Blickfeld
LiDAR / scan your world

Application Note:
Fence Security with smart 3D LiDAR

AGENDA

1 INTRODUCTION

1.1 Current security challenges in fence security

Effective fence monitoring is essential for maintaining security in various industries, yet it faces numerous challenges due to dependencies on external factors like e.g. environmental conditions and the limitations of established technologies.

Fences are particularly prone to false alarms for intrusions due to small animals, vegetation, and dynamic scenes with frequently changing weather and lighting conditions. These frequent false alarms lead to high personnel costs due to the need for manual checks and responses. Camera technology, though intuitive and capable of providing high-resolution feedback, fails to offer object size determination or precise location information. One significant issue is the high dependence on external factors such as weather and lighting conditions, as this can temporarily disable common security cameras, making them unreliable.

Ensuring privacy adds another dimension of complexity to securing a fence. Video technologies lack the ability to offer intrinsic privacy protection, posing a challenge for precise monitoring especially in public applications, where safeguarding personal privacy is a critical concern due to the visibility and potential identification of individuals. Additionally, large perimeters often require extensive coverage, posing a challenge in ensuring seamless monitoring along the entire fence line. The infrastructure needed for real-time data processing and continuous operation can be expensive, particularly in remote or industrial areas where power and network connectivity are limited. Thus, ensuring the monitoring system integrates seamlessly with existing security infrastructure without requiring significant modifications is another critical challenge.

Addressing these multifaceted challenges necessitates solutions that provide reliable and privacy-compliant detection and minimize false alarms, while being adaptable to diverse and dynamic environments. This is precisely where Blickfeld's 3D LiDAR technology comes into play. In the following sections, you will discover why 3D LiDAR is particularly suited for securing fences, and how it can be integrated into fence security applications.

1.2 Benefits of smart 3D LiDAR technology in fence security

Blickfeld's QbProtect, the smart 3D LiDAR specifically developed for the security industry, provides a transformative approach to fence applications.

Real-time 3D point cloud data of a scene: Allows for defining alarm areas ("zones") in real space with all 3 dimensions ("volumetrically") which provides a significant advantage to 2D images which can not determine the depth of objects and are highly dependent on perspective. The high resolution point cloud can already be used for alarm verification. People and objects can reliably be recognized as such in the dense data.

Object-size based detection: As compared to a camera, a 3D LiDAR can determine the size of objects in 3D space, significantly minimizing false alarms with filtering by size. With 400 scan lines, the sensor delivers high-resolution data, allowing for the detection of small objects and the accurate determination of object size even at large distances. Additionally, the 3D data allows for determining the direction in 3D, hence it can identify the movement direction of objects.

Data processing on-device eliminates the need for an external processing unit: Transmitting raw 3D LiDAR data over a network can consume substantial bandwidth, whereas on-device processing minimizes this by only sending essential information, such as alarm notifications or processed data. This conserves bandwidth and reduces the load on network infrastructure and is particularly advantageous in remote or difficult-to-wire areas where fence security is critical.

Intrinsically privacy-compliant: LiDAR technology ensures privacy by design while maintaining security. QbProtect captures no personally identifiable information, such as facial features, therefore no conclusions can be drawn about individuals. 3D LiDAR recognizes objects like people, but not identities.

Resilience to sabotage: QbProtect incorporates sabotage and malfunction alarms using the internal IMU and constantly monitors its optical performance to detect intentional obstructions or dirt on the sensor. These features ensure sustained system health and reliability.

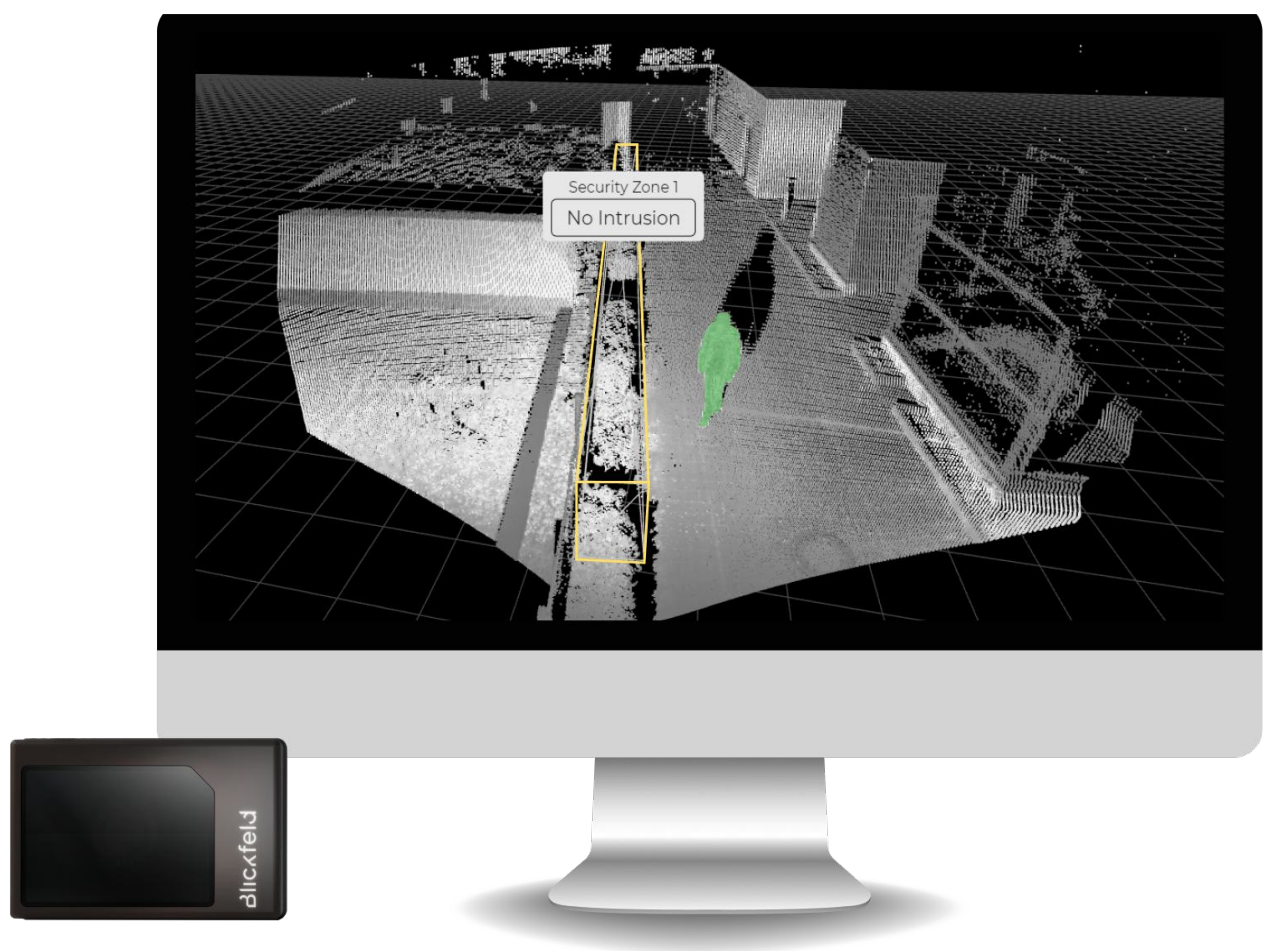
Seamless integration into existing security infrastructures with industry-standard interfaces: With its camera-like handling and minimal cabling requirements via Power-over-Ethernet, Blickfeld LiDAR is easy to mount, without any additional expertise needed. Customizable alarm logic and standard interfaces such as TCP/IP, MQTT, and Onvif compatibility further streamline the integration into existing security systems.

Robust sensor technology: The solid-state design of the hardware inside an IP67-rated housing makes the Blickfeld QbProtect durable for both indoor and outdoor applications. In addition, with its intrinsic light source, the QbProtect reliably detects under various weather conditions, such as rain, snow, and fog.

In summary, Blickfeld's QbProtect leverages advanced 3D LiDAR technology to address the numerous challenges of fence security, offering a reliable, privacy-protecting, and robust solution.

1.3 System overview

Blickfeld's system for fence security comprises advanced 3D LiDAR hardware and on-device software. This combination enables the system to analyze high-resolution point clouds in real-time without the need for external computing units, facilitating precise object detection.



Blickfeld QbProtect with on-device software and visualization in the WebGUI

At its core, the system delivers alarms when objects enter user-defined areas (called "zones" in the following). Specifically for fence security, alarms can be triggered for actions like crawling under or climbing over the fence. The accompanying software allows for the simultaneous monitoring of multiple zones, providing comprehensive coverage.

Possible alarm types include:

- Pre-alarms: Zones for early warnings based on unusual behavior.
- Main alarm: Intrusion detection for confirmed zone breaches.
- Sabotage/Tampering: Alerts for attempts to interfere with the system.
- Malfunction detection: Notifications for system faults.

The alarm parameters are highly customizable and can include:

- Object size: Categorization into small, medium, or large objects, which can also be fine-tuned.
- Direction: Detection of the movement direction.
- Number of objects: Counting multiple objects in the monitored area.
- Alarm duration: Setting the time period for which an alarm is active.
- Alarm logic: Using logical operators (AND/OR/NOT) to define complex alarm conditions.

This system relies on the accuracy and reliability of the collected information to trigger an alarm only when an object truly enters the security perimeter, ensuring minimal false alarm rates. By leveraging the detailed and precise data provided by the 3D LiDAR sensor, the system can distinguish between genuine security threats and suspicious behavior, thereby optimizing security operations and reducing unnecessary interventions.

2 TECHNICAL APPLICATION DESCRIPTION

2.1 Fence application scenarios

We distinguish between three fence security applications based on sensor mounting locations.

Direct Fence Mounting:
In the first scenario, the sensor is mounted to a pole attached directly to the fence.

Offset Mounting:
In the second scenario, the sensor is mounted on a pole that is positioned behind the fence.

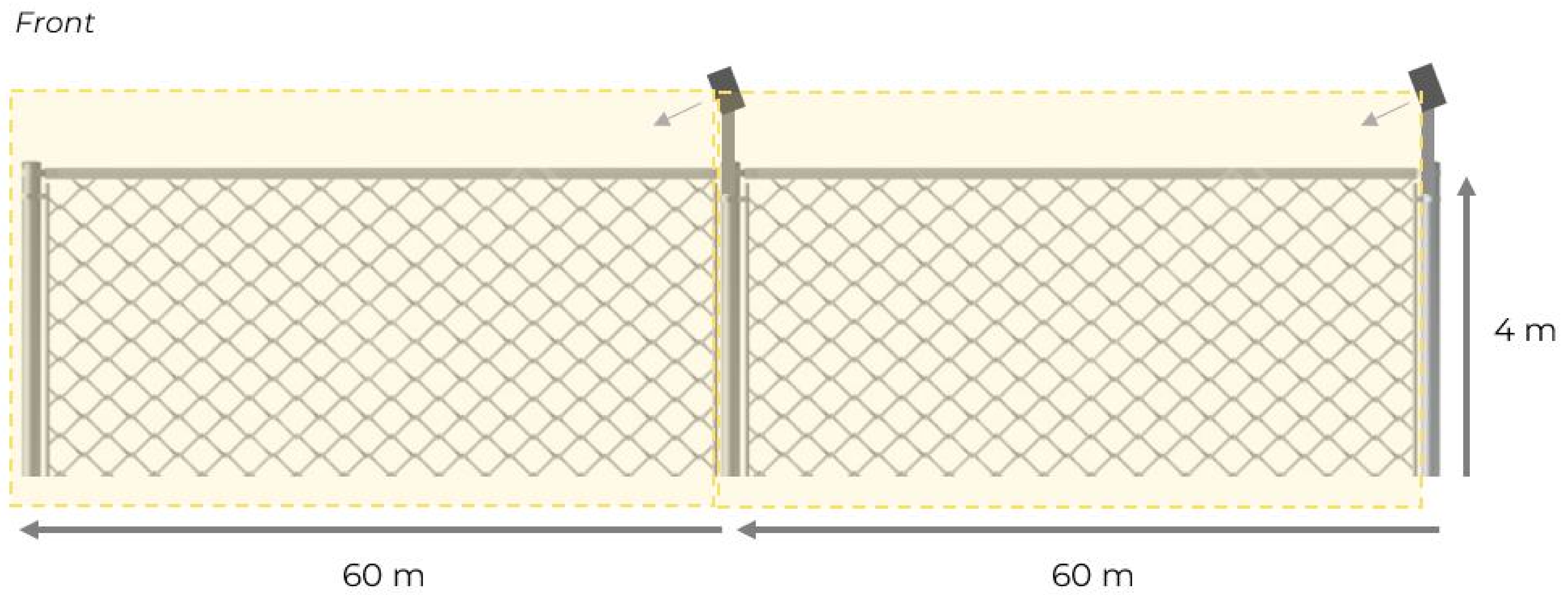
Virtual Fence:
In the virtual fence scenario, the sensor monitors an open area without a fence, with zones acting as virtual fences/barriers.

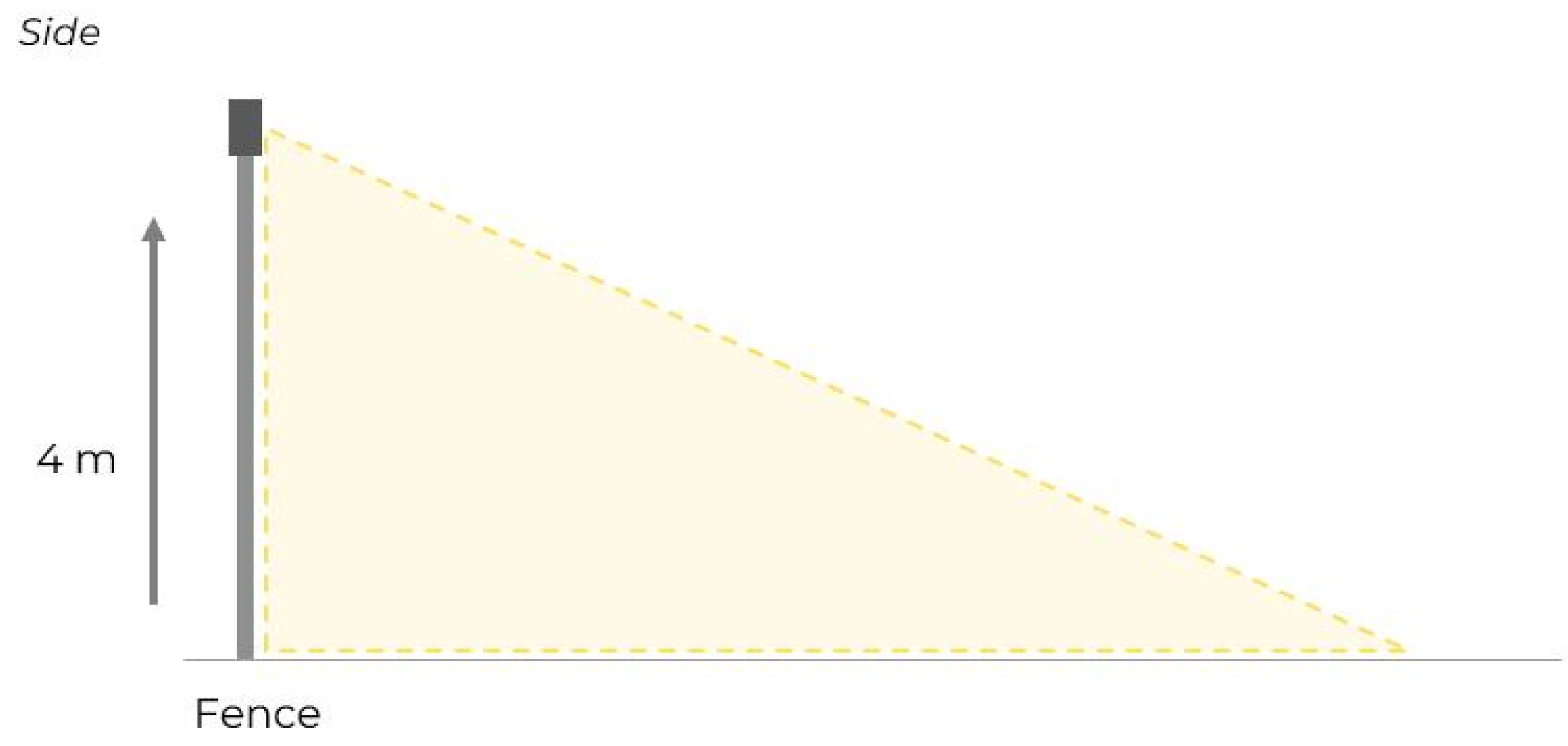
In all scenarios, you can use either a single or dual sensor mounting to achieve the desired coverage. The choice of mounting and configuration depends on the specific security requirements and the layout of the monitored area.

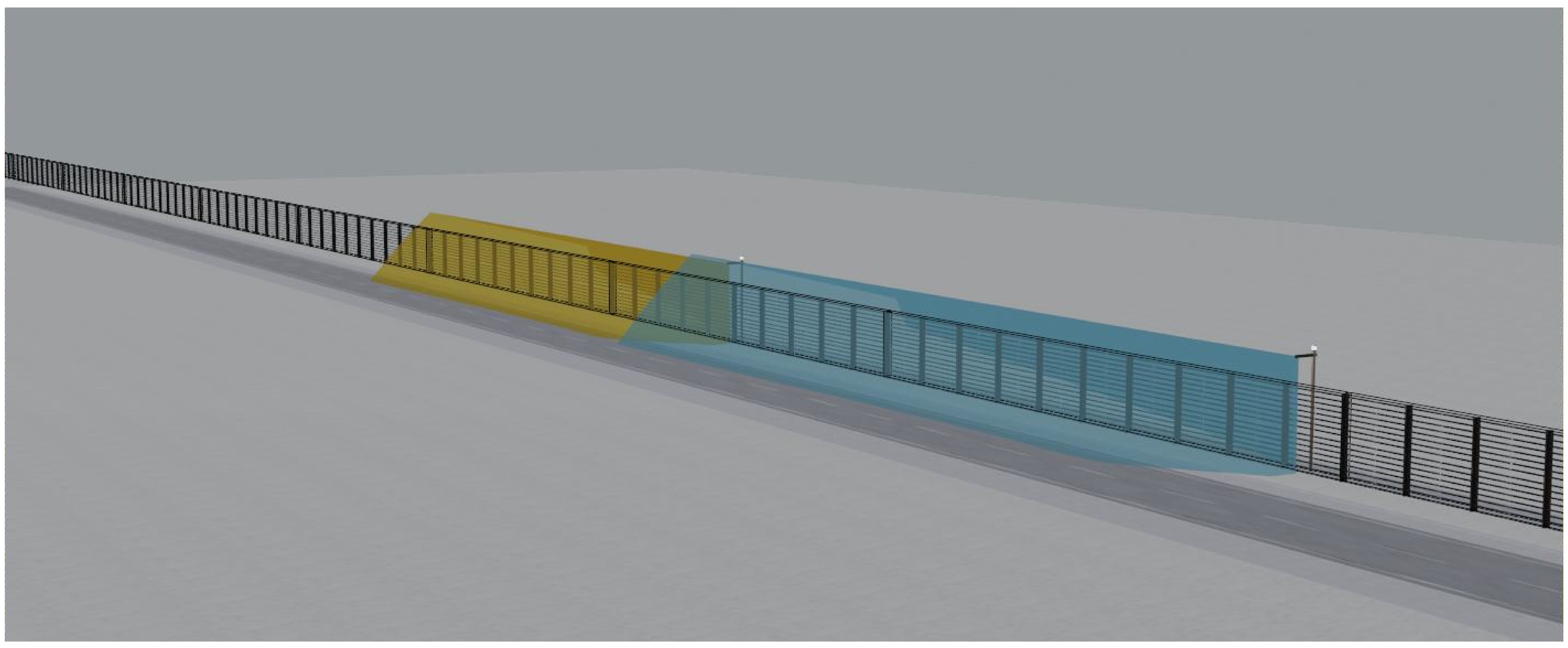
Blickfeld QbProtect with dual sensor mounting

2.1.1 Direct fence mounting: Pole mounting on the fence

In the direct fence mounting configuration, sensors are installed on poles that are integrated into the fence structure itself. For optimal performance, mounting the sensor at a height of approximately 4 to 8 meters on the pole allows for a detection range of up to 60 meters. The sensors can be arranged sequentially along the fence, with each sensor mounted every 60 meters, all facing the same direction.

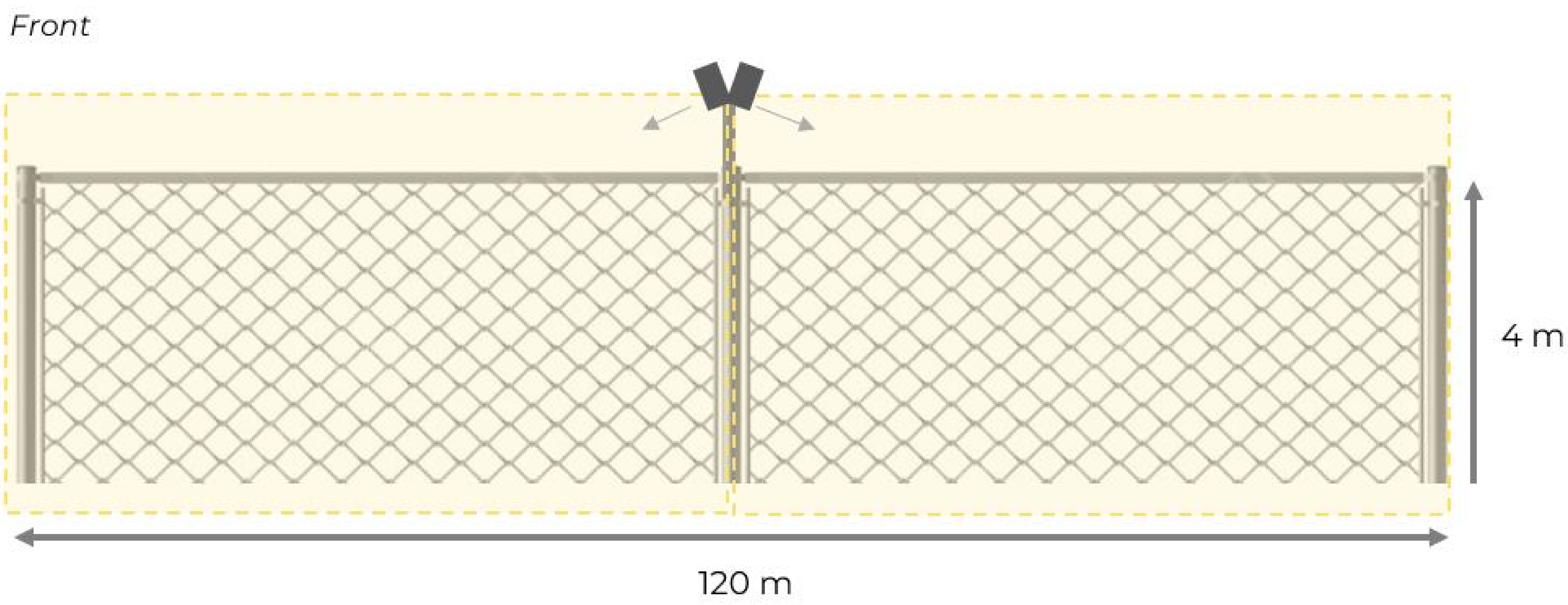


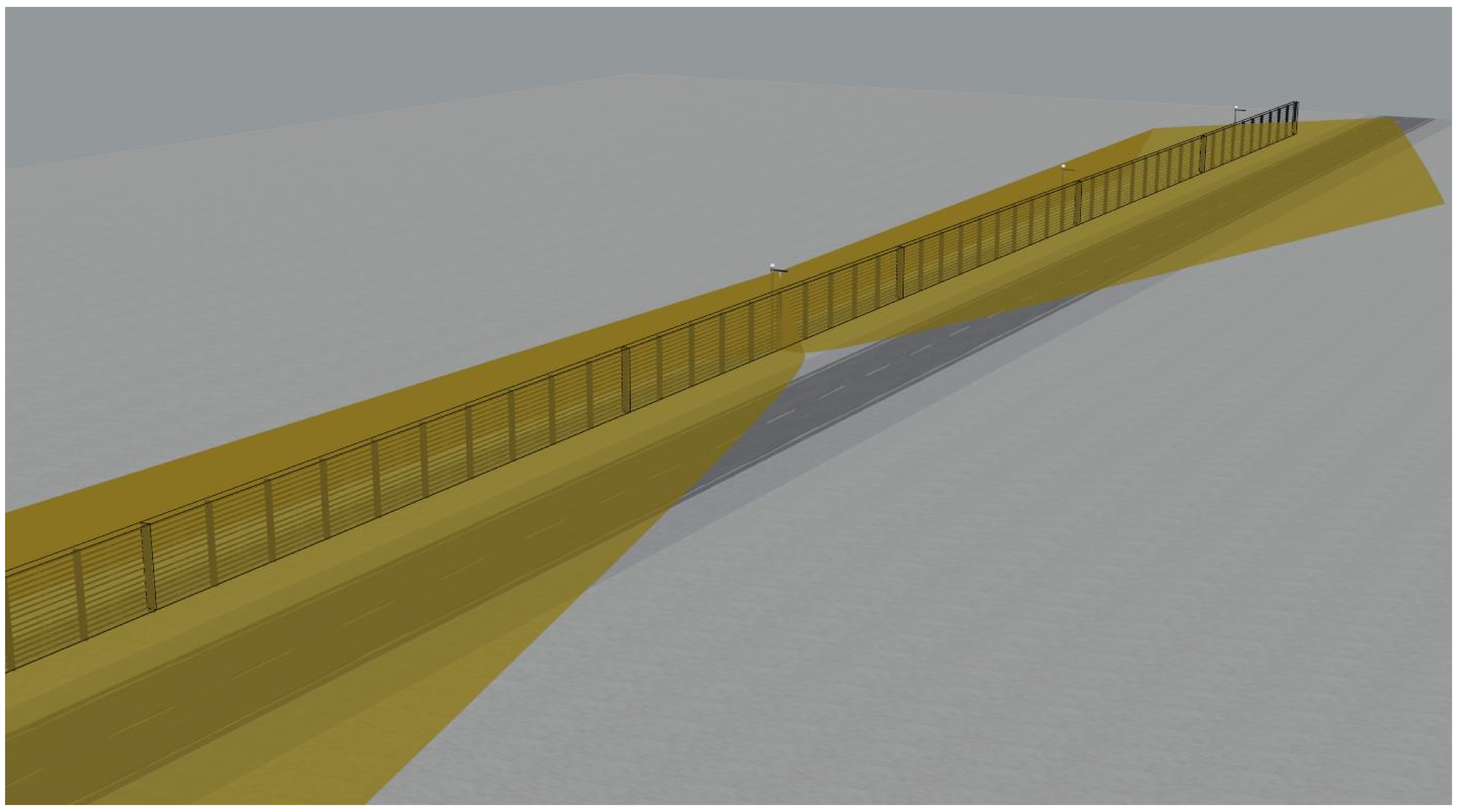




3D simulation of direct fence mounting

Alternatively, a dual sensor mount can be utilized, where two sensors are installed on each pole, with one facing forward and the other facing backward, covering opposite directions. This setup effectively doubles the coverage area, allowing for sensor installation every 120 meters.





3D simulation of direct fence mounting with dual sensor mount

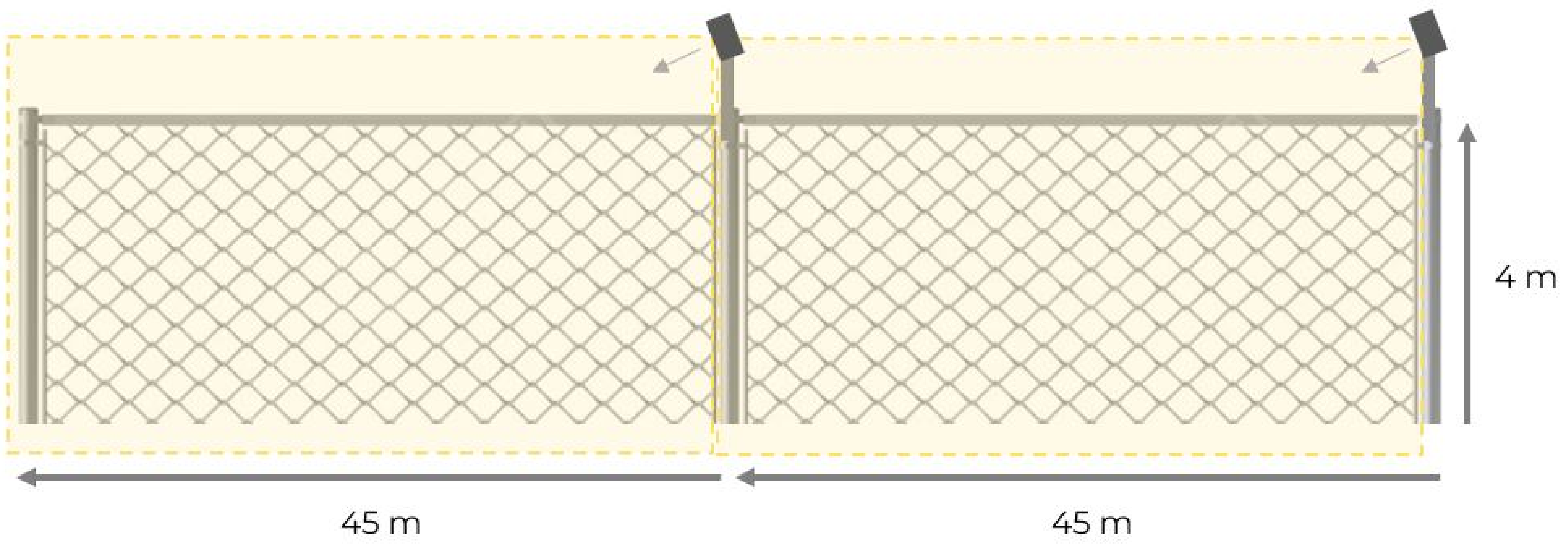
The choice between single and dual sensor mounts depends on specific application requirements, environmental conditions, and existing infrastructure. In either configuration, the sensors work in unison, creating a comprehensive security system composed of multiple LiDAR sensors, all seamlessly integrated to provide robust perimeter protection.

2.1.2 Offset mounting: Pole mounting behind the fence

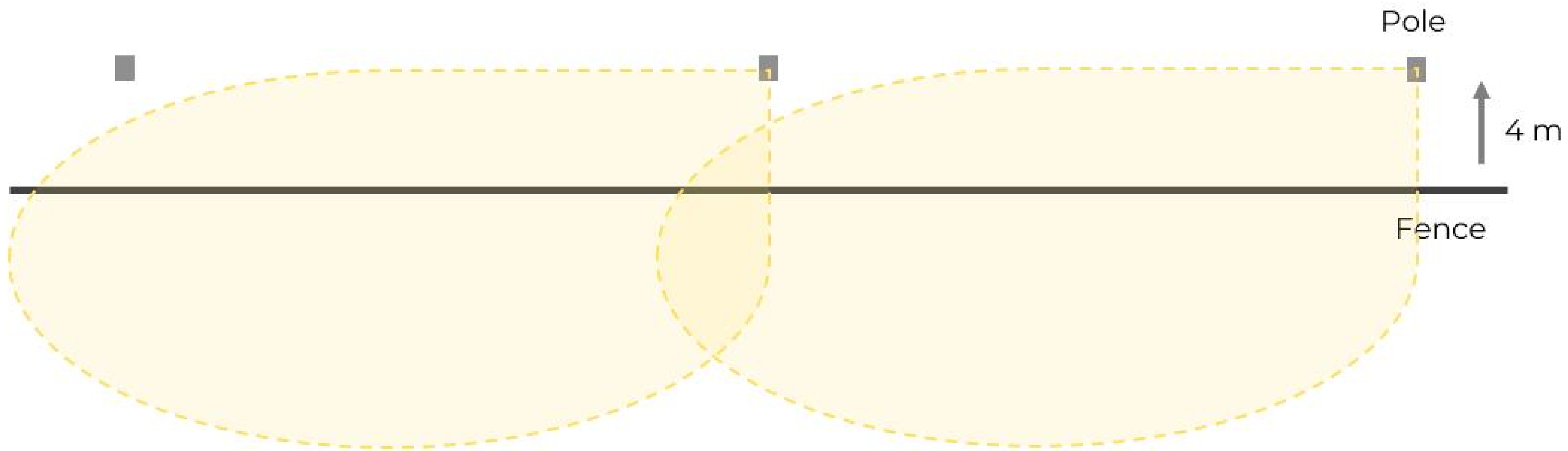
In the offset mounting configuration, the sensor pole is positioned behind the fence. For instance, when the sensor is mounted at a height of 4 meters and the offset distance is 4 meters, the detection range extends up to 45 meters. The pole mounting needs to be higher than the fence. The sensor's visibility and detection depend on the fence type, as certain fences may create shadows behind the structure.

Similar to the direct fence mounting scenario, sensors can be arranged sequentially in a chain, with individual sensors placed at regular intervals along the fence line. In this configuration, each sensor is installed every 45 meters, all facing in the same direction.

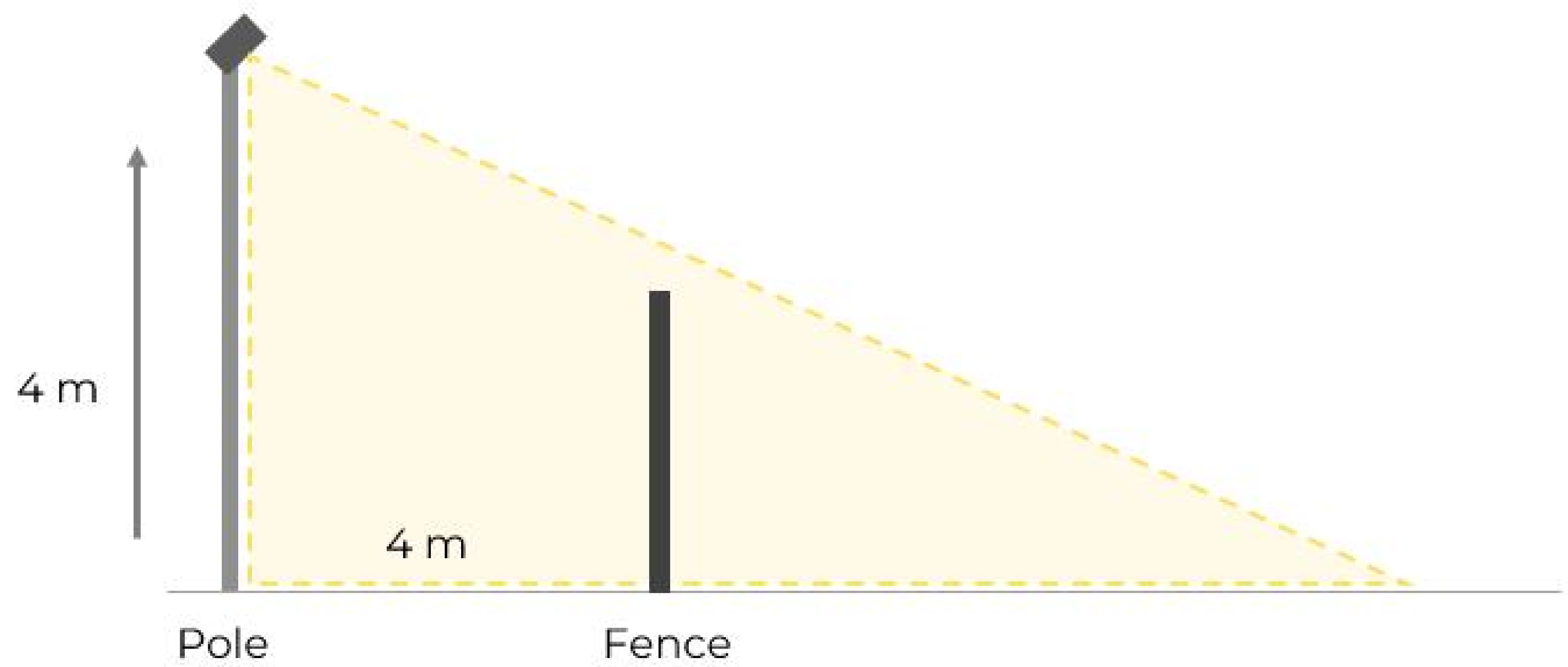
Front

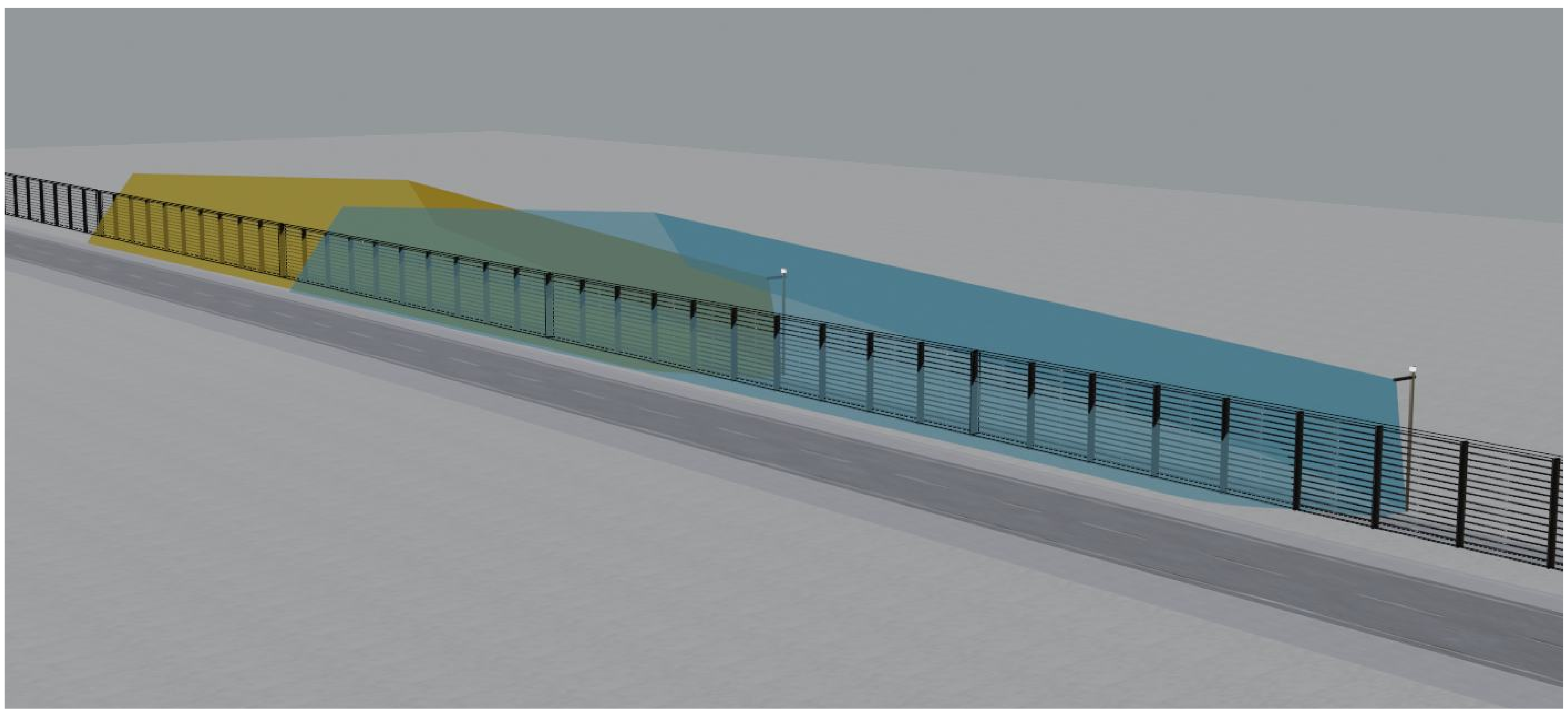


Top



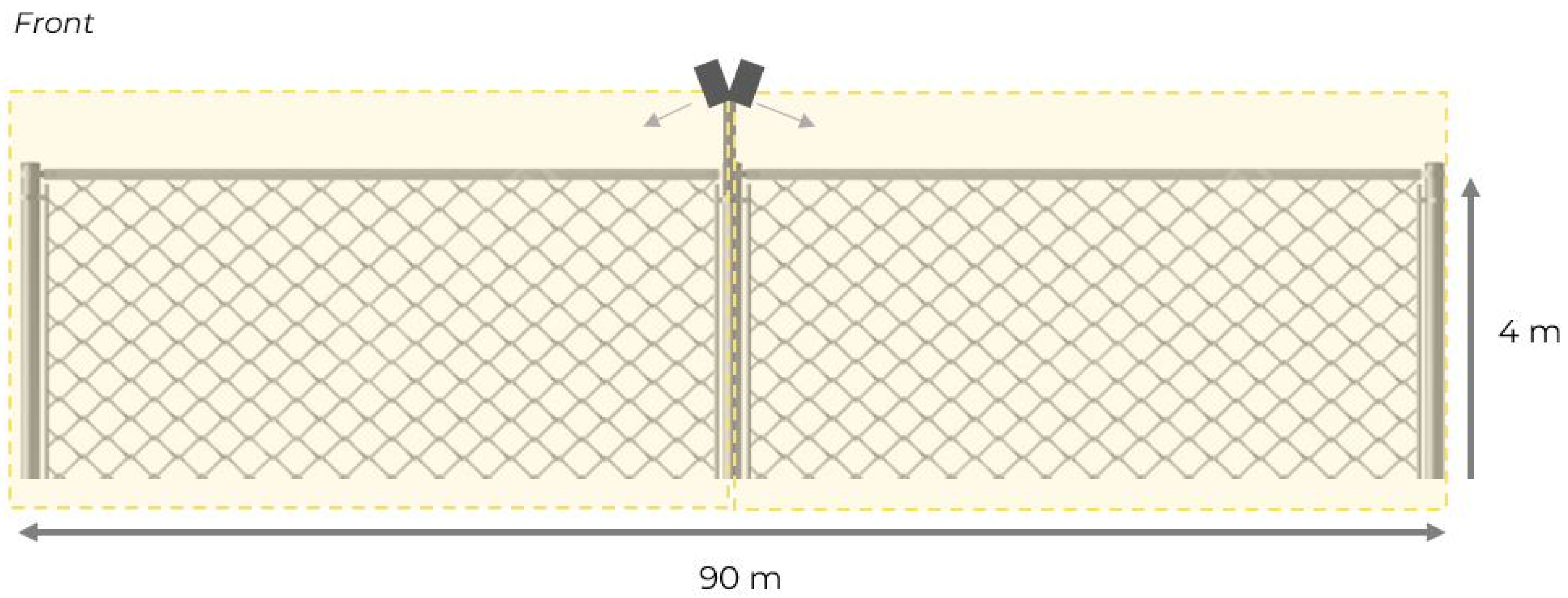
Side

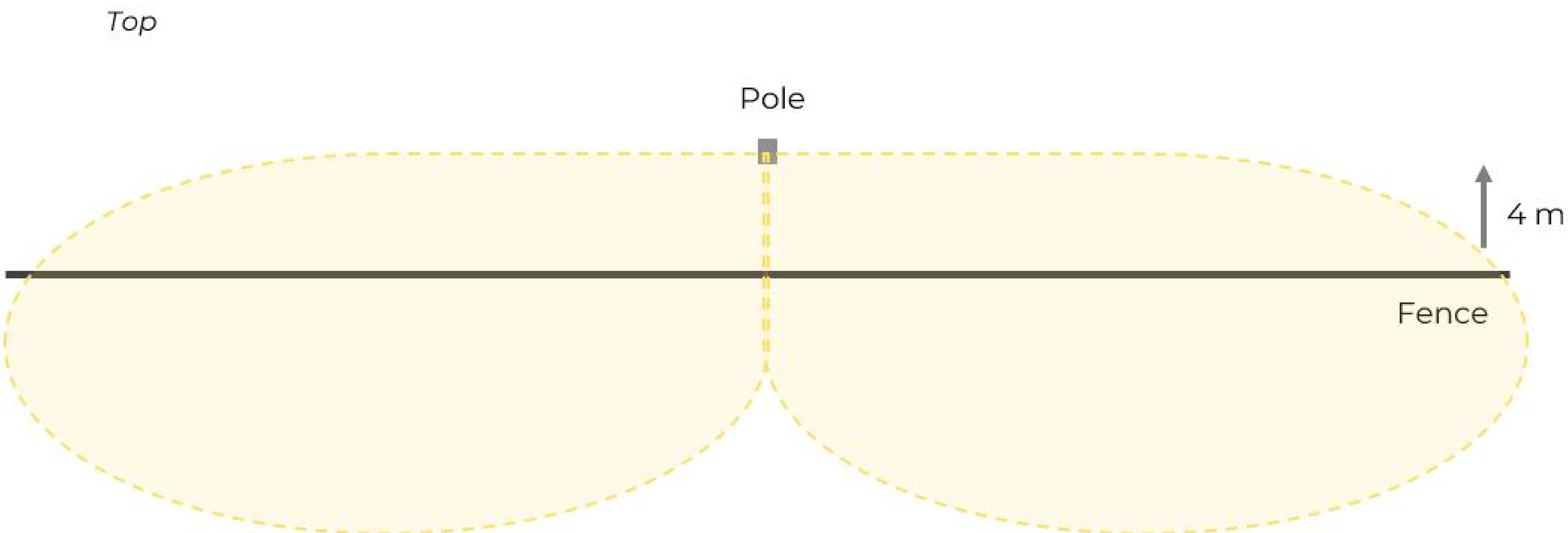


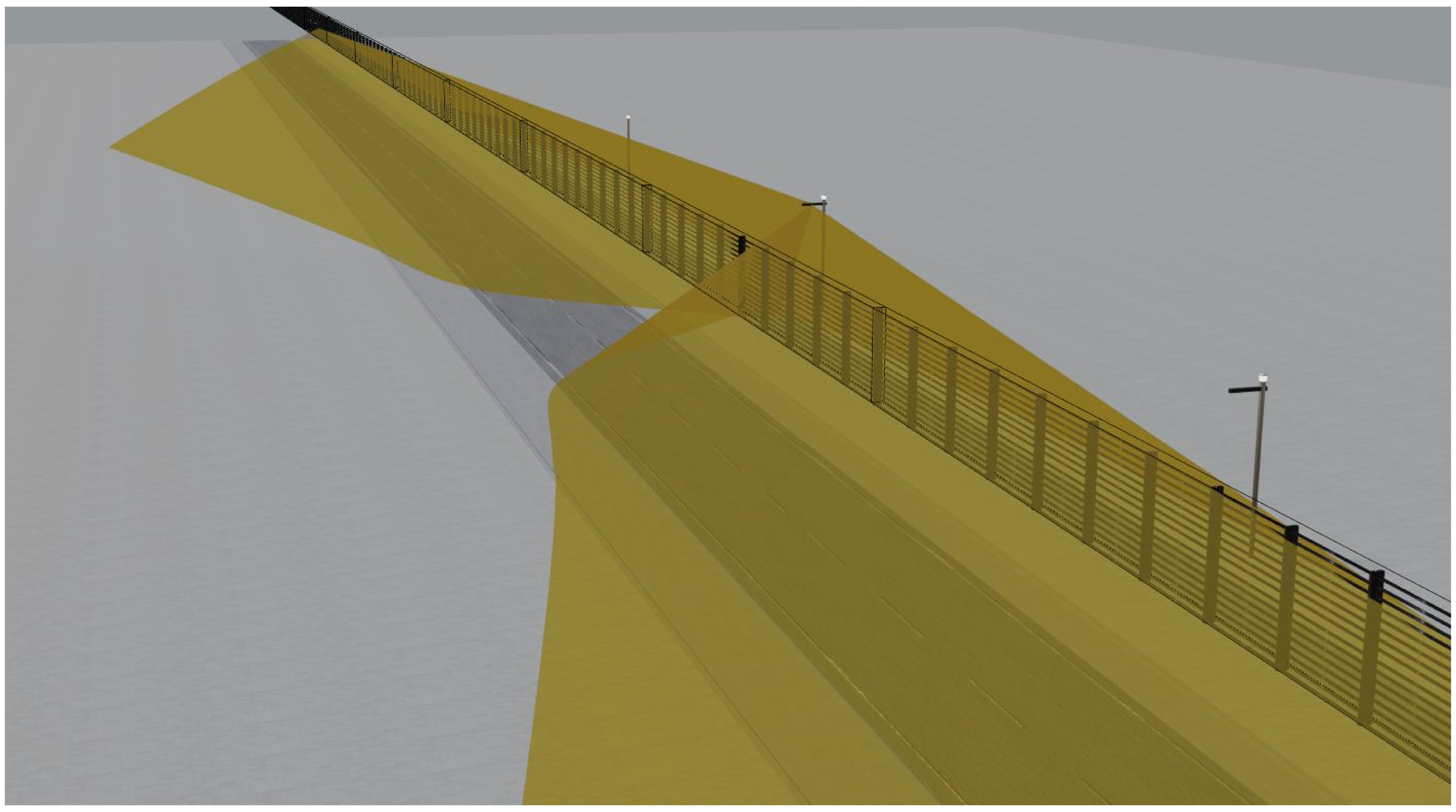


3D simulation of offset fence mounting

Alternatively, a dual sensor mount can be employed, where two sensors are mounted on each pole, one facing forward and the other backward, covering opposite directions. This configuration increases the effective coverage, allowing for sensor installation every 90 meters.





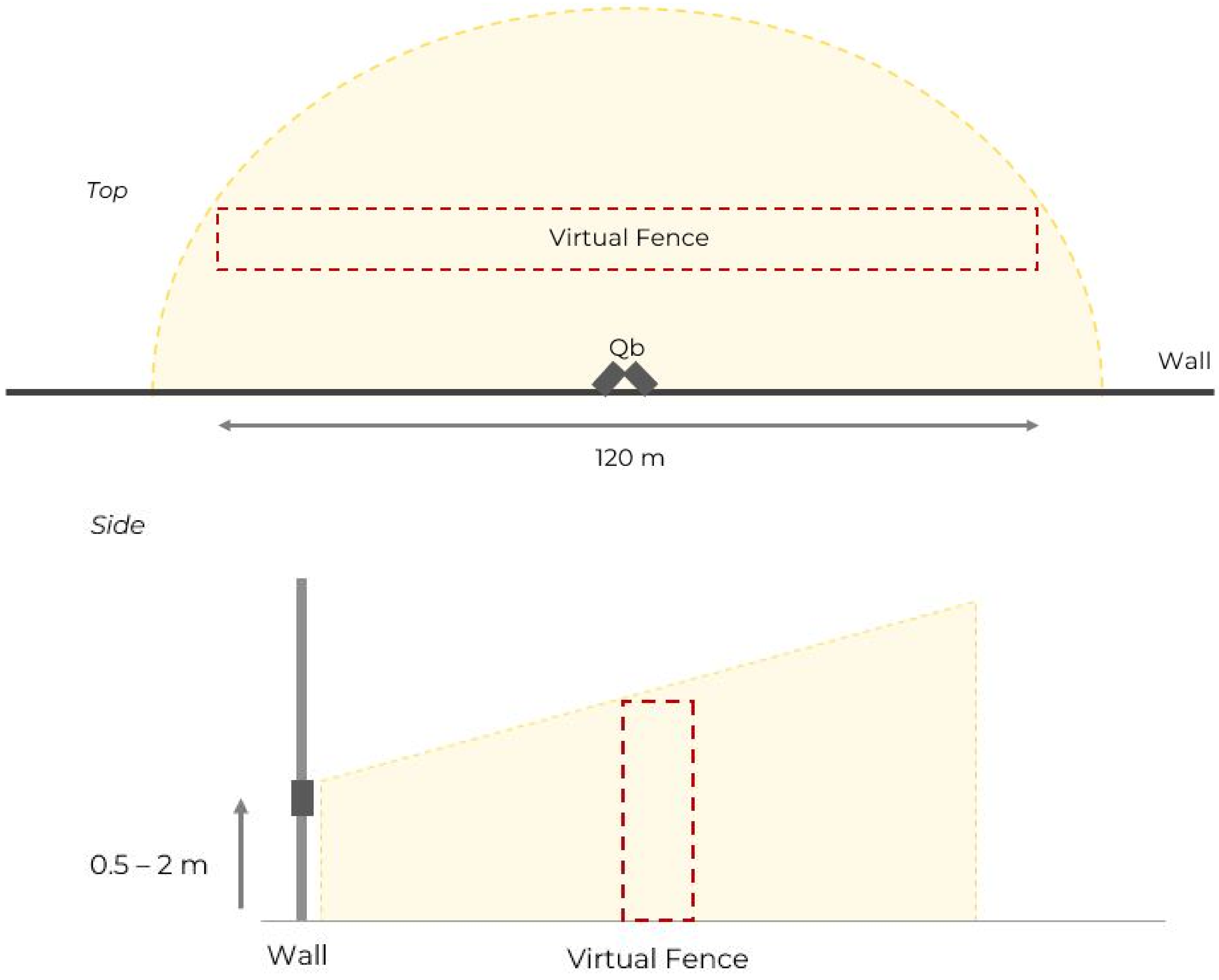


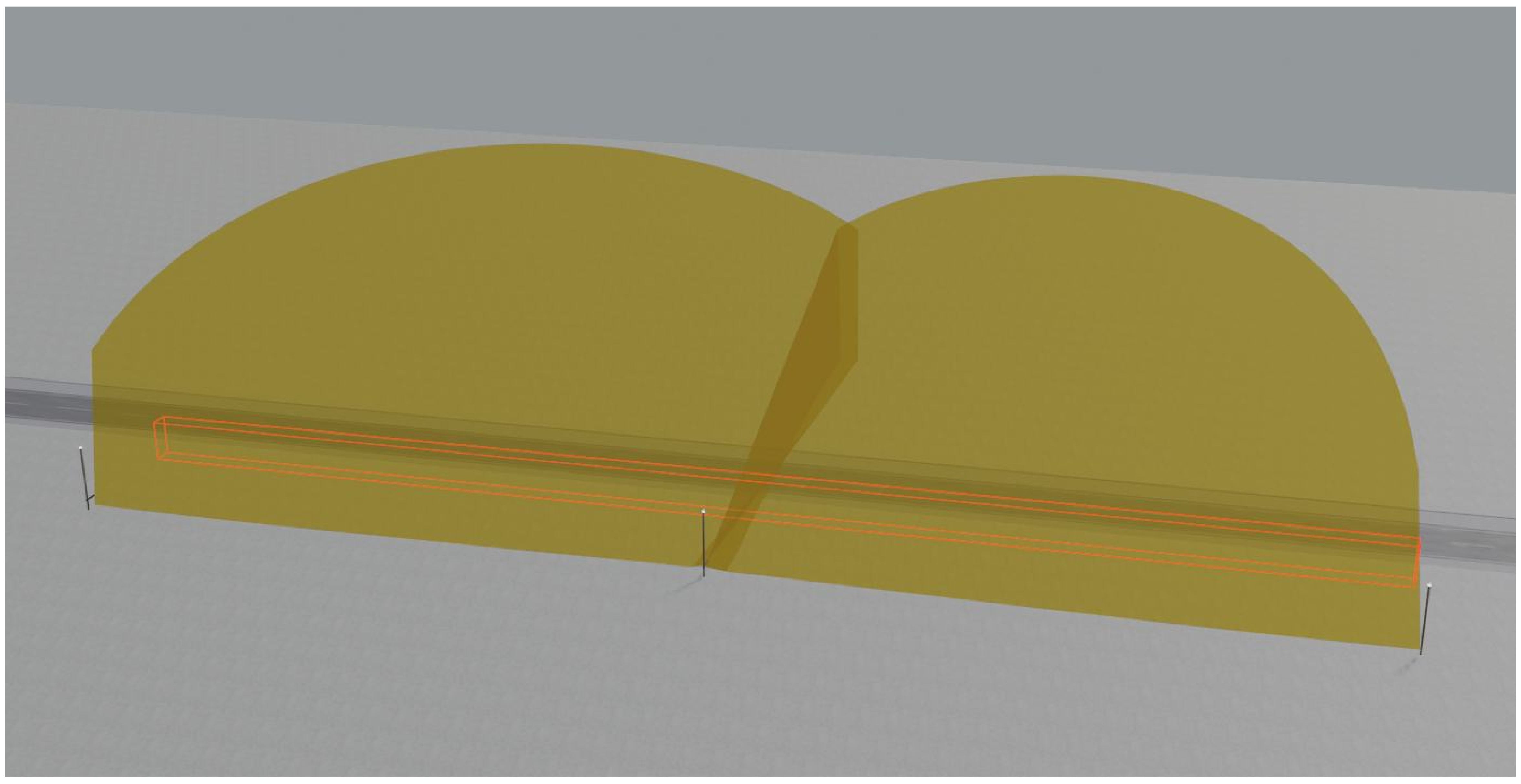
3D simulation of offset fence mounting with dual sensor mount

2.1.3 Virtual Fence

In the Virtual Fence configuration, no physical fence is present. Instead, a virtual barrier is created to detect intrusions. This setup involves mounting the sensor on a wall or similar structure at a height ranging from 0.5 to 2 meters, with the sensor oriented to monitor an open area.

By utilizing two sensors in this configuration, a detection range of up to 120 meters can be achieved, effectively creating a virtual fence. The sensors work together to monitor the designated area, ensuring that any intrusion into this virtual boundary is promptly detected. This setup is ideal for environments where a physical fence is impractical or undesirable, yet reliable perimeter security is still required.



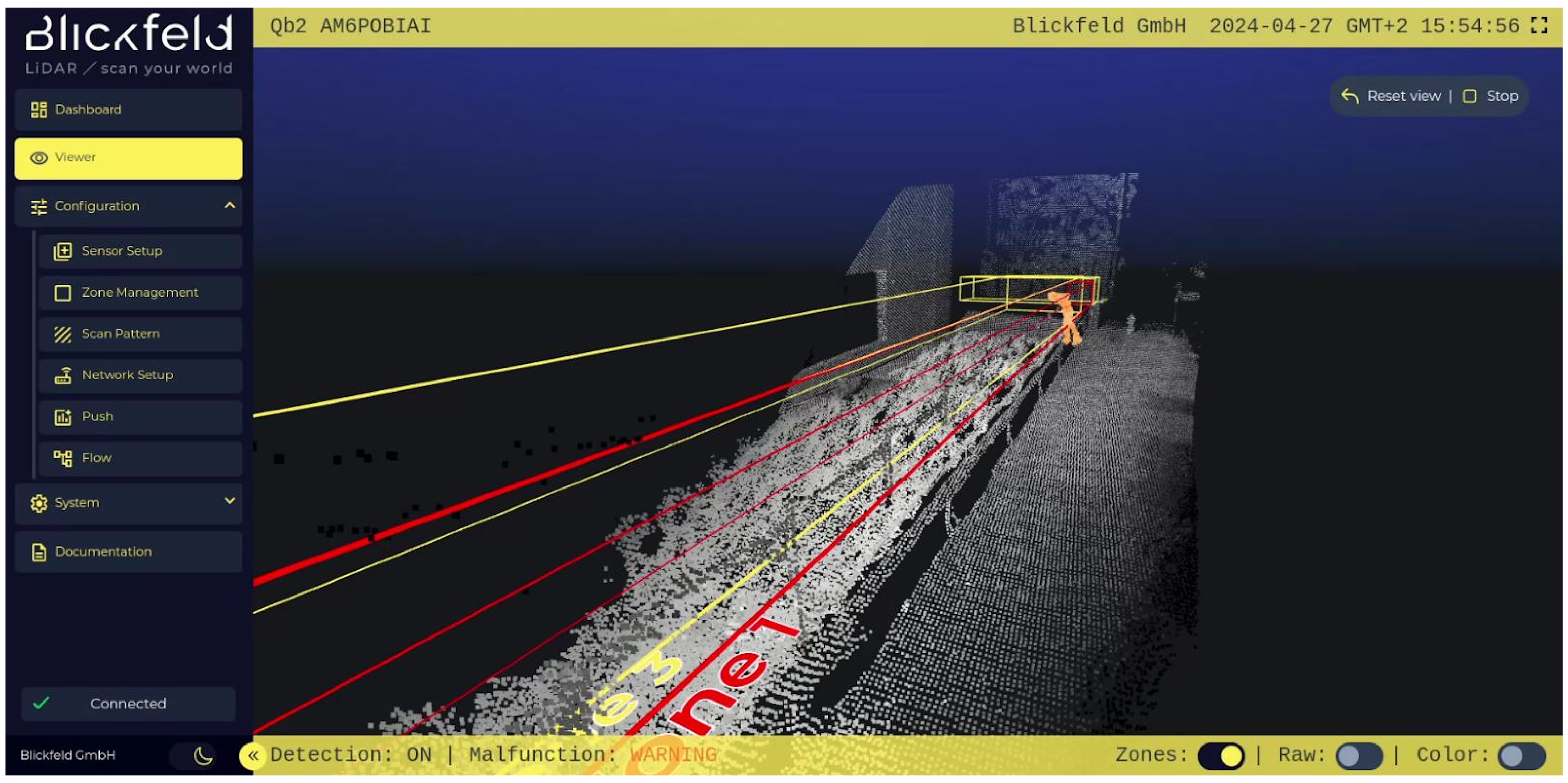


3D simulation of virtual fence scenario

2.2 Software overview and configuration

2.2.1 Overview of the sensor's software

Blickfeld's intuitive software is designed to maximize the capabilities of Blickfeld's 3D LiDAR sensors. Here, you can easily set up and configure zones in 3D space to trigger alarms when objects enter them. The on-device software includes an integrated web graphical user interface (WebGUI), accessible via your browser, providing a seamless user experience.



Blickfeld Web Graphical User Interface (WebGui)

Key functionalities of Blickfeld's software include:

- **Interactive 3D LiDAR point cloud visualization:** The WebGUI offers a real-time visualization of the 3D LiDAR point cloud, allowing users to get insights into their monitored areas.
- **Network configuration and sensor setup:** The software simplifies the process of configuring and setting up the LiDAR device, ensuring that it is optimized for the specific needs. Users are able to e.g., configure individual scan patterns, network options or fuse multiple point clouds together.
- **Zone management:** Users can define and adjust zones via drag and drop within the monitored area. Alarms are triggered precisely when an object enters a specified zone.
- **Alarm logic definition:** Users can define complex alarm logic using various parameters such as object size, direction, number of objects, alarm duration, and logical operators (AND/OR/NOT). This customization ensures that only relevant alarms are triggered, minimizing false alarms.
- **Interface and output specification:** The software supports defining how alarms and other data are communicated to external systems. Blickfeld offers various output formats via standard interfaces for seamless interaction with existing security infrastructure.

With these features, Blickfeld provides a comprehensive and user-friendly WebGUI for managing 3D LiDAR sensor data, enhancing security operations, and ensuring reliable and precise intrusion detection.

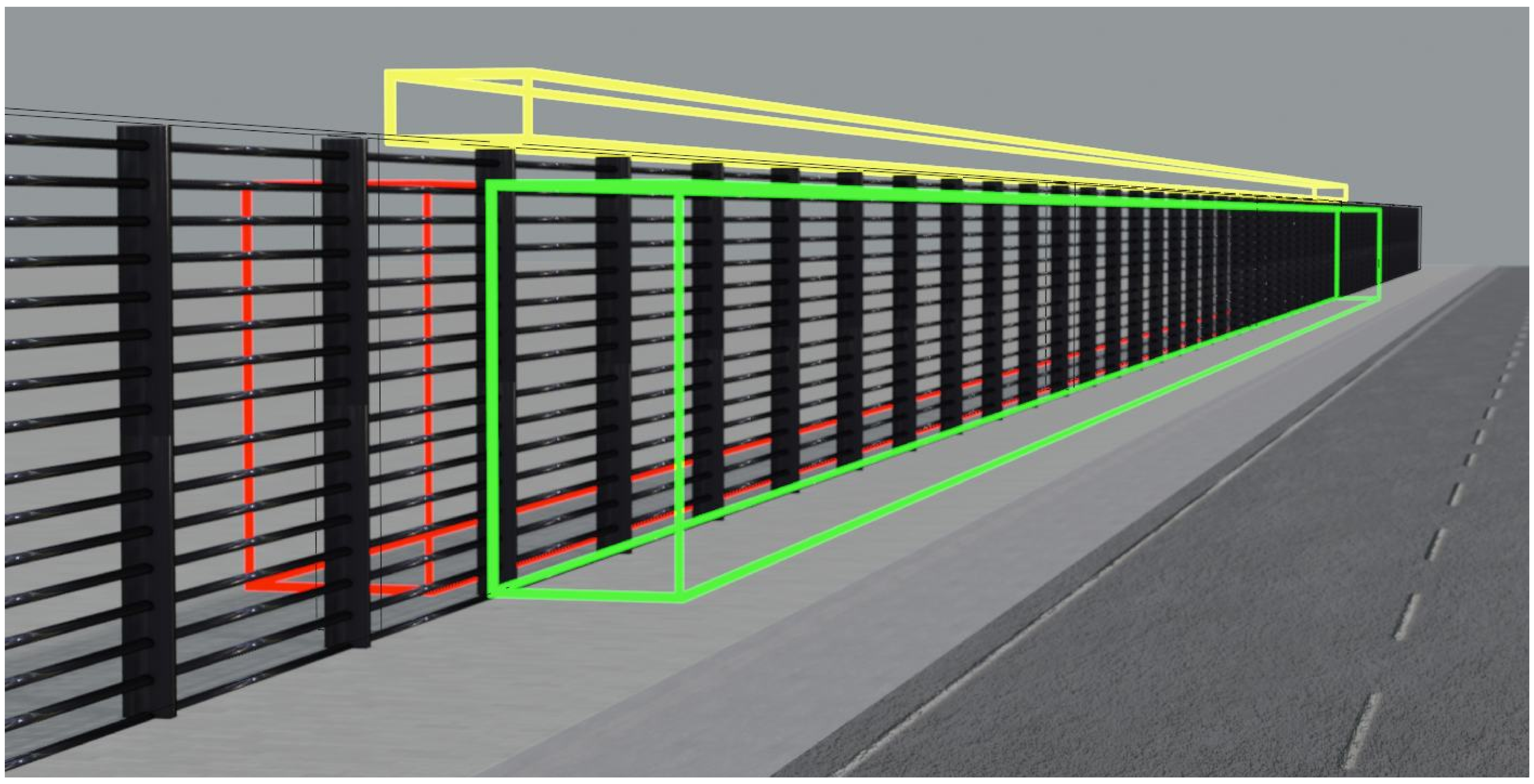
2.2.2 Setting up a security project with Blickfeld's software

The following abstract describes how users can set up their own security projects using Blickfeld's on-device software.

After mechanical setup and orientation of the device, the user needs to define the alarm logic and decide on a suited interface to communicate with the customer system (EMA, VMS, I/O-Box, etc).

Users can customize the zones and alarm types according to their specific needs and application requirements. First, the desired intrusion zones have to be defined and positioned accordingly in the scene. As shown in the graphic below, multiple zones with different alarm types can be assigned, such as pre-alarm, fence crossing / over-climbing alarm, and main alarm.

Graphical example of alarm zones for fence security

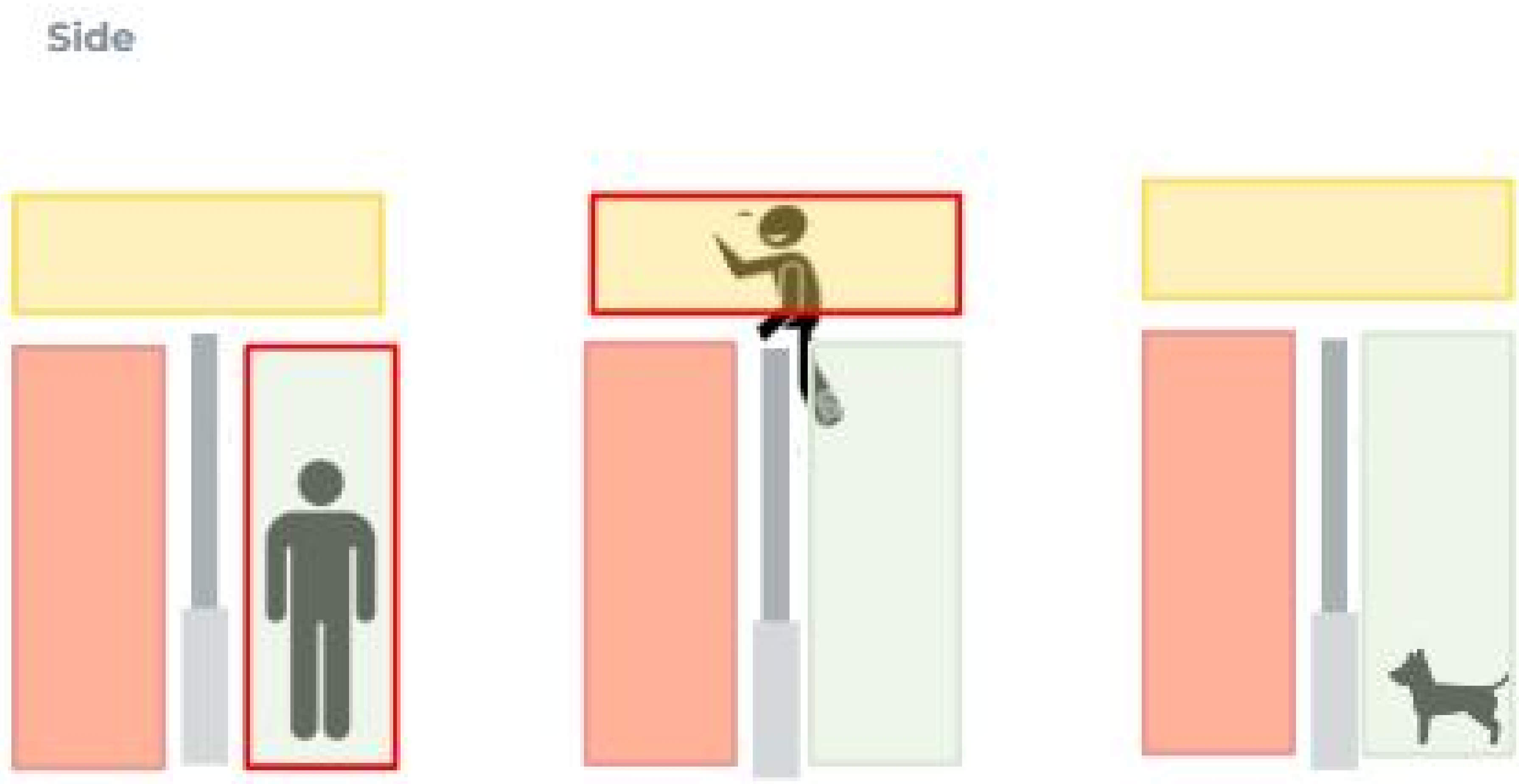


3D simulation of alarm zones

The triggering of a zone depends on four main criteria:

- The size of the intruding object
- The duration of the object's existence in the scene
- The time the object is located in the alarm zone
- The path length the object moves within the zone

Accordingly, an alarm can be triggered based on the size of the object, allowing small objects (such as animals) to be completely disregarded or ignored, as depicted in the graphic below.



Alarm generation based on big object-size

Secondly, the user needs to define the desired output interface.
Possible output interfaces include: ONVIF; TCP Socket; MQTT.

Third, it has to be determined whether the alarm state is delivered continuously or event-based. The alarm state notifications are:

- Continuous:
  - Send current state of alarm zones (alarm: true/false)

- Event-based:
  - Send notification as soon as alarm is raised (rising flag)
  - Send notification as soon as alarm state is changed (rising & falling flag)

This allows a user to configure their own alarms individually and adjust them at any time to accommodate new needs and environments.

3 PRODUCT PORTFOLIO

3.1 Blickfeld QbProtect - The Smart 3D Security LiDAR

QbProtect, the Smart 3D Security LiDAR, provides advanced physical security thanks to innovative on-device processing of 3D data. With accurate 3D point cloud data, it ensures reliable threat detection, minimizing false alarms and enabling a dependable response to actual security incidents. The system features real-time object detection through on-device processing, seamless integration with industry-standard interfaces, and object-size based threat assessment. Built-in tampering and malfunction detection ensure system reliability, and rule-based alarm generation allows for a prompt response. The LiDAR system, based on Qb2 hardware, boasts a solid-state design, IP67-rated housing for durability in both indoor and outdoor applications.

The product information sheet of QbProtect can be accessed on the download page of the Blickfeld website via this link.

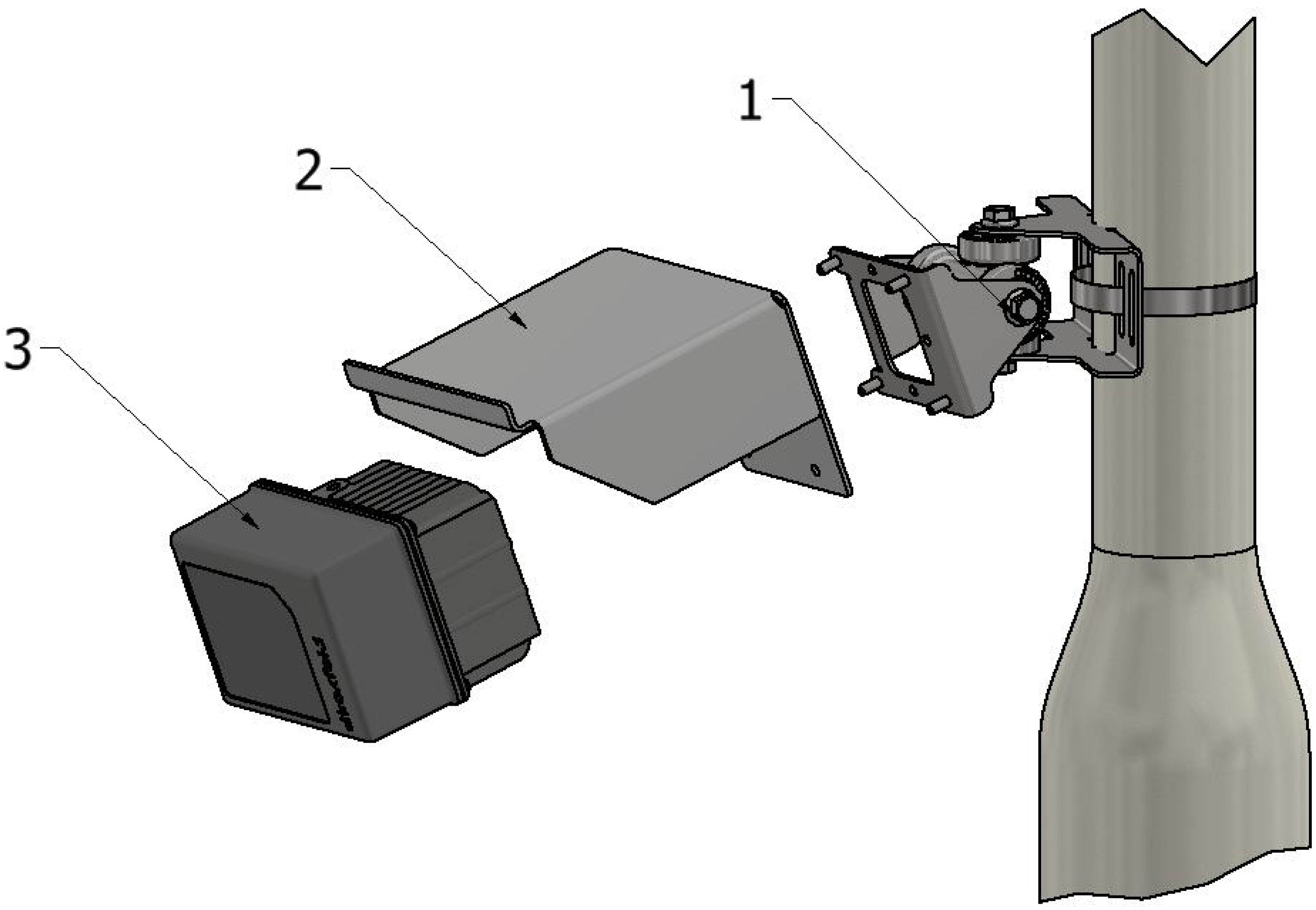
3.2 Accessories

Blickfeld's product portfolio consists of various accessories designed for individual use cases. The following provides an overview of all available accessories, the respective datasheets can again be accessed on the Blickfeld website via this link.

Power-over-Ethernet cable:

Pan-tilt mounting bracket:

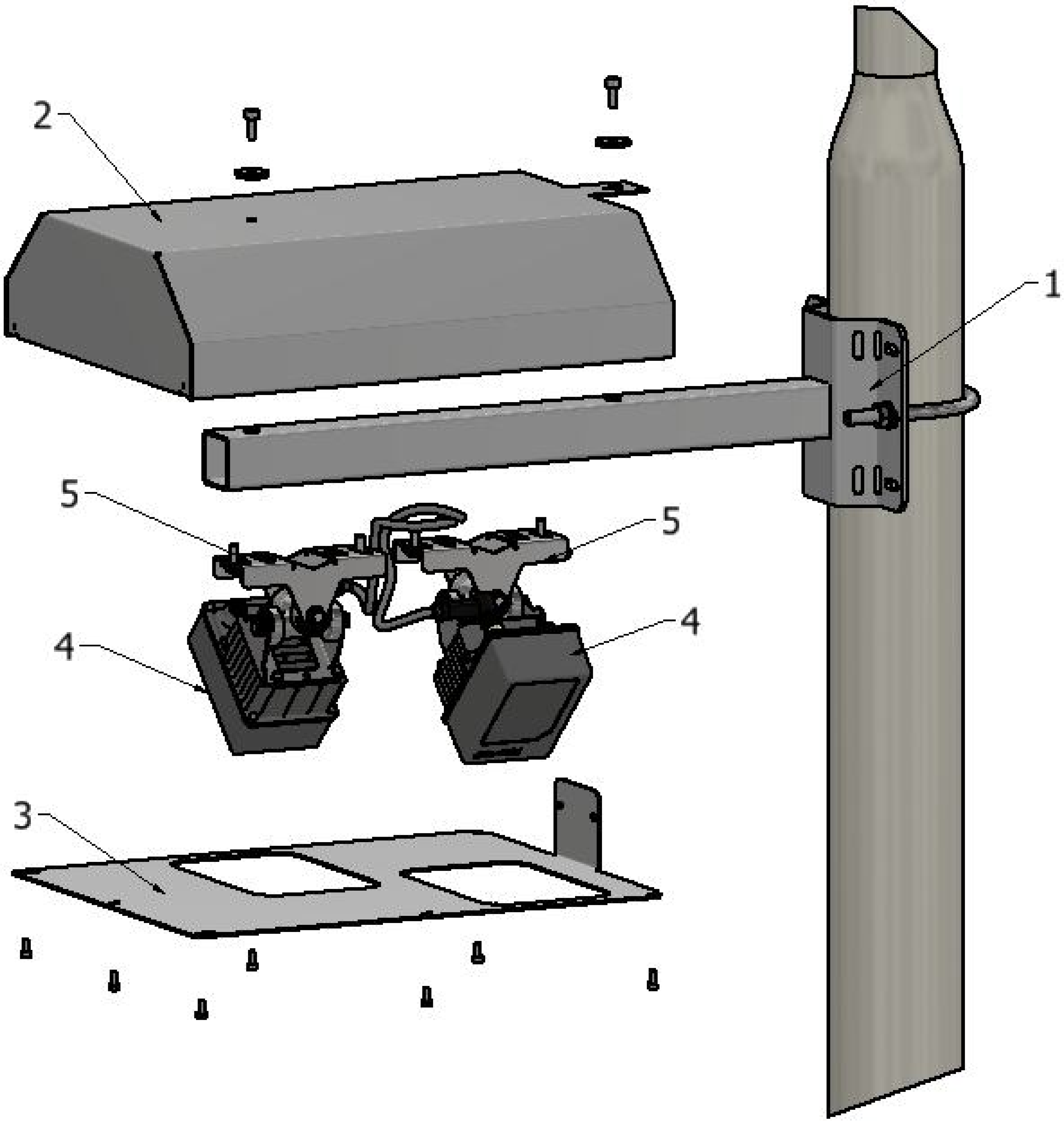
Weather protection roof:



Weather protection roof components:

1. Pan/tilt mounting bracket
2. Weather protection roof
3. Blickfeld LiDAR sensor

Dual sensor mount:



Dual sensor mount components:

1. Pole mount, diameter range 80 - 100 mm
2. Top weather protection cover
3. Bottom cover
4. QbProtect LiDAR sensor
5. Adjustable pan/tilt mounting bracket

4 SUPPORT AND RESOURCES

Blickfeld offers a range of support services to ensure users get the most out of Blickfeld's LiDAR solutions. Our technical team consists of field application engineers with different technical backgrounds, including experts in software, hardware or networks and IT. The team has gained extensive experience in the field by working closely with key customers.

To ensure that partners are fully equipped to independently execute their projects, Blickfeld provides comprehensive onboarding as well as technical training and resources. These initiatives are designed to impart in-depth knowledge of Blickfeld's 3D LiDAR technology and its applications in fence security. The goal is to empower partners with the skills and expertise necessary to successfully deploy and manage Blickfeld's LiDAR solutions.

Contact information:

Partnership and Business Opportunities
If you are interested in exploring partnership opportunities or discussing potential business collaborations, please get in touch with our business development team.

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