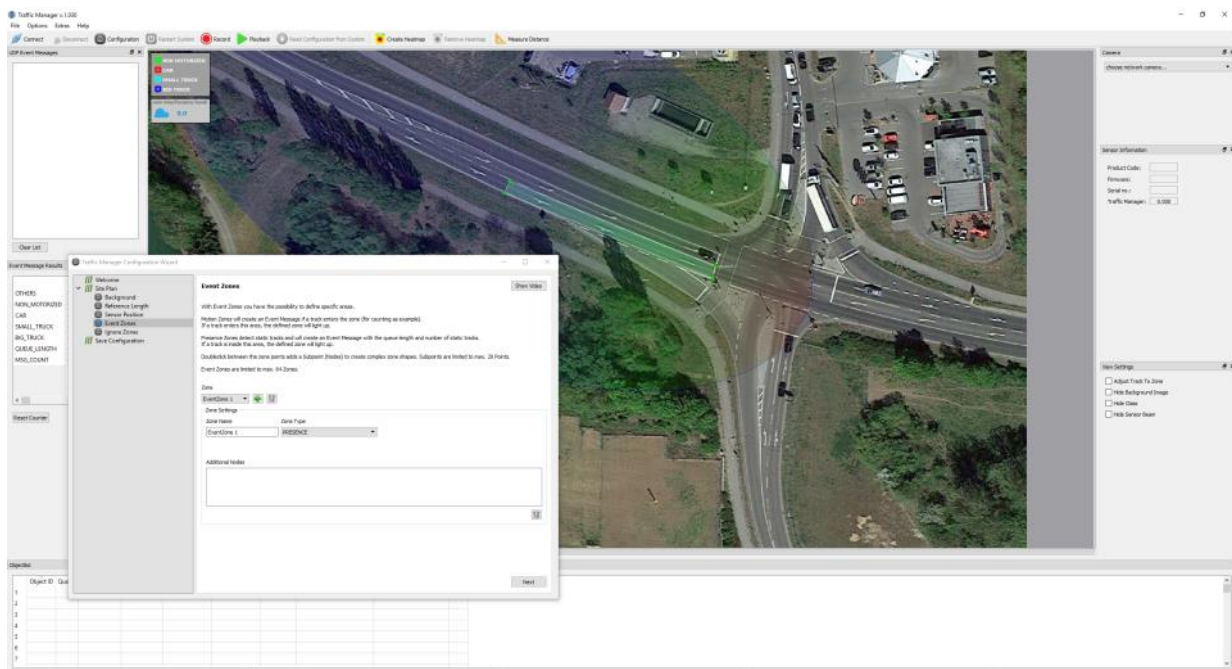


Step 6: As we want to measure the queue length on two separate lanes, we have to use presence zones. Therefore, we add the first Presence Zone in the Event Zone set up.

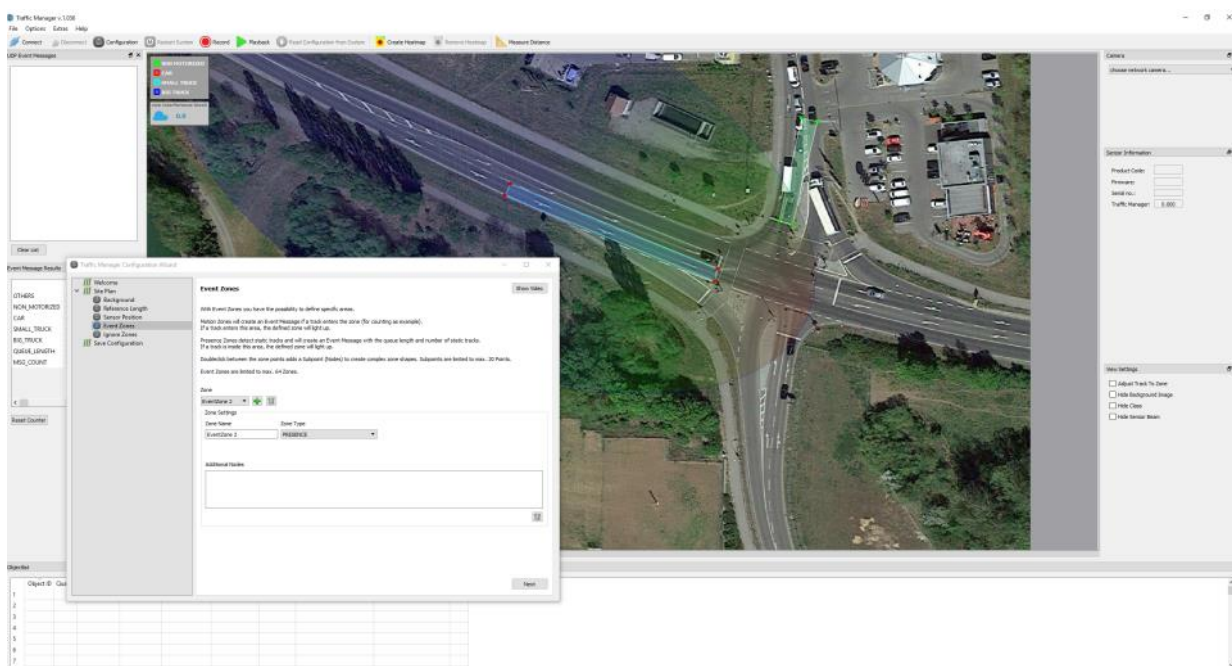


## 13.8 Working Example — In 10 easy steps to our own configuration

Step 7: The presented presence zone does not have the required shape yet. Hence, we have to adjust the presence zone to the desired maximum queue length. This is quickly done by dragging the zones' nodes into the correct shape.

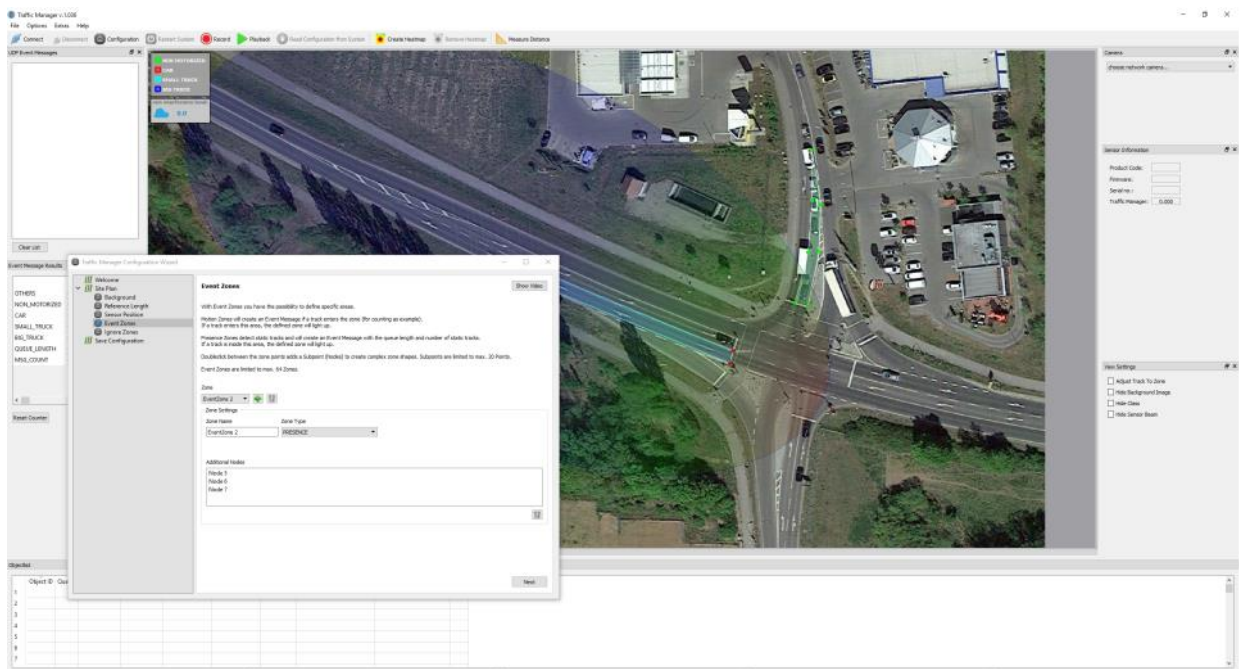


Step 8: As we want to measure queue length on two separate lanes, we need to add another presence zone. We notice that we have got a curve in our lane, so we need bring the zone into the appropriate shape. This is easily done by adding more nodes to our zone by just double clicking on the corresponding lines.



## 13.8 Working Example — In 10 easy steps to our own configuration

Step 9: After having added three more nodes to the zone, we adjusted the presence zone to the desired shape.

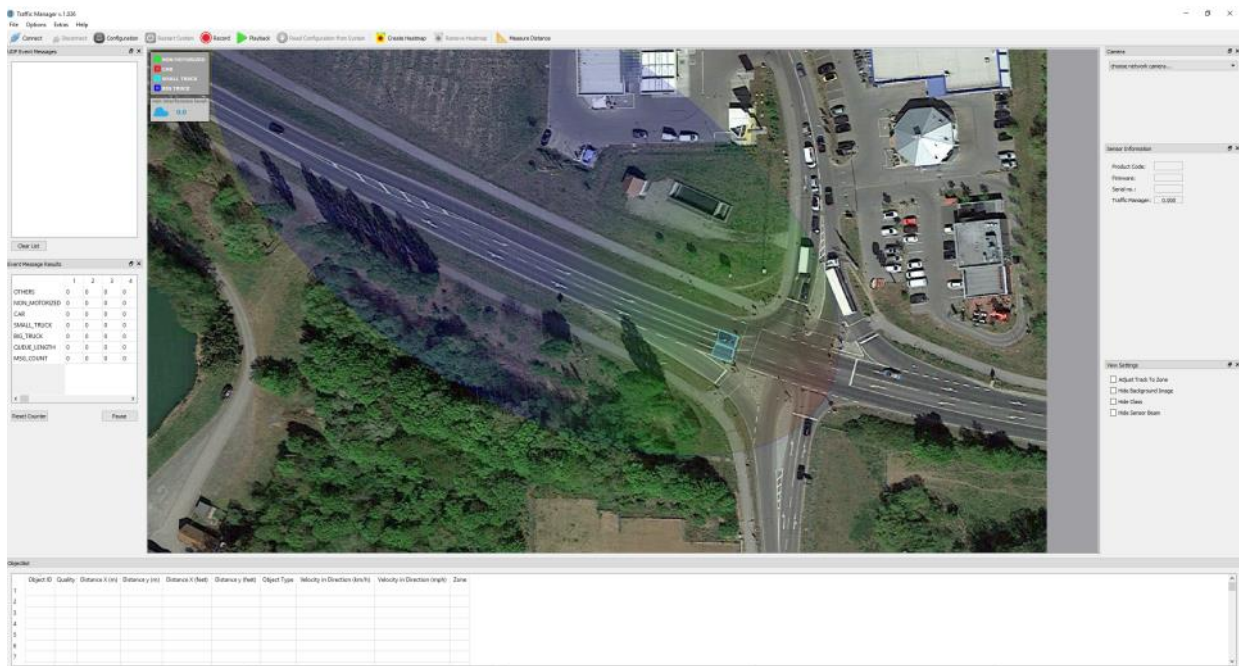


Step 10: After having set all our presence zones, we can save this configuration file. Afterwards, when having established a connection to the sensor, the saved configuration can be sent to the iSYS-5220 and we are ready to measure the queue lengths in Hassfurt, Bavaria.



## 13.9 Working Example — Application Stop Bar Detection

Step 1: In the next example, we want to have a Stop Bar Detection for traffic lights. We will have to set Presence Zones for our Stop Bar Detection. Remember, the zones must have the right size for Stop Bar Detection.

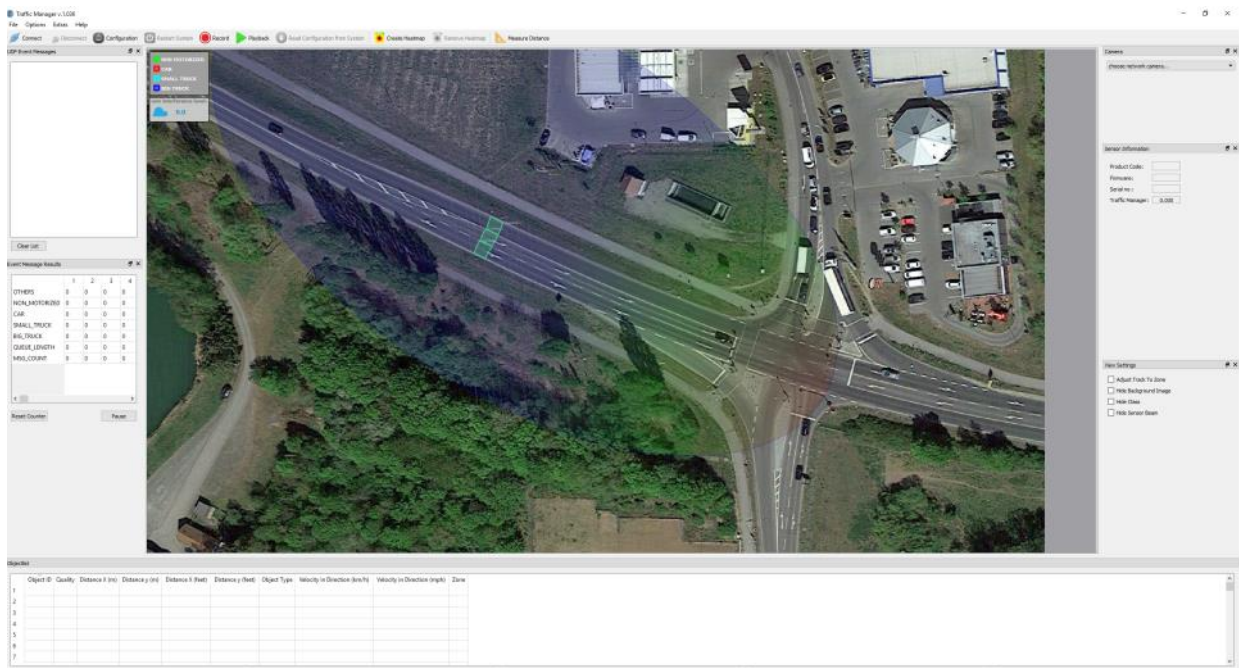


Step 2: As we can see, the iSYS-5220 detects and tracks the two objects in front of our traffic light. If a track becomes stops in front of the traffic light and becomes static, the iSYS-5220 generates an UDP event message (highlighted yellow in the picture). Now we could trigger our traffic light and therefore optimize traffic flow.



## 13.10 Working Example — Application Traffic Counting

Step 1: In our traffic counting application, we want to count the approaching and receding traffic separately on each lane. Therefore, we need three motion zones.



Step 2: As the traffic approaches, we get each time an UDP event message an object passes through a motion zone.



## 13.10 Working Example — Application Traffic Counting

Step 3: The motion zones are capable of detecting at what speed the traffic is approaching or receding. Check out the [UDP event messages](#) in getting the speed and direction of the tracked object. Now we could calculate traffic flows and average traffic speed. We can even detect wrong way drivers.

The screenshot shows the iSYS-5220 Traffic Manager v1.0.0 interface. The main window displays an aerial view of a road intersection with a green motion zone. On the left, a 'UDP Message Results' panel shows a list of messages with columns for ID, Quality, Distance, etc. Below this is a 'Speed Counter' panel with a table of speed data. On the right, there are 'Sensor Information' and 'Map Settings' panels.

**UDP Message Results**

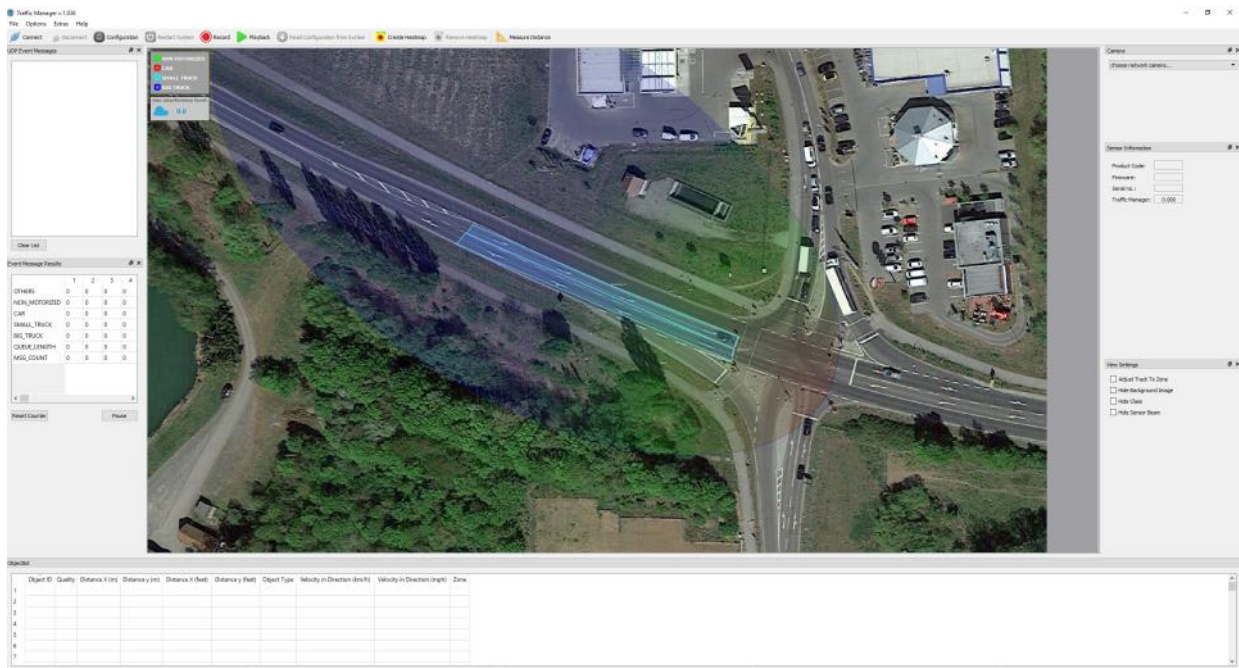
| ID | Quality | Distance | Speed | Direction |
|----|---------|----------|-------|-----------|
| 1  | 0.8     | 10.0     | 10.0  | 0         |
| 2  | 0.8     | 10.0     | 10.0  | 0         |
| 3  | 0.8     | 10.0     | 10.0  | 0         |
| 4  | 0.8     | 10.0     | 10.0  | 0         |
| 5  | 0.8     | 10.0     | 10.0  | 0         |
| 6  | 0.8     | 10.0     | 10.0  | 0         |
| 7  | 0.8     | 10.0     | 10.0  | 0         |
| 8  | 0.8     | 10.0     | 10.0  | 0         |
| 9  | 0.8     | 10.0     | 10.0  | 0         |
| 10 | 0.8     | 10.0     | 10.0  | 0         |

**Speed Counter**

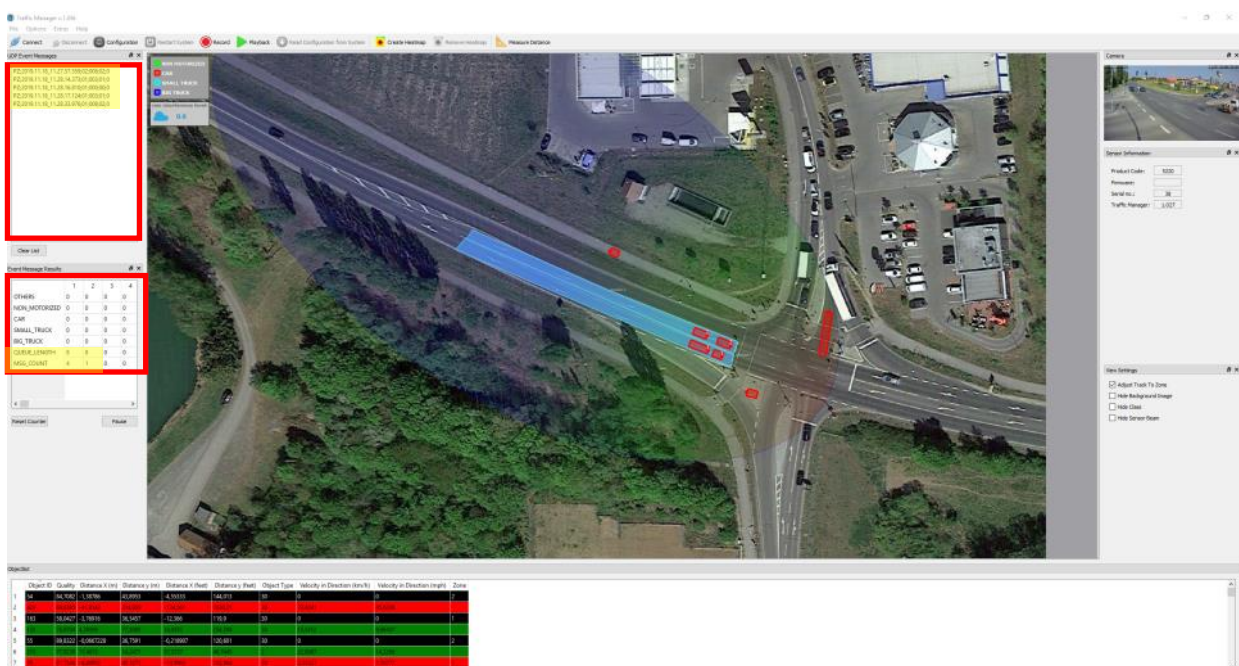
| Object ID | Quality | Distance | Speed | Direction | Zone |
|-----------|---------|----------|-------|-----------|------|
| 1         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 2         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 3         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 4         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 5         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 6         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 7         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 8         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 9         | 0.8     | 10.0     | 10.0  | 0         | 0    |
| 10        | 0.8     | 10.0     | 10.0  | 0         | 0    |

## 13.11 Working Example — Application Queue Length

Step 1: This time we want to measure the queue length on the two approaching lanes right in front of the sensor. Therefore, we have to set two presence zones with an appropriate length.



Step 2: Tracks can now become static in the presence zones. As we can see, the respective queue lengths are several meter long. Thanks to the UDP messages, we now know how many tracks are present in the queue length and how long it is. Each time there is a change in queue length the iSYS-5220 generates an UDP event message. Now we could trigger our traffic light and therefore optimize traffic flow.



## 14. APPROVALS

### ID Label



### Annex A

The information that will be given below is only a rough overview. For details please contact the local approval agencies.

### FREQUENCY BANDS IN US (FCC 15.249)



### FCC APPROVAL

This device complies with Part 15 of the FCC Rules and with RSS-210 of Industry Canada.

Operation is subject to the following two conditions:

(1) this device may not cause harmful interference and

(2) This device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications made to this equipment not expressly approved by InnoSenT GmbH may void the FCC authorization to operate this equipment.

Manufacturers of mobile or fixed devices incorporating iSYS-5220 modules are authorized to use the FCC Grants for their own final products according to the conditions referenced in these documents. In this case, the FCC label of the module shall be visible from the outside, or the host device shall bear a second label stating "Contains FCC ID: UXS-ISYS-5220".

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes:

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Notice:

Changes or modifications made to this equipment not expressly approved by InnoSenT GmbH may void the FCC authorization to operate this equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## 15. DISPOSAL

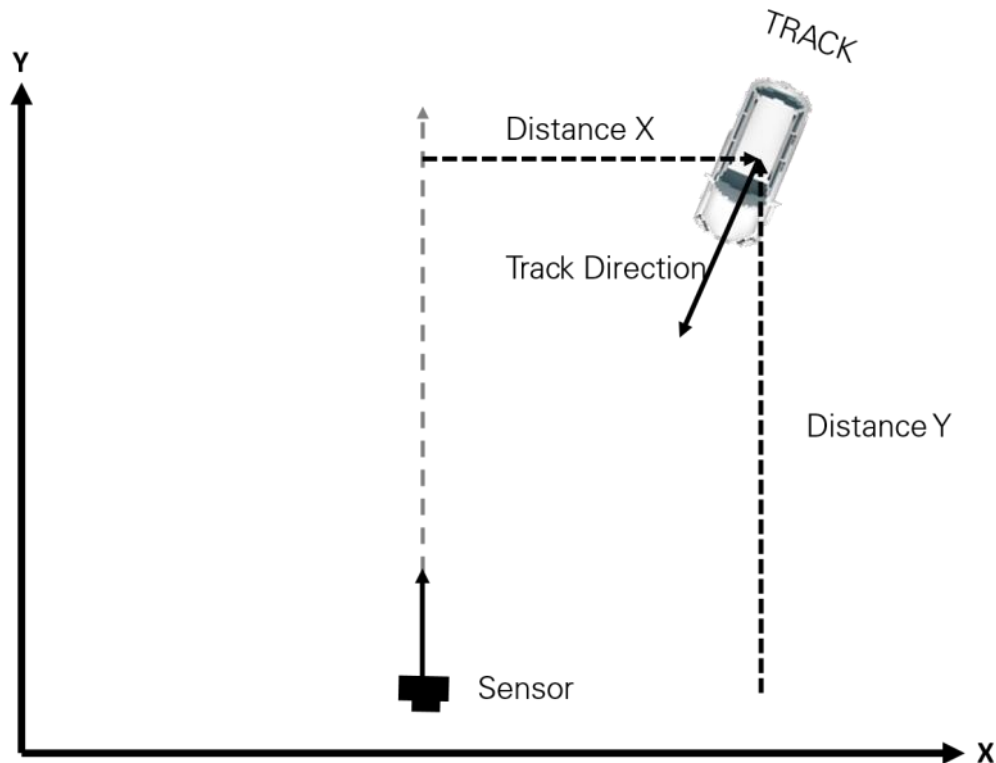
The device is to be disposed of according to the European Community Directive 2012/19/EU on waste electrical and electronic equipment.

Devices must not be disposed of with consumer waste.

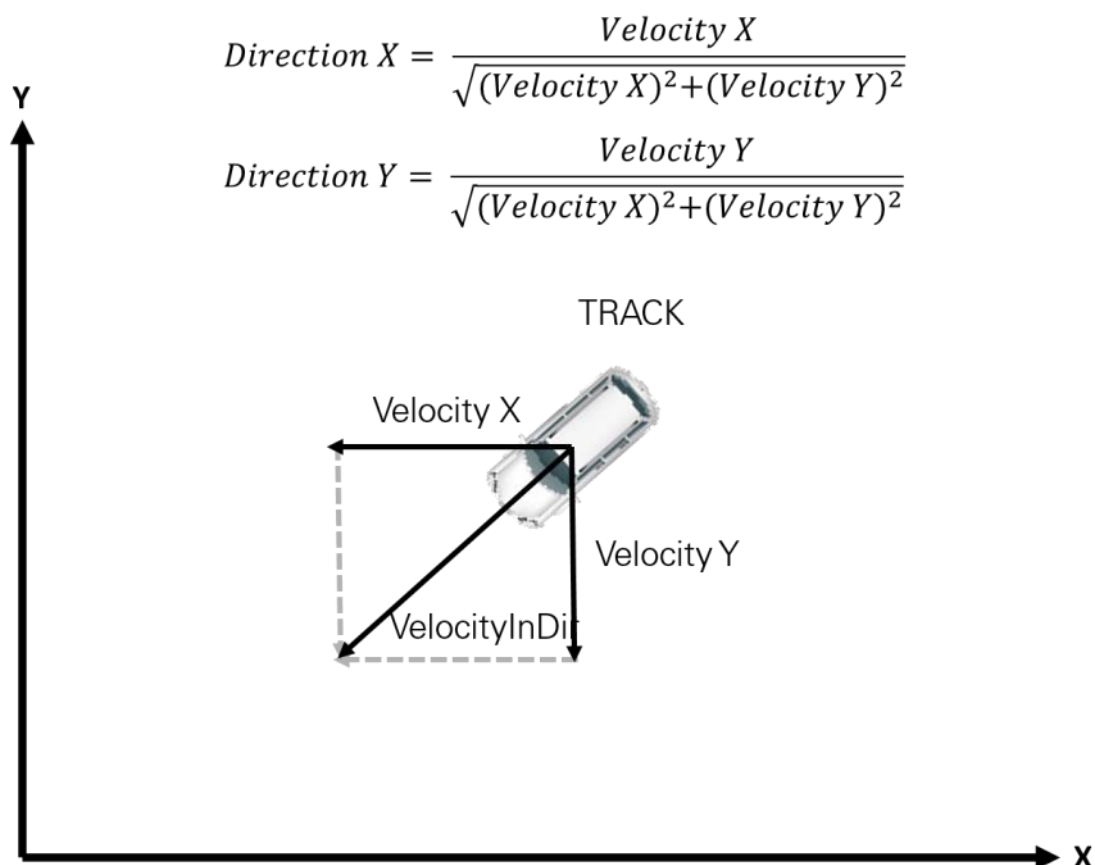
For environmentally compatible recycling and disposal of the device, please contact a certified waste management company or send the device back to InnoSenT.

## 16. APPENDIX

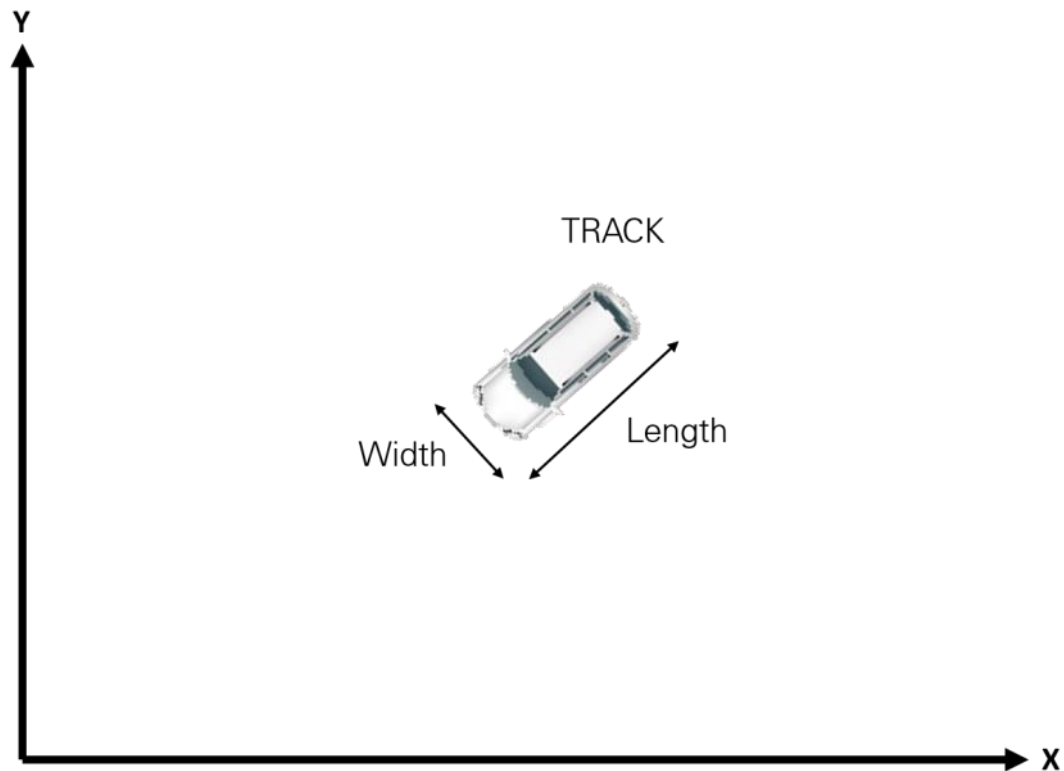
### Distance X and Distance Y



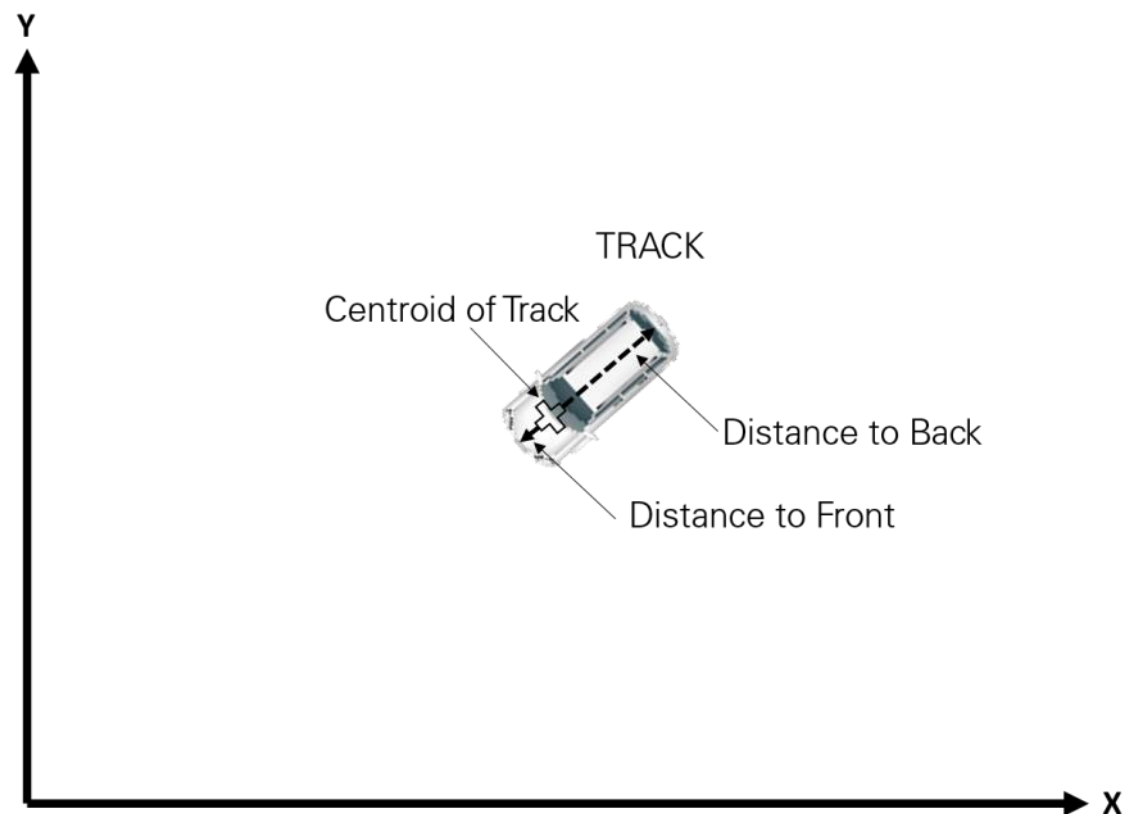
### Velocity and Direction



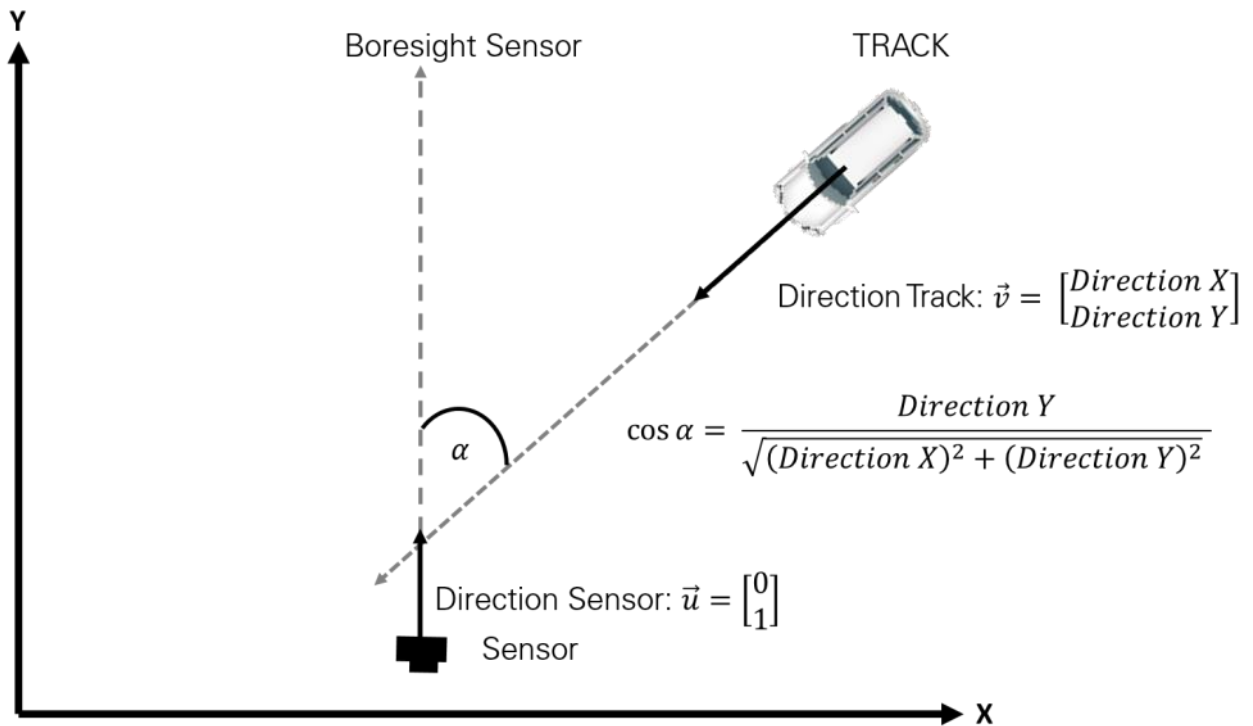
## Track Width and Length



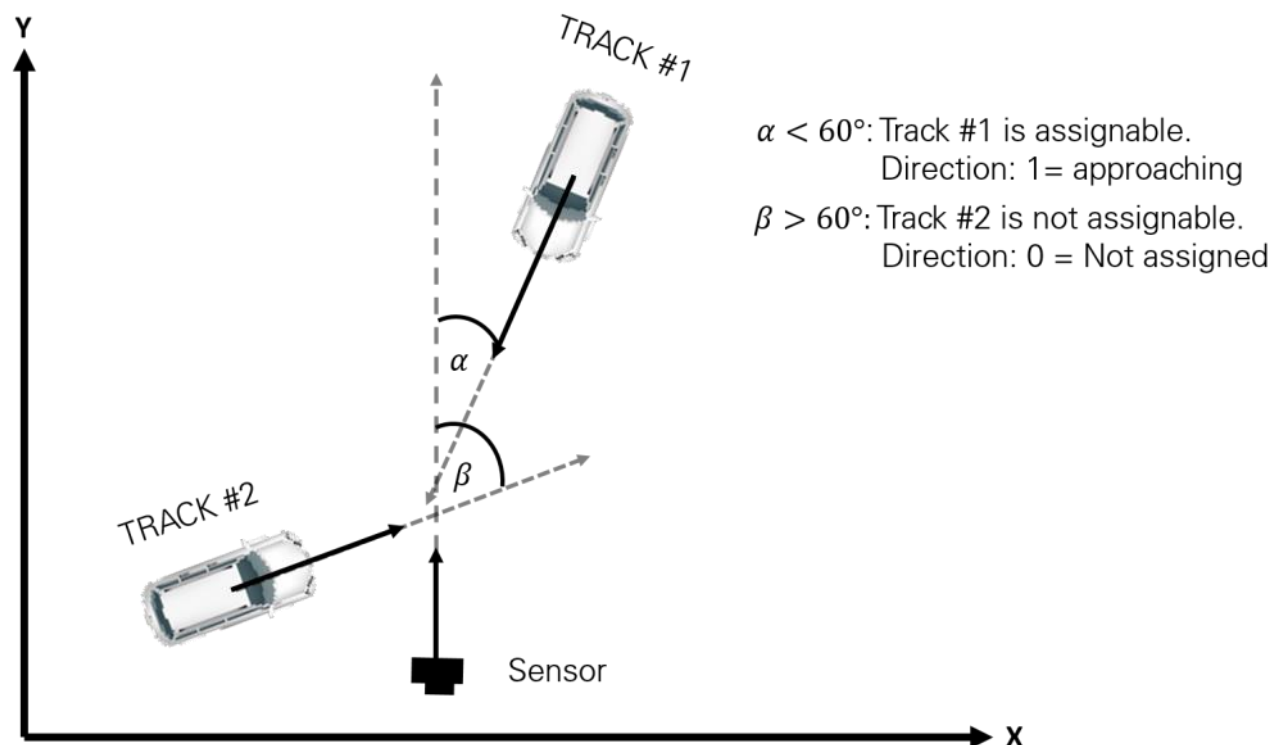
## Distance to Front and Distance to Back



## Track Assignability



## Assignable Tracks



## 17. CONTACT

Customer satisfaction is our most important goal here at InnoSenT. We therefore offer direct support for our customers.

Please send your questions, feedback and recommendations concerning iSYS-5220 to the e-mail:

**[sales@innosent.de](mailto:sales@innosent.de)**



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[www.innosent.de](http://www.innosent.de)