



BOSCH

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Intelligent Insights Counting and Crowd detection V 1.0.1

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1 Introduction

This technical note describes how Intelligent Insights processes and visualizes counted objects and the crowd level of a single camera or multiple cameras in widgets. The document describes best practices of the different use cases. It clarifies how to set up the feature, where to install cameras, and informs about the visualization in Intelligent Insights.

1.1 Application

Intelligent Insights is a software package, based on Microservice architecture, that can be installed on the Windows Operating System. When installing the system, the installer enables Microsoft Hyper-V Virtualization on the host machine and installs a virtual machine containing all microservices. You can access the configuration and dashboard visualization by the standard webbrowser locally on the machine with opening the URL <https://localhost> or from remote machines using the hostname or IP-adress of the system.

Bosch cameras have built-in video analytics to count objects, detect crowded scenes and provide geolocation information of detected objects. In many cases the raw data from a single camera does not give any information to users. The data needs to be consolidated with data from other cameras and visualized in a time-context to create insights for users. Intelligent Insights collects the Bosch Video Analytics metadata from Bosch video cameras, processes the data, combines data from multiple cameras and visualizes the data in a time-context. With the visualization of the aggregated data, users can make fast and smart decisions. The software connects to the configured cameras and subscribes to the Bosch Video Analytics metadata stream. The counter, crowd and object geolocation data is extracted from this metadata stream. The counter and crowd data is stored for 31 days in an internal database and is displayed in widgets for live visualization. Widgets can be grouped in dashboards and accessed by users for live visualization. For later analysis, the data can be accessed by the report function and exported as CSV files.

1.2 Before you start

To use Intelligent Insights, install the software on a Windows host machine. Find the installation guide and minimum hardware requirements here: "link to installation guide" and "link to datasheet". After installing the system, configure the password for the admin user and activate the system with a license. You can start with a free of charge demo license or buy a permanent license for the system. To activate the license, refer to "link to license whitepaper".

When the license is activated, start the system configuration. In order to visualize data in the live dashboard or to access the collected data by reports, you have to do the following steps:

1. Add cameras to the system
2. Configure a use case
3. Define the output of the use case
4. Create a dashboard
5. View a report
6. Optional: add more users

To add cameras to the system, select the **Cameras** tab and click the + icon. Select the protocol used to connect to the cameras, IP-address or hostname of the cameras, username and password.

Note: Special characters such as @ " ' % & / : < > ? @ [] ^ { } + " ; are not supported in the camera password field.

To configure use cases, select the **Use cases** tab. To add a new use case, click the + icon. Select the widget family, define a use case name, select presentation mode, widget range and cameras and assign cameras to the use case.

Note: Only cameras with a valid video analytics configuration appear in the use case.

The next step is to define the output of the use case. By selecting **Widget**, the use case is assigned to a dashboard. By selecting **Reports**, the use case is accessed in the reports tab.

In order to create a dashboard, select the **Dashboards** tab. Click on the + icon to add a new dashboard. Define a dashboard name and select widgets that you want to assign to the dashboard.

Note: The number of dashboards is depending on the available licenses.

To review the collected data, select the **Reports** tab and select the appropriate use case. In the report, select the desired start and end time, the granularity and the presentation mode.

Optional: In the **Users** tab you can add new users to the system. There are two different types of users in the system: Admin users, who can configure the system, and Operator users, who can access the **Dashboards** and **Reports** tab.

1.3 What can be visualized

All Intelligent Insights use cases can be configured as a widget and as a report, except the object positions use case, which can only be configured as a widget.

Intelligent Insights 1.0 supports the following use cases:

1. **Object counting**
Object counting uses Video analytics line crossing counting. It visualizes the counted objects in a certain time range. The object counting use case is available as live abstract widget, graphical widget and as report.
2. **People counting**
People counting uses Video analytics line crossing counting. Compared to the object counting use case, the people counting use case shows two counter values in one widget, one for in going and one for outgoing people. The people counting use case is available as live abstract widget, graphical widget and as report. The use case can, for example, visualize the entering and leaving people of a building.
3. **Area fill level**
The area fill level use case is an expansion of the people counting use case and also uses Video analytics line crossing counting. Based on the counted in going and outgoing objects, the fill level of an area is calculated. The use case visualizes the ingoing and outgoing persons counted by all entrance and exit cameras. The area fill level use case is available as two different live abstract widgets, as a graphical widget and as report.
4. **Occupancy counting**
The occupancy counting use cases uses Video analytics occupancy counting tasks. The Video analytics occupancy counting tasks provide the currently counted objects in the field of view. The use case is used to visualize the absolute number of actual counted objects in the field of view of the cameras. The occupancy use case is available as live abstract widget, graphical widget and as report.
5. **Crowd detection**
The crowd detection use case uses the Video analytics crowd level data. The Video analytics crowd detection provides a crowd level compared to a quiet or empty scene. The use case shows the crowd level in relative values, compared to the occupancy counting use case. It does not visualize the absolute number of people in a specific area, but a value relatively to an empty scene.
6. **Object positions**
The object positions use case uses the Video analytics geolocation feature, which provides GPS or cartesian coordinate information of objects detected in the field of view. The use case visualizes the objects on a map and gives an overview, where objects are moving. The use case visualizes, for example, all objects moving on a perimeter.

1.4 System limits and hardware recommendation

Topic	Limit
Maximum number of IP cameras* ¹	64
Maximum number of data sources, e.g. counter or crowd field	352
Maximum peak counter or crowd events	4224 events / minute 70,4 events / second
Maximum number of objects in object position widget	50

Topic	Limit
Maximum number of data sources per counting or crowd use case	30
Maximum number of cameras per object position use case	16
Maximum number of widgets per dashboard	16
Maximum number of parallel visible dashboards per client	1
Maximum number of parallel clients showing dashboards	5
Database usage per camera* ¹ per 31 days	~ 400 MB
Recommended virtual disk space for 64 cameras	~ 41 GB
Maximum data retention time	31 days
Maximum days in report query	31 days

Note:

*¹ 48 cameras used with crowd or counting use cases, 16 cameras used for object positioning use case.

Hardware recommendations for max system limit	
Operating system	Windows 10 Enterprise 1909 Windows 10 Pro 1909 Windows 10 Pro for Workstation 1909 Windows Server 2016 1607
CPU	Intel Core i7 4770 3.4 GHz (up to 3.9 GHz) Support of CPU virtualization
RAM	Minimum 16 GB
Free disk space	Minimum 20 GB Note: Minimum 10 GB free disk space must be available after installation.
Network card	1000Base-T
Recommended web browser	Google Chrome

Note:

Under overloaded clients or servers dashboards might show different results on different machines. To recover the dashboard, reduce the load on the client or server and refresh the browser.

To ensure system stability, dashboard and report response time, please monitor the client and server load after finalizing the initial configuration and after configuration changes.

2 Detailed use case description

2.1 Object counting use case

The object counting use case collects the line crossing counting data from a single or from multiple cameras. For live visualization in dashboards, the widgets are available in an abstract live view and graphical historical view. For later analysis and data export, all collected counted data can be reviewed in the report settings.

2.1.1 Abstract visualization

The abstract visualization shows the configured widget name, the selected icon and the number of counted objects in the selected time range. Available time ranges for the abstract live visualization are 10min, 30min, 60min, 12h and 24h. The icon shown in the abstract visualization can be customized. By default the standard classification icons for persons, cycles, cars and trucks can be selected or a customized icon can be uploaded.

In the use case configuration an "abnormal" and "critical" counter value (related to a specific time unit, for example 10 minutes) can be configured. Once the threshold of an abnormal or critical counter value is reached, this is indicated in the visualization and an operator will be notified to investigate. The color of the icon shows the threshold level. Green is normal, orange is abnormal and red is critical.

The counter value shows the sum of all counted objects from all configured cameras in the selected time range.

The flexibility of the counter visualization allows a combination with camera trainer use cases. For example, if a camera is trained to detect certain objects, a counter can be configured to only count trained objects passing the virtual line.

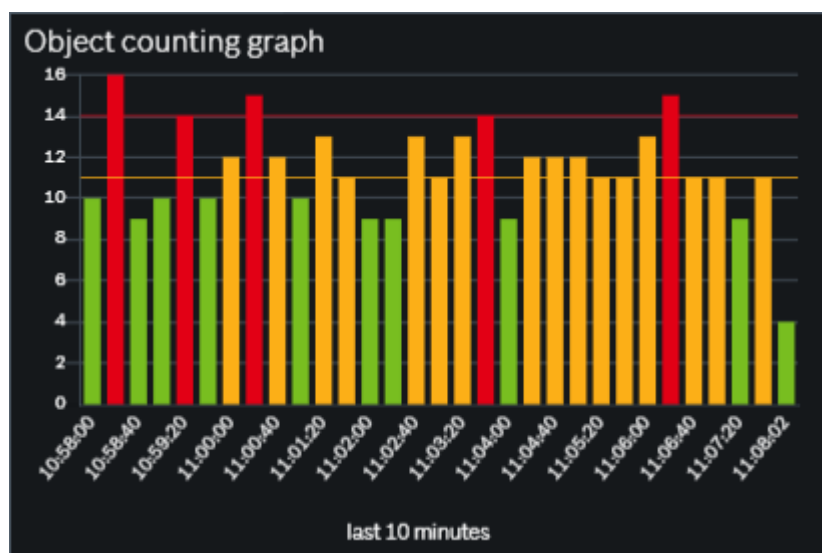


These are typical abstract object counting live widgets. The first widget shows 141 persons counted in the last 10 minutes, the second widget shows 425 counted bicycles in the last 30 minutes, the third widget shows 89 counted cars in the last 60 minutes, the fourth widget shows 17 trucks in the last 20 minutes and the last widget shows 5 counted dozers in the last 24 hours. In the last widget a customized icon is used.

Note: The classification of objects must be specified in the Video Analytics Counter configuration of the camera. The IVA task must define which objects to count.

2.1.2 Graph visualization

The graph visualization shows the historical data of the selected time range (10min, 30min, 60min, 12h and 24h). The selected time range of the graph defines the time range of each bar which visualizes the sum of all counted objects in the selected time range. For example, if a 10 min time range is selected, each bar stands for a 20 seconds time range. The last bar shows the current value and is updated with every counter change. The color of the bar symbolizes the threshold level.



This example for an object counting graph widget shows the counted object in the last 10 minutes, from 10:58 to 11:08. Each bar stands for 20 seconds and shows the sum of all counted objects.

2.1.3 Use case configuration

Use case family: Object count

* Use case name:

☒ Widget

☒ Report

Presentation: ☒ Abstract, ☐ Graph

Use case period: 10 mins

Thresholds: Alarm 200, Warning 100

Subject type: Choose another icon

Cameras: Camera 1, Camera 2, Camera 3, Camera 4, Camera 5

Use case configuration settings:

- Select the use case family: Object count
- Define the use case name
- Select the presentation mode
 - Abstract presentation mode shows the selected icon and number of counted objects in the selected time period
 - Graph presentation mode shows the historical collected data in the selected time range
- Select the use case period
 - Available period: 10, 30 and 60 min, 12h and 24h
- Define thresholds for
 - Warning
 - Alarms
- Select subject type (only for abstract widget)
- Select, if the use case is available as widget and / or as report

- Select cameras considered in this use case

Note: Only cameras with corresponding IVA task configuration are shown. For this use case only cameras with line crossing counters are shown.

2.2 People counting use case

The people counting use cases collect the line crossing counter data from a single or from multiple cameras. Compared to the object counting widget, the widget shows two counter values and customizing the icons is not possible. The people counting use case visualizes the counted objects in two directions. For example ingoing and outgoing people. It can be used to visualize how many people entered a building and left a building through different entrances. By combining counters of all entrances, the overall number of ingoing and outgoing people of a building is visualized. For live visualization in dashboards, the widgets are available in an abstract live view and graphical historical view. For later analysis and data export all collected counted data can be reviewed in the report settings.

2.2.1 Abstract visualization

The abstract visualization shows the configured use case name and the number of counted objects in the selected time range. Available time ranges for the abstract live visualization are 10min, 30min, 60min, 12h and 24h. The left person shows the sum of all counted persons configured as "in" counter in the widget configuration. The right person shows the sum of all counted persons configured as "out" counter in the use case configuration.

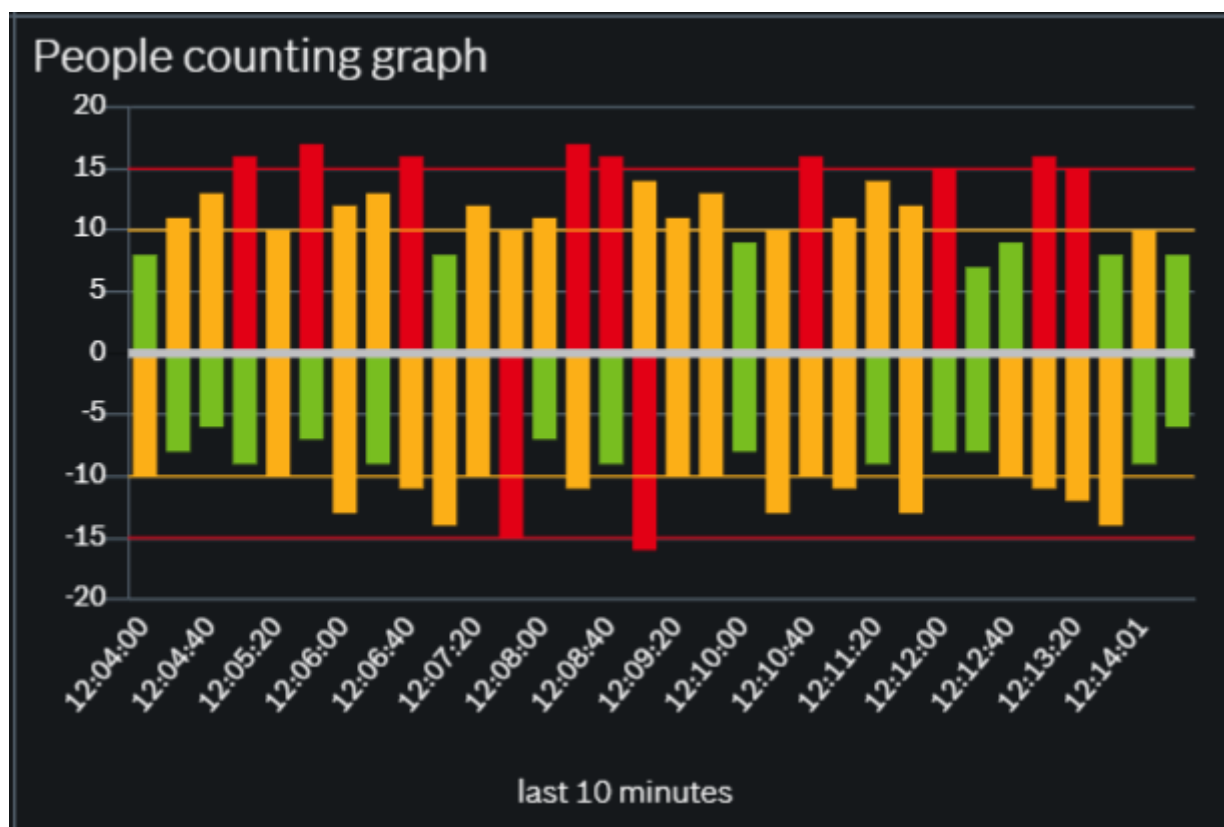
In the use case configuration an "abnormal" and "critical" counter value (related to a specific time unit, for example 10 minutes) can be configured per "in" and "out" counter. Once the threshold of an abnormal or critical counter value is reached, this is indicated in the visualization and an operator can investigate. The color of the icon shows the threshold level. Green is normal, orange is abnormal and red is critical.



This example of an abstract people counting widget shows, that in the last 10 minutes 371 are counted as ingoing persons and 310 are counted as outgoing persons. As configured in this example the value 371 is considered as critical and the value 310 is considered as abnormal.

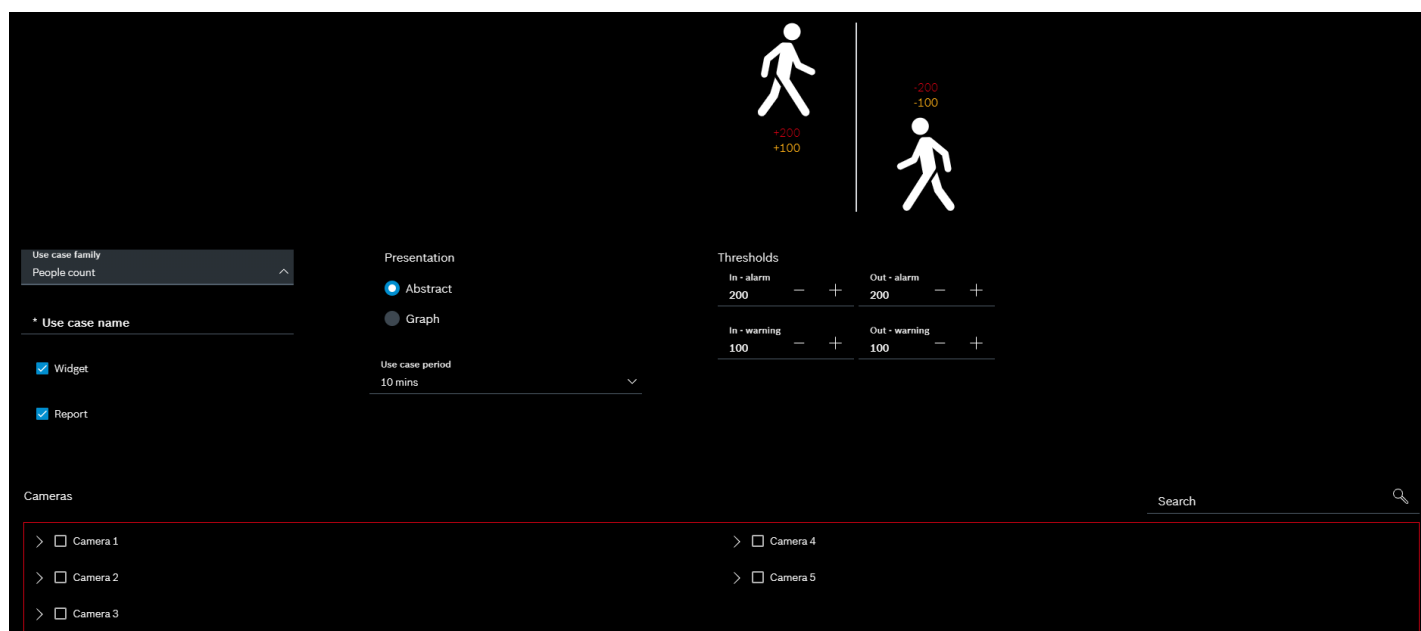
2.2.2 Graph visualization

The graphical visualization shows the historical data of the selected time range (10min, 30min, 60min, 12h and 24h). The selected time range of the graph defines the time range of each bar, which visualizes the sum of all counted objects in the selected time range. For example, if a 10 minute time range is selected, each bar stands for a 20 second time range. Positive values in the graph show the "in" counted objects, negative values show the "out" counted objects. The last bar shows the current value and is updated with every counter change. The color of the bar symbolizes the threshold level.



This example of a graphical people counting widget shows the ingoing and outgoing people in the last 10 minutes from 12:04 to 12:14. Each bar stands for 20 seconds and shows the sum of all counted objects. Positive values show the counted ingoing people, negative values show the counted outgoing people.

2.2.3 Use case configuration



Use case configuration settings:

- Select the use case family: People count
- Define the use case name
- Select, if the widget is available as widget and / or as report
- Select the presentation mode
 - Abstract presentation mode shows two persons, the left person symbolies the entering people, the right person symbolies the leaving people
 - Graph presentation mode shows the historical collected data in the selected time range
- Select the use case period
 - for abstract presentaiton available period: 10, 30 and 60 min, 12h and 24h
 - for graphical presentation available period: 10, 30 and 60 min, 12h and 24h
- Define thresholds for
 - Warning
 - Alarms
- Select cameras considered in this use case
Define, if the camera counter is considered as "in" counter or as "out" counter.
Note: Only cameras with corresponding IVA task configuration are shown. For this use case only cameras with line crossing counters are shown.

2.3 Area fill level use case

The area fill level is an expansion of the people counting use case and collects line crossing data from a single or from multiple cameras. In this use case cameras of all entrances of an area are counting ingoing and outgoing people. Therefore the fill level of an area can be calculated. For live visualization in dashboards the widgets are available in an abstract live view and graphical historical view. For later analysis and data export all collected counted data can be reviewed in the report settings.

2.3.1 Abstract visualization

There are two options for the area fill level abstract visualization:

- **Area fill level visualization**
The standard area fill level abstract visualization is designed to display in a dashboard. The widget visualizes the fill level of the area in percentage compared to the defined maximum fill level.
- **Area fill level traffic light**
The area fill level traffic light is designed to display in full screen mode on monitors. It shows the current number of people in an area and indicates if people should enter this area or not. The area fill level traffic light shows the absolute numbers of persons in the area.

Area fill level visualization

The abstract visualization shows the configured widget name, the current fill level of the area, the start time of the fill level configuration and the number of ingoing and outgoing people in the selected time range. The area fill level is shown as a relative value to the defined maximum occupancy of the area. The maximum occupancy of the area has to be defined in the use case settings. The start time of the calculation is a predefined time when the calculation of the area fill level starts. The start time resets the area fill level every day on the selected counting start time to 0. This counting start time should be set, when the area is empty or the counting should start. For example, the opening hour of a store. Available time ranges for the ingoing or outgoing people are 10min, 30min, 60min, 12h and 24h. The visualization of ingoing and outgoing people can be disabled.

In the use case configuration an "abnormal" and "critical" fill level (related to the start time) can be configured. Once the threshold of an abnormal or critical fill level is reached, this is indicated in the visualization and an operator can investigate further. The color of the bar shows the threshold level. Green is normal, orange is abnormal and red is critical.

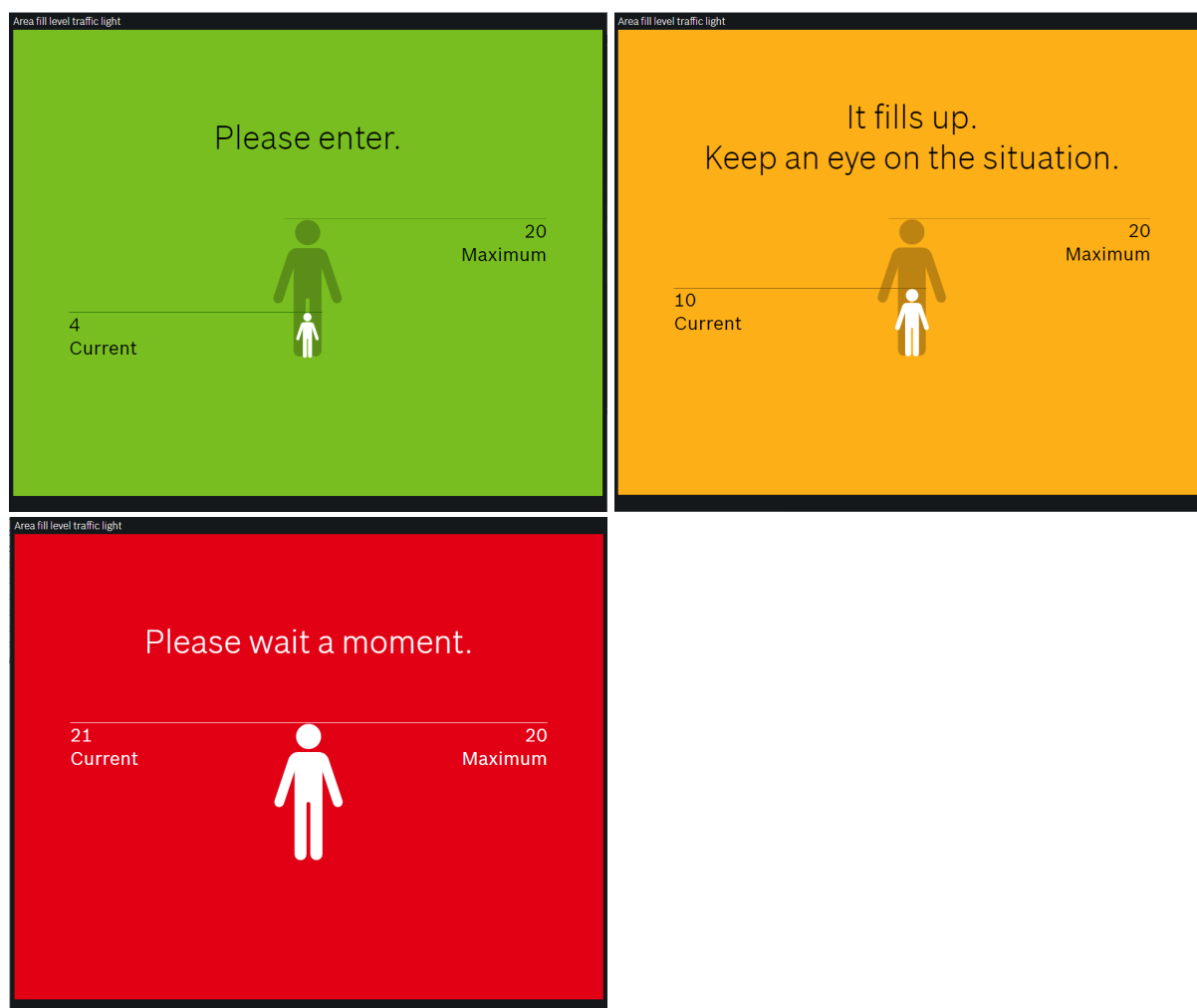


This example of an abstract area fill level visualization shows an area fill of 28%. The calculation of the area fill level starts at 12:00. The person left of the fill level visualizes the number of ingoing people in the last 10 minutes. In this example 225 people entered the area in the last 10 minutes. The right person visualizes the number of outgoing persons in the last 10 minutes. In this case 180 people left the area in the last 10 minutes.

Area fill level traffic light

The area fill level traffic light shows the configured widget name, the current number of people in the area, and the maximum allowed number of persons in the area. The background color of the widget indicates, which threshold level is reached. If the number of people in the area is still within the "normal" threshold level, the background of the widget is green. As soon as the number of people in the area reaches the warning level, the background color changes to orange. If the number of people in the area exceeds to the maximum area fill level, the background color changes to red. The red color warns people either to stay outside of the area or to leave the area.

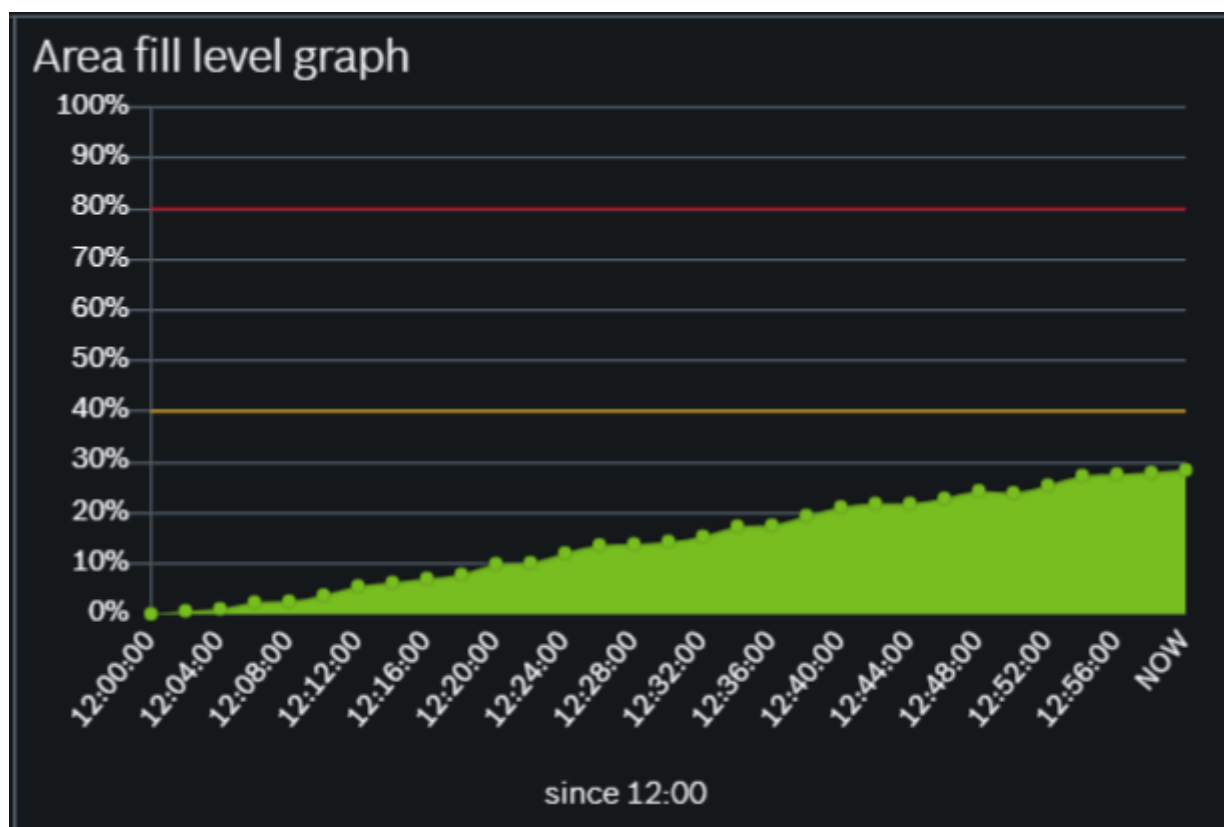
The information message of the different threshold levels and the label of the current and maximum value is customizable. The information message can be up to 60 characters. The label can be up to 16 characters. This also allows to use the visualization in different languages.

**Note:**

The area fill level traffic light use case supports the threshold actions but cannot be configured as a report. To review the collected data in a report, please setup an area fill level use case with the same settings as the area fill level traffic light and make the use case available as a report.

2.3.2 Graph visualization

The graphical visualization shows the historical data from the selected counting start time. The graph shows a line bar and is updated with every change of area fill level. The color of the graph shows the threshold level. Green is normal, orange is abnormal and red is critical.



This example of an graphical area fill level widget shows the historical view of the area fill level from the counting start of 12:00 until now (13:00). The counting start time defines the start time of the graph and does not change until the counting start time of the next day.

2.3.3 Use case configuration

Area fill level use case configuration:

The configuration interface for the Area fill level use case includes the following sections:

- Use case family:** Area fill level (selected).
- * Use case name:** (empty field).
- Presentation:**
 - ☒ Abstract
 - ☐ Graph
- Use case period:** NOW (selected).
- Start time:** 09:00.
- Thresholds:**
 - Maximum occupancy: 100.
 - Warning threshold: (slider at 100).
 - Normal threshold: (slider at 0).
- Calibration value(optional):** (empty field).
- Calibration value note:** Calibration value will not be considered in reports.
- Threshold actions:**
 - ☐ Enabled
 - (Three circular icons for action configuration)
- Cameras:**
 - Camera 1, Camera 2, Camera 3 (all unchecked).
 - Camera 4, Camera 5 (all unchecked).

Use case configuration settings:

- Select the use case family: Area fill level
- Define the use case name

- Select, if the use case is available as widget and / or as report
- Select the presentation mode
 - Abstract presentation mode shows the fill level in a fill level indicator in % relatively to the maximum defined fill level

Note: Optional the people counting information of a certain time period can be added. This informs additionally about the people flow into and out of the area.
 - Graph presentation mode shows the historical fill level since the start time
- Select the use case period
 - Available period: 10, 30 and 60 min, 12h and 24h

Note: Selecting a time range enables the people counting visualization.
- Define the start time for the occupancy calculation

Note: The occupancy is always set to 0 at the selected start time. The selected start time is, for example, the opening hour of a shop. The start time can be configured in 10 minutes intervals, e.g. 09:00, 09:10, 09:20 etc. The current Area Fill level value can be modified via the calibration value if the actual fill level does not match the displayed level.
- Define the maximum occupancy

Note: This defines the maximum allowed people in the area and is used for the occupancy calculation.
- Define thresholds for:
 - Warning
 - Alarms
- Calibration value

Calibrate the current fill level of the use case with entering the absolute number of objects in the area or pressing the + and - button. Please note the calibrated values are not considered in the reports. The calibrated values only apply to the abstract visualization.
- Select cameras considered in this use case

Define, if the camera counter is considered as "in" counter or as "out" counter.

Note: Only cameras with corresponding IVA task configuration display. For this use case only cameras with line crossing counters display.

Area fill level traffic light use case configuration:

Use case configuration settings:

- Select the use case family: Area fill level traffic light
- Define the use case name
- Select the use case period
 - Only "now" is available as the widget shows the current value
- Define the start time for the occupancy calculation

Note: The occupancy is always set to 0 at the selected start time. The selected start time is, for example, the opening hour of a shop. The start time can be configured in 10 minutes intervals, for example 09:00, 09:10, 09:20

etc. The current area fill level value can be modified by the calibration value if the actual fill level does not match the displayed fill level.

- Define the maximum area fill level

Note: This defines the maximum allowed people in the area.

- Optional: Define the warning area fill level

Note: Setting the warning value to the same value as the maximum value, disables the warning level.

- Define the label of the maximum area fill level and the current value

Note: The label of maximum and current area fill level is customizable to display the label in the local language.

- Define the information messages of the different threshold levels

Note: The information messages are customizable to display the messages in local languages. The maximum number of characters for information messages is 60 characters. The warning information message is only editable if a warning threshold is configured.

- Calibration value

Calibrate the current fill level of the use case with entering the absolute number of objects in the area or pressing the + and - button. Please note that the calibrated values are not considered in the reports. The calibrated values only apply to the abstract visualization.

- Select cameras considered in this use case

Define if the camera counter is considered as "in" counter or as "out" counter.

Note: Only cameras with corresponding IVA task configuration display. For this use case only cameras with line crossing counters display.

2.4 Occupancy Counting

The occupancy counting use case collects occupancy counter data from a single or multiple cameras. Compared to a line crossing counter from cameras used in the use cases object, people counting and area fill level, the occupancy counting in cameras provides the actual number of detected object in the field of view. Cameras are counting the objects in the selected field and provide the number of counted objects. Compared to line crossing counter, the occupancy counter can increase and decrease, while line crossing counters only increase.

For live visualization in dashboards, the widgets are available in an abstract live view and graphical historical view. For later analysis and data export all collected counted data can be reviewed in the report settings.

2.4.1 Abstract visualization

The abstract visualization shows the configured widget name, the selected icon and the number of counted objects in the selected area. The icon shown in the abstract visualization can be customized. By default the standard classification icons for persons, cycles, cars and trucks can be selected or a customized icon can be uploaded.

In the use case configuration an "abnormal" and "critical" counter value (related to a specific time unit, for example 10 minutes) can be configured. Once the threshold of an abnormal or critical counter value is reached, this is indicated in the visualization and an operator will be notified to investigate this further. The color of the icon shows the threshold level, green stands for normal, orange for abnormal and red for critical.

The flexibility of the occupancy counting visualization allows a combination with camera trainer use cases, e.g. if a camera is trained to detect certain objects, an occupancy counter can be configured to only count trained objects in an area and the information can be visualized in this use case



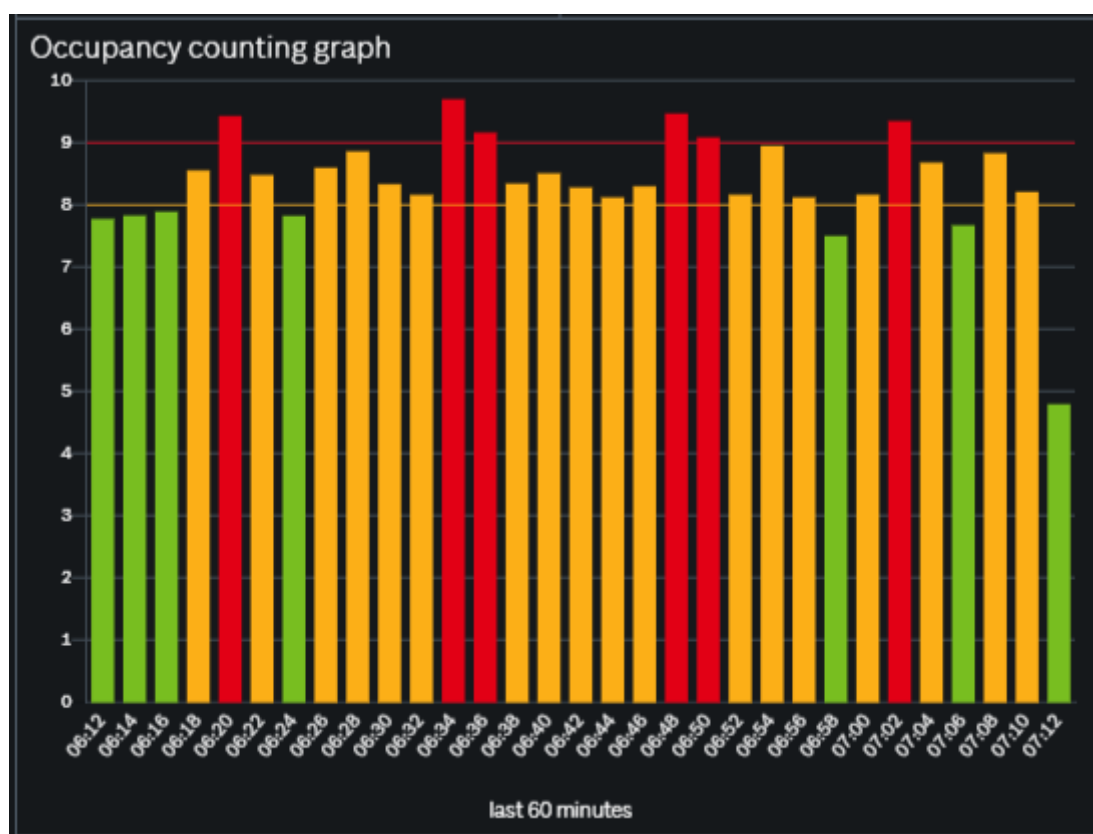
These are typical abstract occupancy counting live widgets. The first widget shows that currently 42 persons are counted in the field of view of a single or of multiple cameras. The second widget shows 3 counted bicycles. The third widget shows

9 counted cars. The fourth widgets shows 16 trucks and the last widgets shows 17 counted dozers. In last widget a customized icon is used.

Note: The classification of objects must be specified in the Video Analytics Counter Configuration of the camera. The IVA task must define which objects to count.

2.4.2 Graphical visualization

The graphical visualization shows the historical data of the selected time range (10min, 30min, 60min, 12h and 24h). The selected time range of the graph defines the time range of each bar which visualizes the average of all counted objects in the selcted time range. For example, if a 10 minutes time range is selected, each bar stands for a 20 seconds time range. The last bar shows the current value and is updated with every counter change. The color of the bar symbolizes the threshold level.



This example of an occupancy counting graph shows the counted objects in the last 60 minutes, from 06:12 to 07:12. Each bar stands for 2 minutes and shows the average of all counted objects. The last bar shows the current counted live data.

2.4.3 Use case configuration

Use case configuration settings:

- Select the use case family: Occupancy
- Define the use case name
- Select, if a widget is available as widget and / or as report
- Select the presentation mode
 - Abstract presentation mode shows the selected icon and the number of currently counted objects in the field of view
 - Graph presentation mode shows the historical occupancy in the selected time range
- Select use case period
 - For abstract view, only "now" is available as the widget shows the current value
 - For graphical view available time ranges: 10, 30 and 60 min, 12h and 24h
- Define thresholds for:
 - Warning
 - Alarm
- Select subject type or upload a customized icon (only for abstract widgets)
- Select cameras considered in this use case

Note: Only cameras with corresponding IVA task configuration are shown. For this use case only cameras with occupancy counters tasks are shown.

2.5 Crowd Detection

The crowd detection use case collects the crowd level data from cameras. For live visualization in dashboards, the widgets are available in an abstract live view and a graphical historical view. For later analysis and data export all collected crowd data can be reviewed in the report settings. The crowd level data from cameras gives a relatively crowd value compared to a quiet scene or a scene with no people or movement. By each camera maximum 3 crowd fields can be configured.

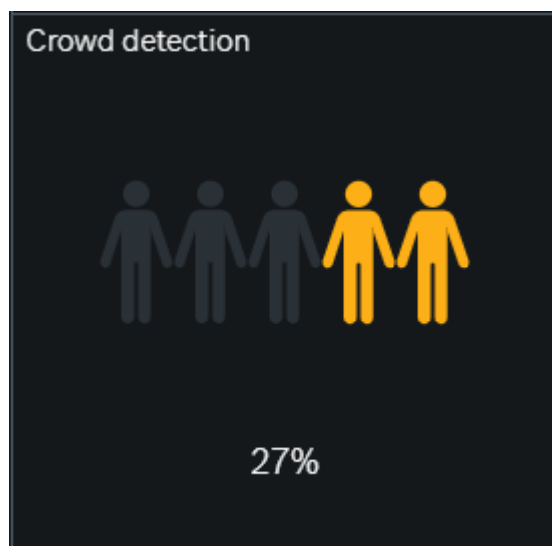
2.5.1 Abstract visualization

The abstract visualization shows the configured widget name and the current crowd level of the configured cameras. Each person stands for 20 % crowd level. For detailed information about the crowd level, the absolute crowd level value is shown in the widget. If the first icon is colored, the crowd level of the configured cameras is between 0 to 20%. If the first and the second icon is colored, the crowd level of all configured cameras is between 20% and 40%.

Note: A customization of the icon is not possible in the use case configuration.

In the use case configuration an "abnormal" and "critical" crowd value can be configured. Once the threshold of an abnormal or critical crowd level is reached, it is indicated in the visualization and an operator is notified to investigate. The color of the icon shows the threshold level. Green is normal, orange is abnormal and red is critical.

If multiple crowd detection fields from a single or from multiple cameras are configured in the use case configuration, the value in the abstract visualization shows the average of the crowd level from all configured crowd fields (Crowdlevel 1 + Crowdlevel 2 + Crowdlevel X)/X.

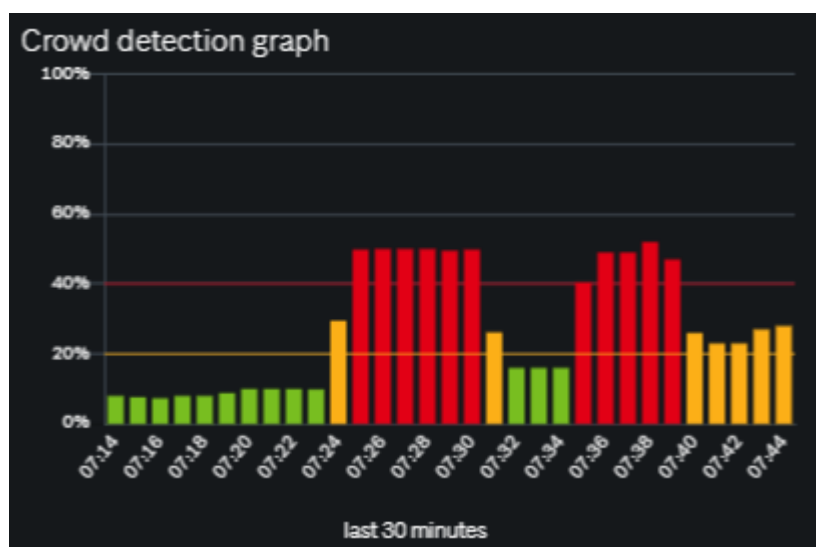


This example of a crowd detection abstract widget shows the current crowd level of 27%, which is considered as abnormal.

2.5.2 Graph visualization

The graphical visualization shows the historical data of the selected time range (10min, 30min, 60min, 12h and 24h). The selected time range of the graph defines the time range of each bar which visualizes the average crowd level in the selected time range. For example, if a 30 minutes time range is selected, each bar stands for a 1 minute time range. The last bar shows the current value and is updated with every crowd level change. The color of the bar symbolizes the threshold level.

If multiple crowd detection fields from a single or from multiple cameras are configured in the use case configuration, the value in the graphical visualization shows the average of the crowd level from all configured crowd fields (Crowdlevel 1 + Crowdlevel 2 + Crowdlevel X)/X.



This example of a crowd detection graphical widget shows the current level history from 07:14 to 07:44. Each bar visualizes the average crowd level per minute. The last bar shows the current crowd level value.

2.5.3 Use case configuration



Use case configuration settings:

- Select the use case family: Crowd detection
- Define the use case name
- Select, if the widget is available as widget and / or as report
- Select the presentation mode
 - Abstract presentation mode shows the current crowd level in %
 - Graph presentation mode shows the historical occupancy in the selected time range
- Select use case period
 - For abstract view, only "now" is available as the widget shows the current value
 - For graphical view available time ranges: 10, 30 and 60 min, 12h and 24h
- Define thresholds for:
 - Warning
 - Alarm
- Select cameras considered in this use case

Note: Only cameras with corresponding IVA configuration are shown. For this use case only cameras with crowd field are shown. The use case always shows 3 crowd fields, even if only one crowd field is configured in the camera.

3 Report function

In addition to the visualization of data in live and historical widgets, the system also allows to review the collected data in reports and to extract the data in CSV file format. For all configured object counting, occupancy counting, people flow counting, crowd detection and area fill level use cases, the collected data is stored for maximum 31 days. After 31 days the oldest data is deleted from the internal database. With the report functionality users can access all collected data and review the data. The reports are based on the configured use cases. When a use case is configured to be available as a report, the report is shown in the **Reports** tab.

In the report users can define the start and end time of the report and, depending on the selected time range, users can define the granularity of the reports. With this function users can run a report of a day to find out the peak hours of a day. Or they can run a report based on multiple days to find out the peak days in general. The graph can be shown in a line or a bar graph and users can switch between a combined view and a separate view. In the combined view all incoming data is summed up and the result is displayed. In the separate view all single input data is shown in a line or a bar graph. The selected view can be exported in CSV file format for further analysis in 3rd party tools, like Microsoft Excel.

Report input data:

Input paramter	Description
Start date	Select the start date of the report
Start time	Select the start time of the report on the selected start date
End date	Select the end date of the report
End time	Select the end time of the report on the selected end date
Granularity	Select the granualrity of the data
< 1 min	1, 2, 3, 5, 10 seconds
< 20 min	10, 20, 30 seconds, 1, 2 min
< 30 min	20, 30 sec, 1, 2, 3, 5 min
< 60min	1, 2, 3, 5, 10 min
< 3h	3, 5, 10, 20, 30 min
< 6h	5, 10, 20, 30, 60min
< 12h	10, 20, 30min, 1, 2 hours
< 24h	20, 30 min, 1, 2, 3, 4 hours

Input paramter	Description
< 48h	30min, 1, 2, 3, 4, 6 hours
< 5 days	1, 2, 3, 4, 6, 12 hours
< 7 days	2, 3, 4, 5, 12, 24
> 7 days	1/2 day, 1, 2, 7 days

Bar graph combined view

The combined bar graph view shows the sum of all counted objects in bars. The number of bars in the selected time range can be defined with the selected granularity.
Note: In the crowd detection use case the bar graph shows the average of all configured crowd detection fields.

Bar graph separate view

The separate bar graph view shows the sum of all counted objects. The share of each camera or counter is symbolized in a separate color.

In the legend of the graph individual counters can be deactivated or activated.
Note: In the crowd detection use case the bar shows the average of all crowd detection fields. In the separate view, the different colors show the percentage per camera.

Line graph combined view

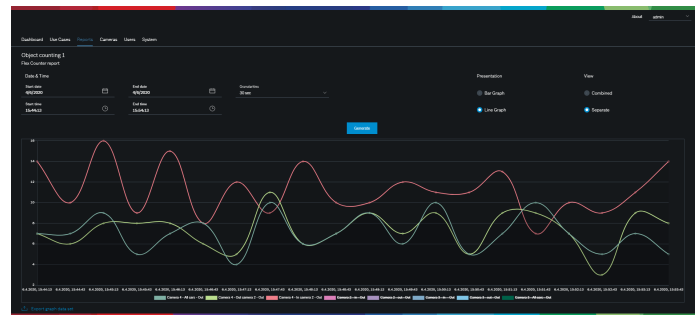
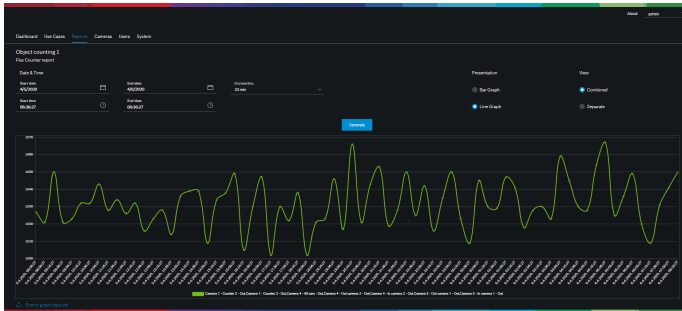
The combined line graph shows the sum of all counted objects in bars. The number of measuring points displayed are defined with the selected granularity.

Note: In the crowd detection use case the bar graph shows the average of all configured crowd detection fields.

Line graph separate view

The separate line graph view shows a line for each counter or crowd detection field.

In the legend of the graph individual counters can be deactivated or activated.



Limitations:

- When using the browser zoom in and out function, the graphs in the report function are not shown properly.
- When using a crowd detection report in separate view, the height of a bar shows the average of all crowd detection fields and the percentage of each crowd detection field to the sum. When you switch to the line graph, the line graph shows the absolute crowd detection of the level. As the bar graph shows the average of all crowd detection fields, the bar graph shows a lower value than the line graph.
- When configuring an area fill level use case with a counting start time before the configuration is finished, the area fill level shows incorrect values until the counting start time meets the next day. For example, an area fill level is configured for 1 pm and the counting start time is configured for 9 am, the area fill level shows a wrong fill level until the next day starting at 9 am. The people in the current configuration are not considered.
- When selecting a time period of more than 6 days, the area fill level only allows a granularity of 1 day. This allows to compare the area fill level with other days.
- People counting and area fill level shows positive and negative values in the report. Positive values are objects considered as "in" counted objects, negative values are objects considered as "out" counted objects.
- Depending on the selected granularity and time period, the last bar in the bar chart might show misleading information.
- Due to performance reasons the system uses aggregated data of 30 minutes chunks when running a report with a granularity of 1 hour or more. When using the aggregated data, the start and end time of the report differs from the selected start and end time. The start time is rounded down to the nearest full hour or half an hour and the end time is rounded up to the nearest full hour or half hour.

Example:

Selected start time: 11:11:2020 09:35

Selected end time: 12:11:2020 10:20

Shown start time: 11:11:2020 09:30

Shown end time: 12:11:2020 10:30

4 Threshold actions

Intelligent Insights supports controlling Bosch IP devices by CGI commands over HTTP or HTTPS or can send a restful API GET call to a 3rd party device when a threshold of the area fill level use case is reached.

Controlling Bosch IP devices by threshold actions:

Bosch IP video products can be controlled and managed using an enhanced version of Remote Control Protocol. This protocol defines commands and messages that allow to control the device, such as controlling a relay or moving the camera to a preposition. The command structure of RCP+ must be translated into parameters and values handed over to the unit's XML-based CGI interpreter as a query string. Using HTTP as transportation protocol, for example with a web browser, an URL may look like: [HTTP://160.10.0.1/rcp.xml?<<query_string>>](http://160.10.0.1/rcp.xml?<<query_string>>)

Example were 10.120.22.214 is the IP address of a selected camera:

For activating a camera relay by Alarm, add URL: http://10.120.22.214/rcp.xml?command=0x01c1&type=F_FLAG&direction=WRITE&num=1&payload=0x01

For deactivation a camera relay by Normal, add URL: http://10.120.22.214/rcp.xml?command=0x01c1&type=F_FLAG&direction=WRITE&num=1&payload=0x00

Detailed information can be found here: [link](#)

External signaling units can be connected to the Bosch camera relay, for example, to start a voice message or turn on lights.

Controlling 3rd party devices by threshold actions:

Next to controlling Bosch IP Camera devices it is also possible to send RESTFUL API Get calls to 3rd party devices. In the current version 1.0 of Intelligent Insights only RESTFUL GET commands are supported. If the 3rd party device allows to control the device by GET commands, this functionality allows to control 3rd party devices.

Note:

- Restful API calls can be send to devices that support
 - basic authentication via https
 - basic authentication via http
- Only restful API GET commands are supported in Version 1.0

How to setup the threshold actions:

1. Enable the threshold action with selecting the checkbox
2. Click on the threshold level that you want to trigger the action with
3. Specify the complete URL of the command that is sent when the fill level of the area is above the warning value set
4. Type the user name and password of the camera / 3rd party device

General notes:

- Intelligent Insights support controlling Bosch IP cameras by CGI commands over HTTP or HTTPS when a threshold of the area fill level, area fill level traffic light or occupancy use case is reached.
- Make sure "Basic authentication" is enabled in the camera security settings.
- Also cameras that are not added to Intelligent Insights can be used to send the CGI commands. There is no check if the camera exists in the configuration or not. The feature just sends the configured command to the configured camera IP address.

- Intelligent Insights support sending a restful API GET call to 3rd party devices when a threshold of the area fill level, area fill level traffic light or occupancy use case is reached.
- Restful API call responses are not further processed.
- When using the CGI commands with Bosch cameras, the XML return message, when controlling, is not further processed.

5 Upgrade to version 1.0.1

Due to performance reasons in displaying historical widgets and query time in reports, Intelligent Insights 1.0.1 introduces continous data aggregation. Collected data is aggregated in 30 minutes chunks to improve query time when running a report with a granularitiy of 1 hour or more. The continous aggregation is running during collecting new data from Bosch cameras, but is also running on collected data when upgrading the system from version 1.0. to 1.0.1. Depending on the amount of recorded data, the aggregation process can take up to one hour or more. During the backgroud process the system response time might be slow. To identify if the process is finished, please monitor the DISK IO by the Windows Task Manager of the Intelligent Insights machine. A high DISK IO indicates, that the background process is not finished yet, and the system response time might be slow. If the DIKS IO is back to normal, the system response time normalizes.

DISK IO during aggregation:

Task Manager					
Processes Performance App history Startup Users Details Services					
Name	Status	7% CPU	80% Memory	99% Disk	1% Network
Configuration Manager		1.3%	394.8 MB	0 MB/s	6.6 Mbps
Google Chrome (7)		0%	175.7 MB	0.1 MB/s	0 Mbps
Antimalware Service Executable		0.3%	150.2 MB	0.2 MB/s	0 Mbps
Service Host: SysMain		0.1%	99.3 MB	0 MB/s	0 Mbps
Service Host: Remote Desktop S...		0%	66.8 MB	0 MB/s	0.1 Mbps
Windows Explorer (2)		0%	62.8 MB	0 MB/s	0 Mbps
Reporting Services Service		0%	56.6 MB	0 MB/s	0 Mbps
Desktop Window Manager		0.3%	46.3 MB	0 MB/s	0 Mbps
SQL Server Windows NT - 64 Bit		0%	43.6 MB	0 MB/s	0 Mbps
SQL Server Windows NT - 64 Bit		0%	40.3 MB	0 MB/s	0 Mbps
Secure System		0%	39.4 MB	0 MB/s	0 Mbps
Microsoft Windows Search Inde...		0%	32.8 MB	0 MB/s	0 Mbps
Service Host: Diagnostic Policy ...		0%	30.1 MB	0 MB/s	0 Mbps
Start		0%	23.9 MB	0 MB/s	0 Mbps

DISK IO if aggregation is finished:

Task Manager					
Processes Performance App history Startup Users Details Services					
Name	Status	8% CPU	81% Memory	19% Disk	0% Network
Configuration Manager		1.1%	394.4 MB	0 MB/s	4.5 Mbps
Google Chrome (7)		0.1%	175.5 MB	0 MB/s	0 Mbps
Antimalware Service Executable		0%	152.4 MB	0 MB/s	0 Mbps
Service Host: SysMain		0%	99.8 MB	0.1 MB/s	0 Mbps
Paint		0.2%	74.6 MB	0 MB/s	0 Mbps
Service Host: Remote Desktop S...		0.8%	66.5 MB	0 MB/s	0.1 Mbps
Windows Explorer (2)		0%	62.7 MB	0 MB/s	0 Mbps
Reporting Services Service		0%	58.0 MB	0 MB/s	0 Mbps
Desktop Window Manager		0.3%	52.2 MB	0 MB/s	0 Mbps
SQL Server Windows NT - 64 Bit		0%	43.7 MB	0 MB/s	0 Mbps
SQL Server Windows NT - 64 Bit		0%	40.7 MB	0 MB/s	0 Mbps
Secure System		0%	39.4 MB	0 MB/s	0 Mbps
Microsoft Windows Search Inde...		0%	32.9 MB	0 MB/s	0 Mbps
Service Host: Diagnostic Policy ...		0%	29.6 MB	0 MB/s	0 Mbps

6 Camera planning and configuration

6.1 Crowd detection

6.1.1 Planning the camera installation

The camera Video Analytics feature "Crowd Density Estimation" evaluates how many edges or textures are in the selected field compared to the reference image. The output is a density value. Crowd density can be used, if the entire area of interest is covered by cameras.

You can achieve good crowd density results, if the camera is installed in bird's-eye view.

Typical applications for camera crowd estimation is the entrance or exit area of escalators, the waiting zone for elevators or railway station platforms.

6.1.2 Camera crowd field configuration

A crowd field is the part of the image captured by the camera that is analyzed for crowd detection. Objects moving outside a crowd field are not considered for the crowd density value, even if they are caught by the camera. Only objects within the crowd field are detected and are relevant for the crowd density value.

To use the crowd detection functionality, first create a reference image of the background without people present on the standard VCA configuration page. The reference image must display the current background captured by the camera. Create a new reference picture if the background has changed.

In the Configuration Manager: **VCA** tab > **Profile #1** or **Profile #2** and Intelligent Video Analytics or Essential Video Analytics > **Metadata Generation** tab > **Crowd Fields** tab

In the web browser: **Alarm** > **VCA** > **Profile #1** or **Profile #2** and Intelligent Video Analytics or Essential Video Analytics > **Configuration** button > **Metadata Generation** tab > **Crowd Fields** tab

6.1.3 To define crowd fields:

On the **Crowd Field Settings** page, click **Add**. A crowd field is added to the camera image.

Note: You can also define a crowd field directly in the camera image. Click on the camera image. Each click creates a new corner of the crowd field. A double-click closes the crowd field.

In the camera image, adjust the position and size of the crowd field if necessary.

6.1.4 To remove crowd fields:

On the **Crowd Field Settings** page or in the camera image, select a crowd field. Then click **Remove**.

6.2 Counters

Bosch Video Analytics provides virtual line crossing counter and occupancy counters.

The line crossing counter in the camera counts all objects crossing a specified line. A line can consist of up to 16 edge points or 15 segments.

Intelligent Insights uses the virtual line crossing counter information for the use cases:

- Object counting
- People counting
- Area fill level

Occupancy counters count all objects that are currently in a specified field. The field can have up to 16 vertices and edges.

Intelligent Insights uses the occupancy counter tasks for the use case:

- Occupancy

Both counter can apply to arbitrary objects and can be restricted according to the objects properties. For example by the object class to separate vehicles from bikes and pedestrians. People counting is supported by a special 3D people tracking mode for accurate results even in well-populated scenes.

6.2.1 Limitations:

- General objects need to be well separated for the counter to work accurately. If objects occlude each other, they will be combined into single objects, skewing the results.
- Shadows, reflections, moving backgrounds, like vegetation, and light changes will decrease the performance.
- Use 3D people tracking to accurately separate people even in well-populated scenes. 3D people tracking requires accurate calibration. It assumes that every moving object is a person or group of persons, including shopping carts, and will thus generate counts for non-person objects.

6.2.2 Planning the camera installation

Perspective



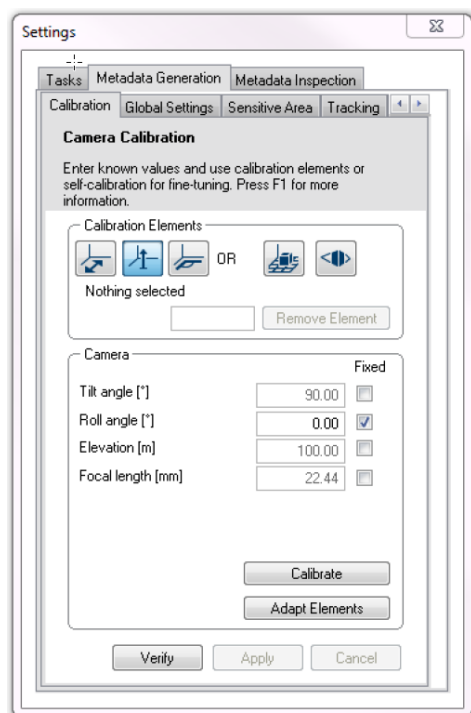
- All people can be seen and separated easily.
- Position in the room is easy to determine.
- Maximum quality of the counting results.

Camera configuration

Calibration

For a good people counting result, the camera has to be calibrated. For detailed information on how to calibrate a camera in bird's eye view, see the **Counting with FW 6.60** technical note.

To calibrate the camera for a bird's eye view perspective, open the **Calibration** dialog and fix all parameters. Tune the parameters manually using the description below. The grid visualization can be used for verification by aligning a cube with vertical structures, or with tiles on the ground. For final verification, set the calibration, enable 3D (people) tracking mode (see also Enabling people counting) and check the fit of the resulting 3D person model shapes on people walking through the observed scene (see also Example configurations). Note that especially the 3D person model size will later influence people counting accuracy and should be used to tune a trade-off between separation of people piggy-backing and adding false positives on baggage.



Parameter	Comment
Tilt Angle	90° = Birds eye view 0° = Fully frontal view Vertical line alignment <-> \/
Roll Angle	Left/right camera rotation Vertical line alignment \\ <-> <-> //
Elevation	Please measure camera height Can be used for 3D person model size fitting
Focal length	See camera lens Can be used for 3D person model size fitting

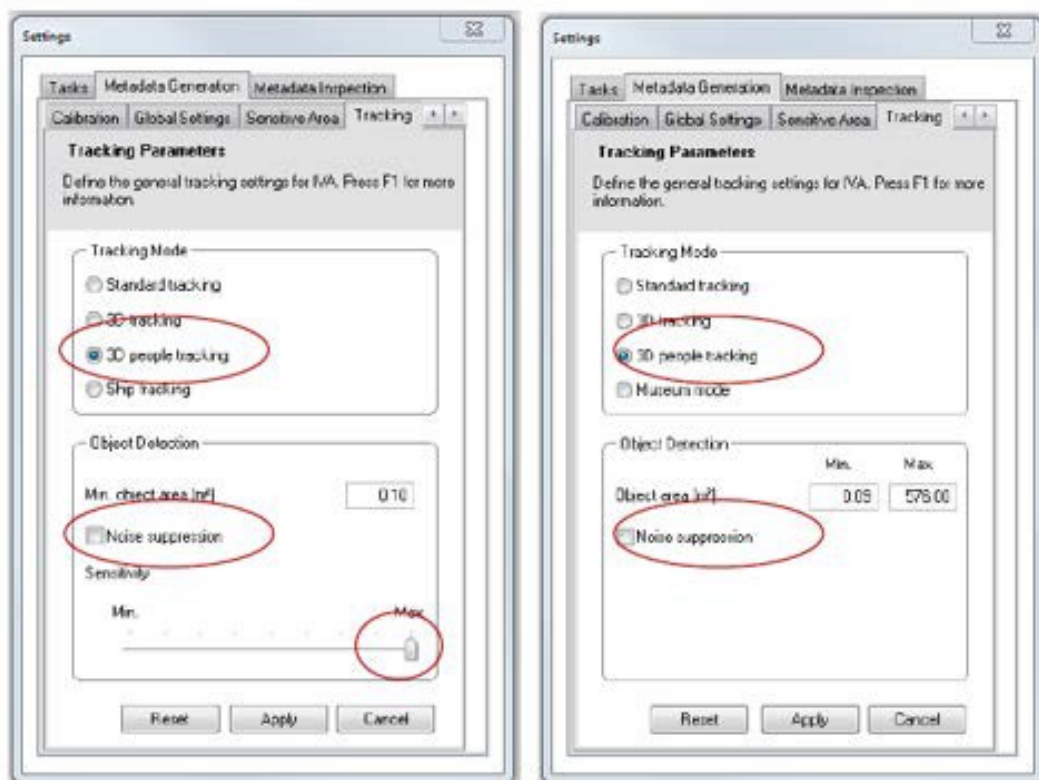
Enabling people counting (FW 6.60)

When using FW 6.60, simply select the scenario default **People counting**. This will automatically set the correct parameters in **Metadata Generation** and add a line crossing counting task. Adjust the line or exchange with an occupancy task.

Enabling people counting (< FW 6.60)

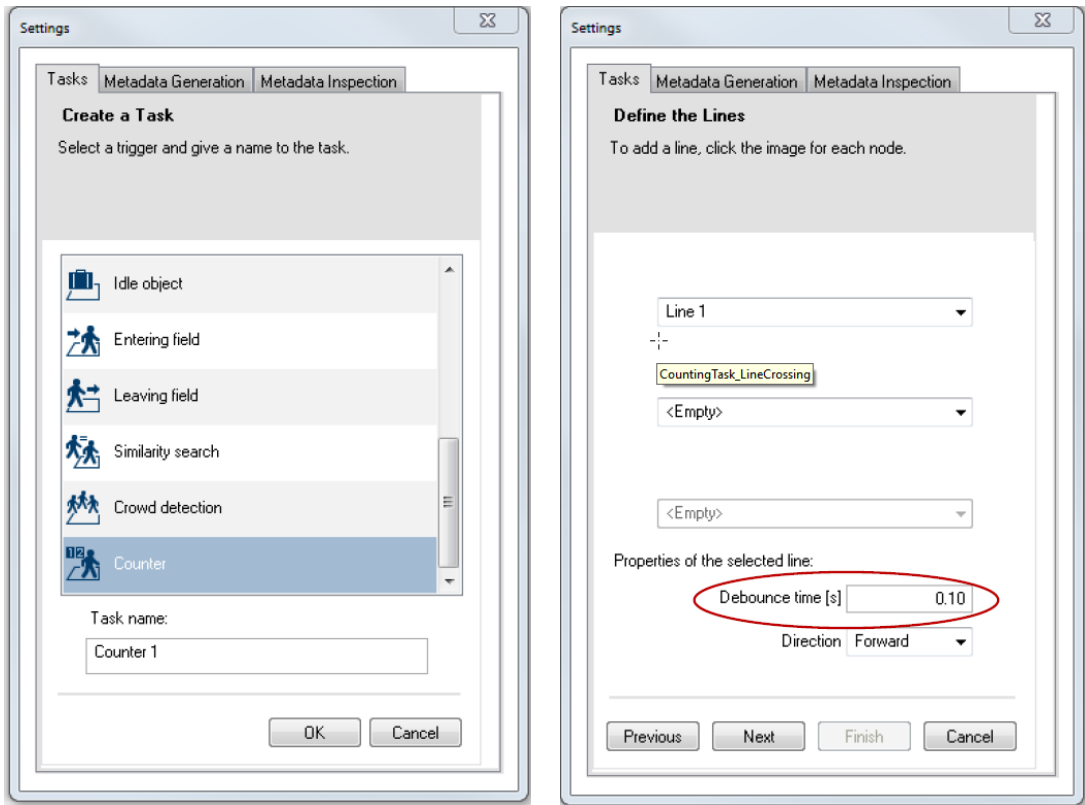
When using an older firmware, set the following parameters:

Parameter	Value	Effect & Comments
3D people counting	On	Use 3D person model, interpret everything as persons, separate all persons. Will only be available if camera is calibrated.
Noise suppression	Off	Noise suppression can delay detection and will not work well in crowds.
Sensitivity (Intelligent Video Analytics on CPP6/7 only)	Max	Initialize new persons immediately instead of validating them over time. Needed especially for bird's eye view as the people are only in the FOV for a short time.



480pxSetup of counting lines / field (FW <6.60)

To set up a people counter, create a counter task or an occupancy task. Counting lines or fields can be defined by the corresponding wizard. Note that the lines and fields will be shown in the camera image and can be changed there. Set the counting lines / fields up, thus that objects can be well detected both before and after crossing the line / field border. This ensures observation of the person crossing the line / field border with high quality needed for high counting accuracy. Make sure the counting lines / fields are large enough that people can not slip by. Select whether the foot point or the center of the object shape should be used to determine the line / field border crossing. Note that all visualizations in the camera image can be selected and dragged around.



Set the debounce time of the line or field to 0.1. Debounce time is useful to avoid alarm flickering in case of objects moving along a detection line or field border. In order to do this, it enforces a certain duration of the detected object before and after crossing the line. In a birds eye view (BEV), the camera is very close to the persons and the persons remain only a short time within the monitored area. The duration needed for debounce is often not available, and a large debounce time cuts down the number of correctly counted people. A short debounce time is needed to not count people, who stop at the counting line, several times.

6.2.3 Best practices

Checklist	Comments
Use birds eye view if possible	Note that performance will decrease the more the camera view differs from birds eye view (90° tilt angle).
Camera height ~3-6 meter (also depending on camera lens)	Less height and the people walk through the observed area too fast to be detected and counted properly. More height and the people become too small, reducing accuracy.
Uniform illumination	Changing illumination triggers false foreground especially at edges up to a global change where nothing is processed anymore
Ambient light	Shadows of persons move with them and might be counted falsely. No shadows are visible in ambient light
Indoor only	To keep illumination stable, uniform and ambient.
No reflecting surfaces	Reflections of persons move with them and might be counted falsely

Checklist	Comments
No moving background, for example doors, glass windows, escalators, shopping card or basket collecting points, ...	Moving background always yields false foreground segmentation. Take these areas out of the sensitive area or completely out of the image. Besides generating false people themselves, they can also delay the detection of objects entering nearby. For example, a track started by a person moving through a door might stay at the door, delaying the detection of the person.
No baggage, shopping carts, cars, ...	All non-person objects of size similar to or larger than persons will be counted as persons.
Maximum number of persons in scene at once for Intelligent Video Analytics: 10 (CPP4) / 20 (CPP≥6), for Essential Video Analytics: 10(CPP7)	If more persons are in the camera scene at once, real-time performance can no longer be guaranteed. This means that single frames might be dropped, though object tracks will be continued. This may lower the overall performance.
Use straight passageways where possible	Avoid scenes where people enter, directly turn around a corner and immediately leave the camera image before the algorithm had a chance to detect and track them robustly. Avoid scenes where people loiter and cross the counting line several times.