SWARM
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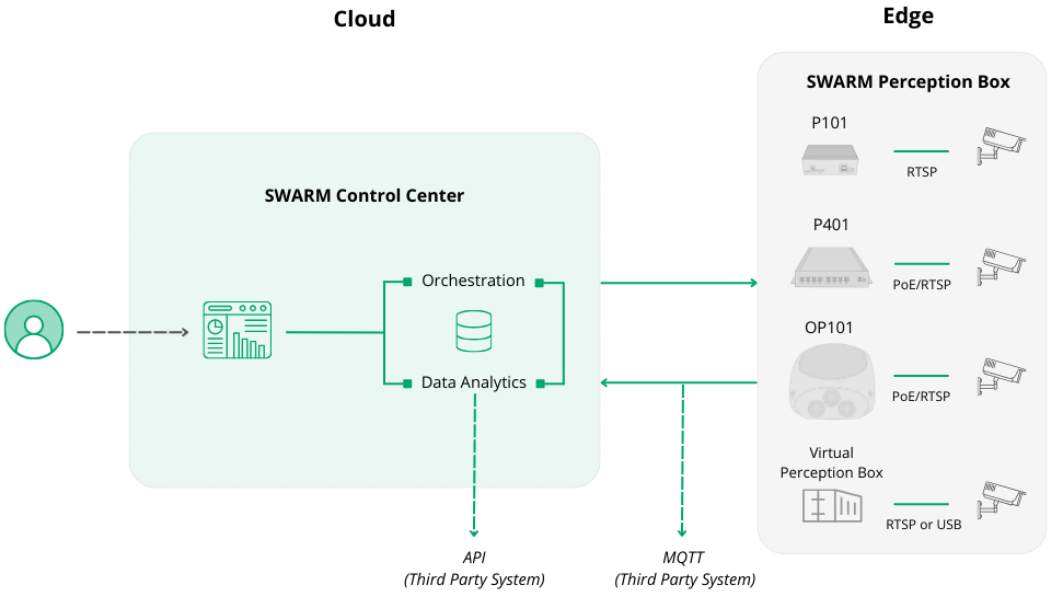
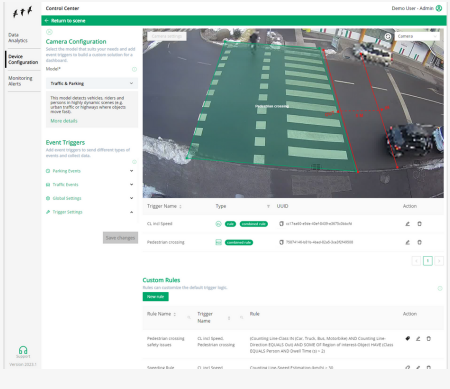
SWARM Perception Architecture: Overview

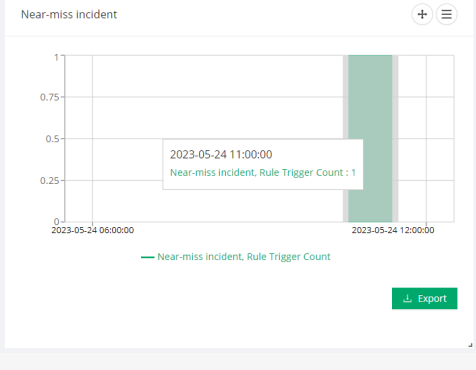


The **SWARM Perception Platform** consists of two major components: The SWARM Control Center in the cloud and the SWARM Perception Boxes on the edge. Together they provide:

- Management and configuration of the edge devices
- Real-time video analytics and event analysis
- Data Analytics and visualization



(1) The SWARM Control Center allows a straightforward camera configuration. The for respective use case required model can be easily selected from a drop-down menu, before event triggers can be defined directly in the camera frame. If needed, custom rules can be activated for the trigger logic.



(2) Data is aggregated and analyzed automatically. Various predefined widgets provide real-time and historical insights. API calls to further integrate information in third party platforms are included.

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Cloud: SWARM Control Center

The SWARM Control Center (SCC) is a cloud-based platform providing one web interface for orchestration and configuration, Data Analytics and visualization.

Data Analytics & Visualization

The SWARM Control Center supports users with a wide range of integrated features and options:

- Simple data compression and aggregation
- Integrated historic data analysis
- Real-time capacity figures of parking areas
- Support of data exports in csv format
- Easy creation of dashboards for traffic or parking scenes with all needed information and parameters *(i.e. GPS coordinates for visualizations in the respective time zone)*
- Numerous sorting options for dashboards *(i.e. list view, map view, grouping function)*
- Access to predefined widget types with the ability to filter and segment by various parameters
- Selection from numerous visual representations *(i.e. bar chart, pie chart, table)*
- Parking space capacity and adjustment of the current utilization level at any time
- Setting of maximum parking time to detect parking violators

Data retention: For Swarm Perception Boxes with active Swarm Perception Subscription (SPS), the respective data is stored and accessible for 30 days. To extend this period to three years, the additional Swarm Data Subscription (SDS) is required.

Traffic Insights	Parking Insights	Advanced Traffic Insights
Bidirectional counting and classification	Single- and multi-space occupation	Adaptive Traffic Control integration
Origin-destination analysis	Barrierless parking	Journey time and traffic flow calculation
Real-time speed analysis	Capacity analysis	Traffic type distinction (commute, transit, visit)*
Granular short- and long-term trends	License Plate Reading (LPR) with configurable data retention/deletion	Safety analysis
	Granular short- and long-term trends	Queue length detection
		Custom rules

*: coming soon

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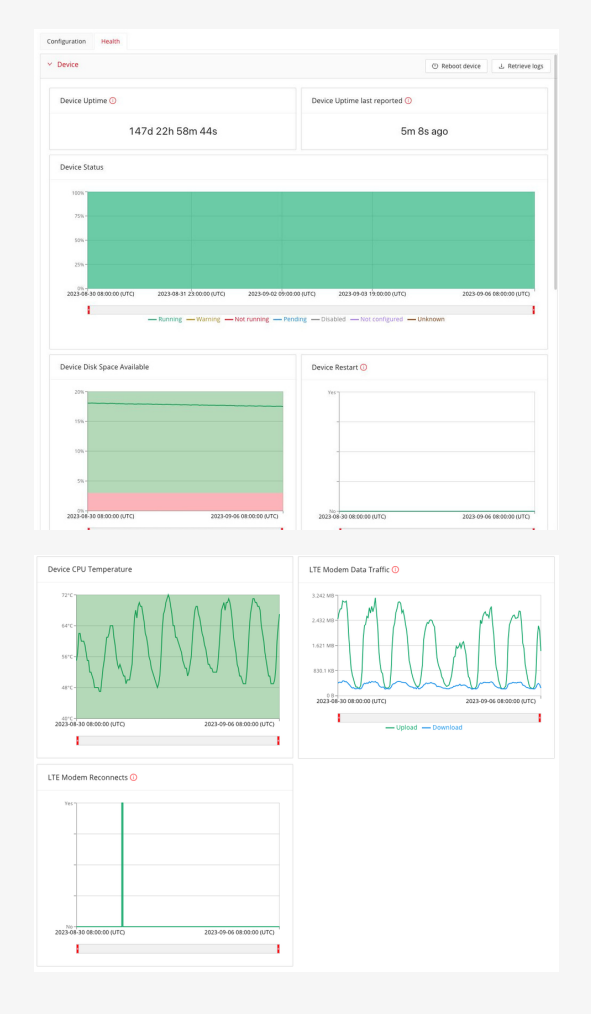
Orchestration & Configuration

The SWARM Control Center offers a variety of features and options to support users with the perfect handling:

- **Configuration and calibration**
  - Configuration of all basic and advanced edge video analytics features
  - Configuration of event rules for contextual data
  - Assisted track and live calibration as well as track calibration history for highly accurate data collection
  - Multi role support (viewer, user, admin, super admin)
- **Monitoring**
  - Real-time runtime device health monitoring (with 7 day history)
  - Configurable device alerts with mail notification
- **Maintenance**
  - Automatic platform update
  - Centralized over-the-air software updates for Swarm Perception Boxes with device update management
  - Quick access to device logs
  - Reboot option for all devices



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Edge: SWARM Perception Box Software

Video Analytics
Object detection and **classification** in **12+1** standardized traffic **classes:** • *Car* • *Van* • *Car with trailer* • *Single unit truck* • *Articulated truck* • *Truck with trailer* • *Bus* • *Tram* • *Motorbike* • *Person* • *Bicycle* • *Scooter* • *Other*

Counting Lines (CL)	Easy counting of objects when objects cross a configured line in two directions
Origin-Destination Zones (OD)	Provide traffic flow information when objects enter and leave configured zones
Region of Interest (RoI)	Provides the number of objects in a specified region
Single-/Multispace Parking	Dedicated Parking *RoI* for single and multispace parking capacities
Virtual Door	Improved *Counting Line* for person detection
Speed Estimation	Each *Counting Line* supports a speed estimate. Output km/h as parameter within the created *Counting Line* events
Custom Rules	Customization of event triggers: from simple adjustments to count only bicycles at a given *Counting Line* to more complex rules to monitor crosswalks by combining *RoI* status with *CL* crossings
Automated Number Plate Recognition (ANPR) *License Plate Reading* (LPR)	Support of all European license plates. Can be utilized for LPR and country classification. License plate area codes supported for 13 countries. License plate data retention time can be configured in compliance with the respective data privacy regulation (e.g. GDPR)

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Edge: SWARM Perception Hardware

Product Datasheet: Indoor and Cabinet Use

Indoor and Cabinet Use		
Category	**P101**	**P401**
General		
# of IP camera streams (depends on the use case)	1 to 4	1 to 12
Video source	IP/RTSP (H264) USB (UYVY, YUY2, YVYU)	
Event format	JSON	
Event interface	SWARM Control Center API Third Party MQTT Broker	
Interfaces	1x GbE port	1x GbE port 8x PoE ports for cameras (integrated switch, total 75W)
Power input	6-19VDC (barrel connector 5.5 mm x 2.5 mm)	6-36VDC (with ignition pin)
Power consumption (on load without cameras)	<12W	<20W
Recommended power supply	12VDC/2A (included)	24VDC/4A (not included)
Mechanical		
Mounting options	DIN Rail Mount	Bracket (screw kit included)
Weight	448g	1800g
Dimensions	110 mm x 89 mm x 36 mm	175,6mm x 183,3mm x 50,5 mm (without brackets)
Cooling	Passive (fan less)	Passive (fan less)
Environmental		
Certification	CE	CE, FCC, E-Mark, EN50155, MIL-STD-810G
Operational temperature (without quality loss)	-10°C to +50°C	-20°C to +65°C
Support		
Operating system	Maintained by Swarm	
Warranty	One year	

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Edge: SWARM Perception Hardware

Product Datasheet: Outdoor Use

Outdoor Use		
Category	**OP101AC**	**OP101DC**
General		
# of IP camera streams (depends on the use case)	1 to 2	1
Video source	IP/RTSP (H264)	
Event format	JSON	
Event interface	SWARM Control Center API Third Party MQTT Broker	
Interfaces	2x Gigabit Ethernet with IEEE802.3at PoE+ support for cameras	1x Gigabit Ethernet with IEEE802.3at PoE+ support for camera
Power input	230VAC (pluggable connector)	9-24VDC (pluggable connector), Reverse polarity protected
Power consumption (on load without camera)	<15W	<15W
Network		
Connectivity	4G/LTE modem	
Mechanical		
Mounting options	Pole mounting kit	
Weight	2310 grams	2040 grams
Dimensions	225 mm x 205 mm x 112 mm	
Environmental		
Ingress Protection Rating	IP65	
Operational temperature (without quality loss)	-10°C to +40°C (ambient temperature)	
Support		
Operating system	Maintained by Swarm	
Warranty	One year	

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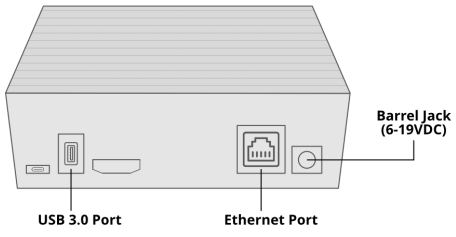
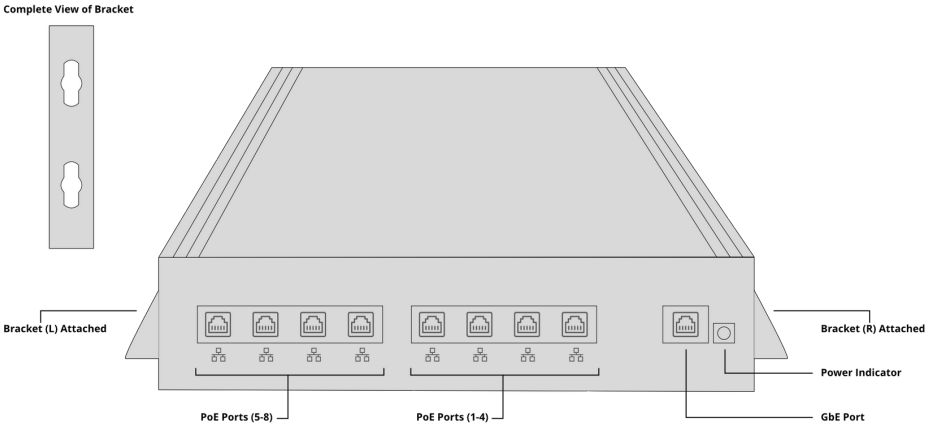
SWARM Perception Boxes

Diagrams

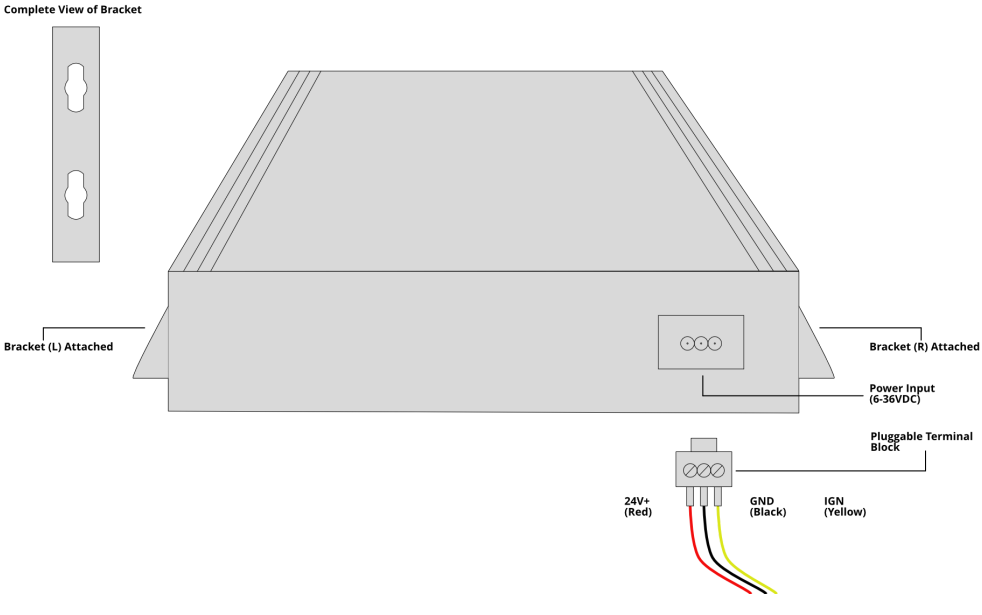
P101 Exterieur



P401 Exterieur - Front



P401 Exterieur - Back



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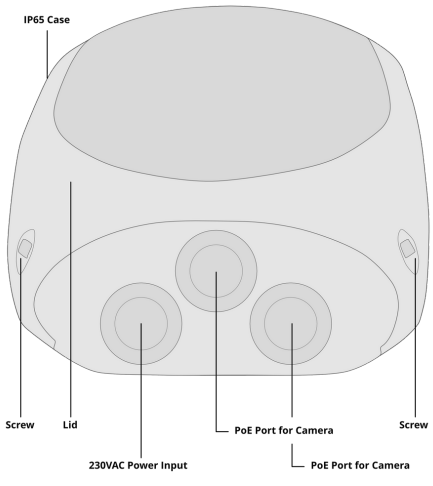
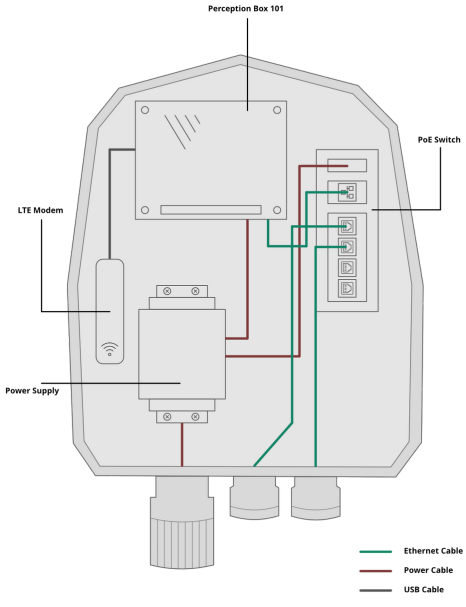
SWARM Perception Boxes

Diagrams

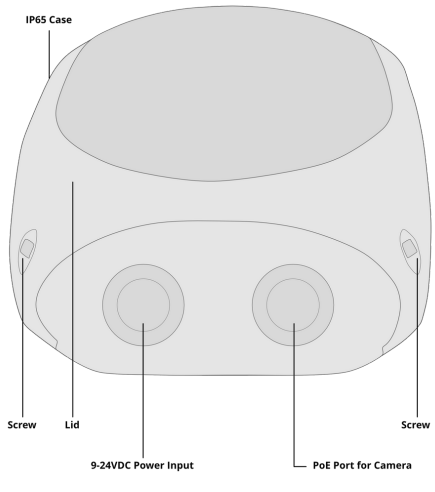
OP101AC Exterieur



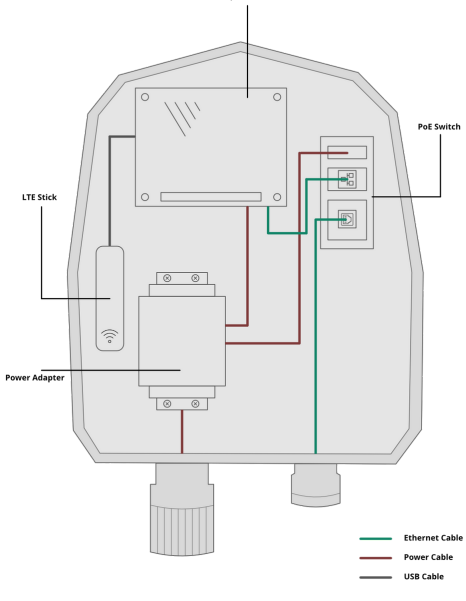
OP101AC Interieur



OP101DC Exterieur



OP101DC Interieur



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