

## **INTELLIGENT SECURITY SYSTEMS SPECIFICATION**

**The service provider(s) shall ensure that all equipment and systems supplied are fully compatible and integrate with the existing CathexisVision platform currently utilised within the Cluster.**

**The full pilot project solution (security and substation plant monitoring) supplied by the tenderer must, however, function as a complete solution, not reliant on the existing security system. It must also allow the existing CathexisVision platform to have full access to Royston Substation and King Williams Town Complex and Warehouse (in the Eastern Cape), and Kraaifontein CNC and Brackenfell Warehouse (in the Western Cape).**

### **A. Substation security systems**

The service provider is required to provide security services and solutions for various Eskom substations in the Cape Coastal Cluster (Eastern Cape and Western Cape) as detailed below.

All material and items used need to be in accordance with the specifications listed in the end.

#### *1. Perimeter fence*

- a) Install the optical fiber on the perimeter fence.
- b) Deploy panoramic or PTZ cameras along the perimeter fence and link them to the perimeter fence optical fiber.
- c) Deploy bullet cameras for intrusion detection in areas where fences are frequently overturned

#### *2. Gates*

- a) Deploy bullet cameras at the gates for real time monitoring

#### *3. Substation control room*

- a) Install HD network dome cameras inside the substation control room.

4. *Battery room*

- a) Install dome cameras in the battery room for intrusion detection.

5. *Fibre sensing*

The perimeter fence fiber sensing system needs to include the optic fiber sensing equipment and servers

6. *CCTV*

CCTV needs to be supported by network video recorder.

7. *CCTV backhaul*

CCTV backhaul needs to include various switches to access cameras, to aggregate traffic and to access serves. The firewall needs to be included.

Storage for all recordings needs to be for at least 30 days.

## **B. CNCs, Complexes and Warehouses**

The service provider is required to provide security services and solutions for various Eskom Customer Network Centres, Complexes and Warehouses in the Cape Coastal Cluster (Eastern Cape and Western Cape) as detailed below.

All material and items used need to be in accordance with the specifications listed in the end.

1. *Perimeter fence*

- a) Install the optical fiber on the perimeter fence.
- b) Deploy panoramic or PTZ cameras along the perimeter fence and link them to the perimeter fence optical fiber.
- c) Deploy bullet cameras for intrusion detection in areas where fences are frequently overturned.

2. *Gates*

- a) Deploy bullet cameras at the gates for real time monitoring

3. *Warehouse (internal)*

- a) Install PTZ cameras, dome cameras and bullet cameras inside the warehouse.

4. *Fibre sensing*

The perimeter fence fiber sensing system needs to include the optic fiber sensing equipment and servers

5. *CCTV*

CCTV needs to be supported by network video recorder.

6. *CCTV backhaul*

CCTV backhaul needs to include various switches to access cameras and access points, to aggregate traffic and to access serves. The firewall needs to be included.

Storage for all recordings needs to be for at least 30 days.

**C. Operation Centre (or Control Station)**

The service provider is required to provide and equip the security operation centres in the Cape Coastal Cluster (Eastern Cape and Western Cape) as detailed below.

All material and items used need to be in accordance with the specifications listed in the end. (The service provider needs to discuss with Eskom the requirements and specifications for additional material and items not listed in the end.)

The security operation centre should be equipped with the facilities below.

1. *Digital twin*

- a) Provide digital twin (3D) for the whole substation and equipment.
- b) Provide unified display of all information in one dashboard.
- c) Provide digital-physical linkage
- d) Interface with asset management and equipment control system.

2. *Intelligent algorithm platform*

- a) Provide equipment defect identification

Based on the inspection industry experience, check whether the capabilities of each algorithm are the following detailed contents.

- i. Equipment Defect Identification

Automated detection of equipment abnormalities and deterioration:

- Abnormal cabinet door closure status
- Breather Silica-Gel Discoloration
- Insulator fractures and cracks
- Silica-Gel Breather Canister Damage

- b) Provide equipment status identification

Based on the inspection industry experience, check whether the capabilities of each algorithm are the following detailed contents.

- i. Equipment Status Identification

Real-time monitoring and recognition of equipment operational indicators:

- Lightning arrester meter readings
- Oil level gauge status monitoring
- Oil temperature identification
- Switchgear Indicator Lamp Recognition
- Switchgear Link Recognition
- Operating Handle and Selector Switch Status Recognition
- Semaphore Indicator Status Recognition

- c) Provide equipment safety identification

Based on the inspection industry experience, check whether the capabilities of each algorithm are the following detailed contents.

- i. Equipment Safety Identification

Environmental hazard detection for operational safety:

- Smoke and fire detection in facility areas
- Identification of oil stains on the surface of components
- Identification of oil stains on the ground

d) Provide human behaviour identification

Based on the inspection industry experience, check whether the capabilities of each algorithm are the following detailed contents.

i. Human Behaviour Identification

Personnel safety compliance and intrusion monitoring:

- Safety helmet compliance detection
- Work uniform compliance verification
- Reflective vest compliance monitoring
- Restricted area intrusion detection
- Tripwire crossing violation detection

### 3. *Private video cloud*

- a) Periodically back up data from the substation and warehouse to the O&M center.
- b) Storage for all recording archive needs to be for at least 90 days.
- c) The video archive storage capacity must be at least 407.87TB, calculated as follows:

Video Storage Capacity Calculation:

$$\text{Total Storage (TB)} = (N \times BR \times T_{\text{day}} \times D) / (8 \times 1024 \times 1024)$$

Parameter Definition:

N = Total quantity of cameras (pcs, 110 in this project)

BR = Encoding bitrate per camera (Mbps, 4 Mbps herein)

T<sub>day</sub> = Total seconds per day = 86400 s/day

D = Required retention days for video footage (90 days herein)

Divisor 8: Conversion coefficient from bit (b) to Byte (B) (1 Byte=8 bit)

1024×1024: Binary conversion factor for unit conversion from MB to TB

## **D. Substation plant monitoring system**

The service provider is required to provide substation transformer monitoring services and solutions for various Eskom substations in the Cape Coastal Cluster (Eastern Cape and Western Cape) as detailed below.

All material and items used need to be in accordance with the specifications listed in the end.

### *1. Transformer monitoring*

- d) Install thermal imaging Pan-Tilt camera for temperature measurement of the main body, cable connectors, insulating bushings, etc.
- e) Install visible light Pan-Tilt camera for readings of oil temperature gauge, winding temperature gauge, oil level gauge, main transformer breather, etc.

### *2. Substation control room*

- b) Install HD Network dome cameras to monitor indicator lights, meters, switches, etc.

These dome cameras need to also be installed and positioned to monitor the environment (smoke, open fire, etc.) and personnel behaviour (during operating, etc.)

### *3. Battery room*

- d) Install explosion-proof bullet cameras in the battery room for temperature monitoring (point, line and surface) on the battery body and cable joints.

### *4. CCTV*

CCTV needs to be supported by network video recorder.

### *5. CCTV backhaul*

CCTV backhaul needs to include various switches to access cameras, to aggregate traffic and to access servers. The firewall needs to be included.

Storage for all recordings needs to be for at least 30 days.

## **E. Warranty**

The material and items used, and work performed to provide the security system solution need to be warranted for a period of at least two (2) years.

### **Distributed Fiber-Optic vibration detection system**

The distributed fiber-optic vibration detection system should be designed for 24-hour perimeter protection of small campuses like substations and data centers, featuring advanced sensing technology and low false positive rates. It should offer comprehensive detection capabilities with a maximum measurement distance of 5 km and a fast event identification time of under 5 seconds.

#### **Features:**

- 1) The system should detect vibrations caused by intruders, such as climbing or cutting fences, and report them instantly.
- 2) The system should integrate with surveillance cameras for visual verification, enabling security staff to view live, zoomed-in video of the alarm location.
- 3) The system should have optical Digital Signal Processing (oDSP) algorithms and an integrated judgment mechanism, that filters out environmental noise like wind, rain, or small animals.
- 4) The fiber cables on the fence should be passive (maintenance-free and easy to deploy).
- 5) The system should handle harsh weather conditions, including heavy rain and strong winds

**Specifications** (*Distributed fiber-optic vibration detection device*)

| Description                                    | Quantity                  |
|--|---------------------------|
| Installation mode                              | In a 19-inch rack         |
| Dimensions (H x W x D)                         | 88.1 mm x 442 mm x 220 mm |
| Number of channels                             | 1                         |
| Maximum one-channel measurement fence distance | 5 Kilometres              |
| Event identification time of a single port     | ≤ 5 seconds               |
| False positive rate                            | ≤ 1 time/km/day           |
| False negative rate                            | < 1%                      |
| Positioning accuracy                           | ≤ 5 metre                 |
| Operating temperature                          | -5°C to +45°C             |
| Relative humidity                              | 5% to 85%                 |
| Power supply                                   | 230 V AC                  |
| Power consumption                              | ≤ 95 W                    |

**NCE (server)**

**Features:**

- 1) Network Cloud Engine (NCE) is the component of the intelligent network and security solutions, and it should be designed to deliver automated, secure, and intelligent infrastructure management.
- 2) It should integrate management, control, analysis, and AI functions.
- 3) It should translate application intent into network configurations, providing full-lifecycle management (deployment, provisioning, and maintenance).
- 4) It should integrate network management with security policies and IoT expansion.



### **SAE (server)**

#### **Features:**

- 1) The data processing system, namely the SAE, receives the information uploaded by the warning unit. After analyzing and processing the information, the information is generated, such as alarm, location, and

### **CCTV System**

The system should consist of an intelligent Network Video Recorder (NVR), PTZ camera and Dome camera.

#### **Features:**

#### **NVR**

- 1) The intelligent Network Video Recorder (NVR) should be designed to be compact for edge AI applications.
- 2) It should utilize AI-powered computing to provide advanced video analytics and high-performance storage for intelligent substation scenarios.
- 3) It should support up to 32 TOPS (Trillions of Operations Per Second) of computing power to run complex, concurrent algorithms, such as face recognition, behaviour analysis, and vehicle recognition.
- 4) It should support up to 128 channels of video access (512 Mbit/s) and provides intelligent analysis for up to 16 channels, or up to 64 channels of image analysis (depending on the specific model).
- 5) It should feature SafeVideo technology, which ensures data is still readable and writable even if multiple hard disks fail simultaneously.
- 6) It should be 3U embedded, quiet desktop-level or cabinet-mountable server with hot-swappable hard disks for easy maintenance.
- 7) It should use an embedded Linux system for 24/7 stability, optimized for security.

## NVR Specification

| Description                  |              | Quantity   |
|------------------------------|--------------|--|
| Access and bandwidth         |              | Supports up to 64-channel network video access. Video input bandwidth is 320 Mbit/s (160 Mbit/s when intelligent services are enabled).  |
| Storage & Reliability        |              | Hybrid storage for video and images. Features SafeVideo technology, ensuring data readability in scenarios with hard disk failures (RAID 5). Data Safe ensures dual backup of key system data. |
| Intelligence                 |              | Supports algorithm plug-in integration, including target analysis, person analysis, vehicle analysis, behavior analysis, and smart tracking  |
| Processor & Operating System |              | Embedded Linux OS with a high-performance 8-core CPU.  |
| External Ports               | Networking   | 2 x 10/100/1000 Mbit/s Ethernet ports  |
|                              | USB          | 3 x USB ports (2 x USB 2.0 on front, 1 x USB 3.0 on rear)  |
|                              | Audio        | 1 x RCA input, 1 x RCA output  |
|                              | Alarm        | 16 alarm-in ports and 4 alarm-out ports  |
|                              | Video Out    | Dual HDMI (one 4K, one 1080p) and one VGA port   |
| Chassis & Power              | Chassis      | 2U or 3U   |
|                              | Power Supply | 100–240 V AC, 900 W (max.)   |
| Operating temperature        |              | Operating temperature ranges from –10°C to +55°C   |
| Video Formats                |              | H.264, H.265, and MJPEG  |
| Management                   |              | Local Display Unit (LDU) or client/server (iClient) management   |
| Storage Support              |              | Compatible with 4 TB, 6 TB, 8 TB, 10 TB, or 16 TB enterprise-level disks   |

## PTZ Camera (for perimeter) specification

| Description  | Quantity                                 |
|--------------|--|
| Image sensor | Dual 1/1.8" CMOS sensors                 |
| Resolution   | 4MP (2560 x 1440 pixels) for both lenses |

|                       |            |   |
|-----------------------|------------|---|
| Lenses                | Prime Lens | F1.0 wide aperture for panoramic awareness  |
|                       | Zoom Lens  | 5.5mm to 220mm (40x optical zoom) with F1.8 to F3.8 aperture  |
| Illumination          |            | IR range up to 200m; white light illumination up to 30m   |
| Minimum Illumination  |            | Color 0.0003 lux; B/W 0 lux with IR enabled   |
| Computing Power       |            | 4 TOPS  |
| Intelligence Features |            | Supports omni-data structuring, behavior analysis (tripwire, intrusion), target/body detection, and crowd flow analysis |
| ISP Performance       |            | AI ISP-based video stream noise reduction and Super Wide Dynamic Range (WDR) of 120 dB                                  |
| PTZ Movement          |            | 360° continuous pan and -10° to +90° tilt   |
| Protection Rating     |            | IP66 (weatherproof), IK10 (vandal-resistant), and 6 kV surge protection   |
| Operating Range       |            | -40°C to +60°C temperature; 5% to 95% humidity  |
| Power Supply          |            | 24V AC or PoE (IEEE 802.3bt)  |
| Power Consumption     |            | Maximum 56.7 W; typical 17.6 W  |
| Local Storage         |            | MicroSD slot supporting up to 256 GB  |
| I/O Ports             |            | 4 alarm inputs, 2 alarm outputs, 1 audio line-in/mic-in, and 1 audio line-out   |

### Dome Camera specification

| Description     | Quantity  |
|-----------------|---|
| Image Sensor    | 1/2.7" 5MP CMOS sensor with a resolution of 2880(H) x 1620(V)                 |
| Focal Length    | 2.8–12mm manual zoom lens   |
| Aperture        | F1.3 (Wide) to F2.4 (Tele)  |
| Field of View   | Horizontal range from 32°C (Tele) to 95°C (Wide)                              |
| Night Vision    | Infrared (IR) range up to 30 metres using 850nm wavelength                    |
| Dynamic Range   | 120 dB Super Wide Dynamic Range (WDR) for clear images in high-contrast light |
| Computing Power | 1 TOPS (Tera Operations Per Second)   |

|                    |   |
|--------------------|---|
| Target Detection   | Supports target detection, person detection, and target attribute recognition       |
| Behaviour Analysis | Detects fast movement, tripwire crossing, intrusion, area entry/exit, and loitering |
| Crowd Analysis     | Provides queue length monitoring, head counting, and crowd flow statistics          |
| Compression        | Uses SuperCoding technology to reduce bit rates by up to 50%                        |
| Memory             | 1.0 GB DDR3 RAM and 512.0 MB SPI NAND Flash   |
| Architecture       | Software-defined architecture allowing algorithm loading and upgrades               |
| Adaptation         | Supports backlight and overcast adaptation modes                                    |
| Durability         | Typically supports IP67 (weatherproof) and IK10 (vandal-resistant) ratings          |

### Access Switch specification

OEM shall be positioned as a Leader or Challenger in the latest Gartner Magic Quadrant for Enterprise Wired and Wireless LAN Infrastructure.

| Description                   | Quantity  |
|-------------------------------|---|
| Downlink Ports                | 24/48 x 10/100/1000BASE-T                                       |
| Uplink Ports                  | 4 x 10GE SFP+ and 40GE/100GE QSFP+                              |
| Switching Capacity            | Up to 2.4 Tbit/s  |
| PoE Support                   | Supports PoE (802.3af), PoE+ (802.3at), and 90W PoE++ (802.3bt) |
| Performance                   | 1.2GHz or higher CPUs with 2GB RAM / 1GB Flash                  |
| Software & Intelligence       | Supporting VXLAN, telemetry, and automated network management   |
| Intelligent Stacking (iStack) | Allows multiple switches to function as a single logical unit   |
| Reliability                   | Supports 50 ms protection switching using SEP or ERPS protocols |
| Operating Temperature         | Typically -5°C to +50°C   |

### Core Switch specification

| Description        | Quantity   |
|--------------------|--|
| VXLAN              | Supports full-stack VXLAN for highly virtualized, automated networks   |
| Intelligent O&M    | Features iPCA (Packet Conservation Algorithm) for measuring network quality, pinpointing faults within minutes |
| IPv6               | Native support for SRv6 and high-performance IPv6 service processing   |
| Port density       | 400GE/100GE  |
| Switching capacity | 14.4 Tbit/s per device   |
| Reliability        | M-LAG (Multichassis Link Aggregation Group) ensures sub-millisecond failover                                   |

### TOR Switch specification

| Description            | Quantity  |
|------------------------|---|
| Network Virtualization | Supports VXLAN routing and bridging and BGP-EVPN for building elastic cloud fabrics |
| Reliability            | M-LAG and iStack  |
| Intelligent O&M        | Telemetry for real-time monitoring and sFlow/NetStream for deep traffic analysis    |

### Firewall specification

| Description    | Quantity   |
|----------------|--|
| Threat Defense | AI-powered Detection Engine (CDE) identifies unknown ransomware/threats and provides 95% detection accuracy                  |
| Performance    | Built-in hardware acceleration engines (NP) enable optimized forwarding, IPS, and IPsec processing, ensuring high throughput |

|                      |  |
|----------------------|--|
| Throughput & Scaling | The NGFW deployed at Substation and Warehouse sites shall provide firewall throughput greater than 10 Gbit/s to meet the required security inspection and service forwarding requirements.<br>The NGFW deployed at operation center shall provide firewall throughput greater than 4Tbit/s to meet the required security inspection and service forwarding requirements. |
| Application Control  | Identifies and controls over 6,000 applications (e.g., SQL injection, XSS) and supports application-layer defense  |
| Capacity             | The NGFW deployed at Substation and Warehouse sites shall provide high concurrent session support, with up to 10 million sessions<br>The NGFW deployed at operation center shall provide high concurrent session support, with up to 960 million sessions  |
| Reliability          | Supports 99.9% availability, featuring redundant power modules and hot-swappable components  |
| AI-Powered Detection | Protects against unknown and evasive threats using machine learning  |
| Unified Management   | Integrates IPS, anti-DDoS, and URL filtering into a single management platform, reducing OPEX  |
| VPN Support          | Supports high-availability IPsec VPN and SSL VPN   |
| Encrypted Traffic    | Capable of detecting threats within encrypted traffic without requiring full decryption  |

### Outdoor access point (AP) specification

| Description    | Quantity   |
|----------------|--|
| Wi-Fi Standard | Wi-Fi 7 (802.11be)                               |
| Data Rates     | At least 1.775Gbps (2x2 MIMO)                    |
| Radios         | Simultaneous 2.4 GHz and 5 GHz (or 6 GHz) radios |

|                          |   |
|--------------------------|---|
| Environmental Protection | IP68-rated for waterproofing and dustproofing   |
| Operating temperature    | -40°C to +65°C  |
| Surge Protection         | Up to 6kV or 6 kA surge protection on Ethernet ports                                  |
| Antennas                 | Built-in smart antennas or external antenna options for optimized coverage            |
| Interfaces               | Gigabit Ethernet (GE) electrical ports and SFP optical ports for long-distance uplink |
| Deployment               | Supports Fit, Fat, and Cloud management modes   |

### Thermal imaging pan-tilt camera (for transformer monitoring) specifications

| Description  | Quantity  |
|--|---|
| <b><i>Thermal imaging</i></b>                      |   |
| Detector Type                                      | Uncooled VOx (Vanadium Oxide) IR focal plane detector           |
| Resolution   | 640 x 512   |
| Thermal Pixel Spacing                              | 12 µm   |
| Thermal Lens Focal Length                          | 25 mm   |
| Temperature Measurement Range                      | -20°C to +550°C   |
| Temperature Measurement Accuracy                   | ±2°C or ±2% of range  |
| Detection Distance                                 | 3m to 30m   |
| <b><i>Visible light camera (dual spectrum)</i></b> |   |
| Image Sensor                                       | 1/1.8" Progressive Scan CMOS                                    |
| Resolution   | 5MP (2880 x 1620)   |
| Optical Zoom                                       | 32x   |
| Focal Length                                       | 5–160mm   |
| Min Illumination                                   | Color: 0.005 lux; B/W: 0.0025 lux (F1.2)                        |
| <b><i>Pan-Tilt-Zoom (PTZ) Capabilities</i></b>     |   |
| Rotation Angle                                     | Pan: 0°–360° (continuous),<br>Tilt: -90°–90°                    |
| Rotation Speed                                     | Pan: 0.1–80°/s (manual)<br>Tilt: 0.1–60°/s (manual)             |
| Preset Positions                                   | 512   |
| Park Action  | Supported   |
| <b><i>Intelligence and Security</i></b>            |   |
| AI TOPS  | 2.5 TOPS (used for object recognition and intelligent analysis) |
| Thermal Functions                                  | Hot/cold spot tracking and temperature analysis                 |
| Video Encoding                                     | H.265 / H.264 / MJPEG   |

| <b>Structure and Environment</b> |                |
|----------------------------------|----------------|
| Protection Rating                | IP66           |
| Vandal Resistance                | IK10           |
| Operating Temperature            | -40°C to +60°C |
| Power Supply                     | AC24V & PoE    |

### Visible light pan-tilt camera (for transformer monitoring) specifications

| Description                            | Quantity  |
|--|---|
| <b>Camera &amp; Imaging</b>            |   |
| Sensor                                 | 1/1.8" Progressive Scan CMOS sensor   |
| Resolution                             | 5MP (2880 × 1620) resolution  |
| Zoom                                   | 32x optical zoom and 16x digital zoom   |
| Focal Length                           | 5 mm to 160 mm  |
| Minimum Illumination                   | Color: 0.005 lux (F1.2); B/W: 0.0025 lux (F1.2)   |
| WDR                                    | Physical WDR 120 dB   |
| Illumination Distance                  | 100m for LED supplementary lighting   |
| <b>PTZ (Pan/Tilt/Zoom) Performance</b> |   |
| Pan Range                              | 0°–360° continuous rotation   |
| Tilt Range                             | -90° to +90° (auto-flip)  |
| Pan Speed                              | 0.1°–240°/s (manual); 100°/s (preset)   |
| Tilt Speed                             | 0.1°–160°/s (manual); 60°/s (preset)  |
| Presets                                | Supports up to 512 preset positions   |
| <b>AI &amp; Intelligence</b>           |   |
| Computing Power                        | 2.5 TOPS (Trillion Operations Per Second)   |
| Intelligent Functionality              | Supports intelligent video analytics, including behavioral analysis, crowd density detection, and object classification |
| <b>Video &amp; Audio</b>               |   |
| Video Encoding                         | H.265/H.264/MJPEG   |
| Frame Rate                             | Up to 5MP@30fps   |
| Audio                                  | Built-in audio input and output interfaces  |
| <b>Durability &amp; Physical</b>       |   |
| Protection Rating                      | IP66 for weather resistance   |
| Impact Resistance                      | IK10 rating   |
| Power Supply                           | AC24V and PoE (Power over Ethernet)   |



## HD Network Dome Camera (for control room monitoring) specification

| Description              | Quantity   |
|--------------------------|--|
| Imaging System           | 1/1.8" CMOS sensor, 4MP resolution   |
| Dual-Lens Design         | Supports both a panoramic view and detailed zoom capture   |
| Optical Zoom             | 40x optical zoom lens (5.4–216 mm) and a wide-angle prime lens (5 mm)  |
| AI Computing Power       | 2 TOPS (Trillion Operations Per Second)  |
| Intelligent Analysis     | Supports automatic tracking, behavior analysis, crowd flow analysis, object classification (motor vehicle, non-motorized vehicle, and pedestrian), vehicle recognition, traffic flow statistics, and parking violation detection |
| Image Quality            | 120 dB Super Wide Dynamic Range (WDR), backlight adaptation, and overcast adaptation   |
| PTZ & Stabilization      | Built-in six-axis gyroscope for image stabilization and built-in electronic compass/accelerometer for real-time PTZ direction tracking   |
| Infrared Range           | Supports infrared (IR) for night vision with a distance of up to 200 meters  |
| Security/Storage         | Supports MicroSD card storage (max capacity not explicitly listed, but supports secure encrypted storage)  |
| Environmental Protection | IP66-rated protection  |
| Operating Conditions     | -40°C to +60°C operating temperature range   |
| Power Supply             | AC24V; PoE (IEEE 802.3bt)  |
| Omni-data Structuring    | Extracts features from pedestrian, motor vehicle, and non-motorized vehicle images for intelligent search  |
| Algorithm Upgrades       | Supports online loading and upgrading of AI algorithms   |
| Fog Detection            | Uses deep learning algorithms for agglomerate fog detection  |

## Panoramic camera specification

| Description                | Quantity   |
|----------------------------|--|
| <b>ROM</b>                 |  |
| Image sensor               | Panorama camera: 1/1.8" 2-megapixel CMOS sensor;<br>PTZ dome camera: 1/1.8" 4-megapixel CMOS sensor  |
| Resolution                 | Panorama camera: 16 megapixel;<br>PTZ dome camera: 4-megapixel   |
| Maximum resolution         | 8192 (H) x 1800 (V)  |
| ROM                        | Panorama camera: 8 GB;<br>PTZ dome camera: 8 GB  |
| Memory                     | Panorama camera: 4 GB;<br>PTZ dome camera: 2 GB  |
| Scanning mode              | Progressive scan   |
| Electronic shutter         | Automatic, manual, or 1/100,000s to 1/3s   |
| Minimum illumination       | Panorama camera: 0.0005 lux @ F1.0 (color mode);<br>0.0002 lux @ F1.0 (B/W mode)<br>PTZ dome camera:<br>0.001 lux @ F1.4 (color mode);<br>0.0005 lux (B/W mode); 0 lux (illuminator enabled) |
| SNR                        | > 56 dB  |
| Maximum radiation distance | Panorama camera: N/A<br>PTZ dome camera: ≥ 400 m   |
| Illuminator                | 7 PCS (infrared LED)   |
| <b>Lens</b>                |  |
| Lens type                  | Panorama camera: prime lens<br>PTZ dome camera: zoom lens  |
| Focal length               | Panorama camera: 2.8 mm<br>PTZ dome camera: 5.5 mm to 220 mm   |
| Max f-number               | Panorama camera: F1.0<br>PTZ dome camera: F1.4   |
| Angle of view (AoV)        | Panorama camera: 360° (horizontal); 111° (vertical)<br>PTZ dome camera: 2.2°–61.8° (horizontal);<br>1.3°–36.3° (vertical); 2.4°–69.2° (diagonal)   |

|   |   |
|---|---|
| Iris type                               | Panorama camera: fixed iris<br>PTZ dome camera: automatic iris  |
| Iris control mode                       | Panorama camera: N/A<br>PTZ dome camera: P-iris   |
| Minimum object distance                 | Panorama camera: 1.4 m<br>PTZ dome camera: 0.5–2 m  |
| <b><i>Lens DORI distance</i></b>        |   |
| Panorama camera                         | Detection: 57.9 m   |
|   | Observation: 23.2 m   |
|   | Recognition: 11.6 m   |
|   | Identification: 5.8 m   |
| PTZ dome camera                         | Detection: 3030 m   |
|   | Observation: 1204 m   |
|   | Recognition: 606 m  |
|   | Identification: 303 m   |
| <b><i>PTZ</i></b>                       |   |
| Pan/Tilt range                          | Pan: 0° to 360°<br>Tilt: –11° to +90°; automatic rotation: 180°   |
| Manual control speed                    | Pan: 240°/s<br>Tilt: 100°/s   |
| Speed adjustment on the long-focus lens | Supported   |
| Positioning error                       | Vertical: 0.05° Horizontal: 0.05°   |
| Automatic positioning calibration       | Supported   |
| Remote lens reset                       | Supported   |
| Remote PTZ reset                        | Supported   |
| Maximum number of preset positions      | 300   |
| Automatic tour                          | 8 (a maximum of 32 preset positions for each tour)<br><i>It supports up to 8 automatic tours, with each tour containing a maximum of 32 individual preset positions</i> |
| Automatic tracking                      | 5<br><i>The system has capacity to configure and store up to 5 simultaneous automatic tracking rules or paths</i>   |
| Automatic linear scan                   | 5<br><i>The camera allows operators to configure and save 5 linear scan paths</i>   |
| Power-off memory                        | Supported   |
| Actions during off-peak hours           | Preset position rotation, tracking, tour, and linear scan   |
| Scheduled tasks                         | Preset position rotation, tracking, tour, and linear scan   |
| 3D positioning                          | Supported   |

|                              |  |
|------------------------------|--|
| PTZ rotation limit           | Supported  |
| Azimuth display              | Supported  |
| Information display          | Supported  |
| Time display                 | Supported  |
| PTZ restart                  | Supported  |
| <b>AI</b>                    |  |
| IVS (perimeter detection)    | Tripwire crossing detection, intrusion detection, and parking detection  |
| <b>Video</b>                 |  |
| Video compression format     | H.265, H.264, H.264H, H.264B, and MJPEG (supports only secondary streams)  |
| Intelligent encoding         | H.264<br>H.265   |
| Video frame rate             | Panorama camera:<br>Primary stream: 8192 x 1800 @ 1–25 fps<br>Secondary stream: 2048 x 452 @ 1–25 fps<br>Third stream: 3840 x 832 @ 1–25 fps<br>PTZ dome camera:<br>Primary stream: 2560 x 1440 @ 1–25 fps;<br>secondary stream: 704 x 576 @ 1–25 fps<br>Third stream: 1920 x 1080 @ 1–25 fps  |
| Resolution                   | Panorama camera:<br>Primary stream: 8192 x 1800, 7680 x 1680, 5760 x 1264, 4096 x 900<br>Secondary stream: 2048 x 452<br>Third stream: 3840 x 832, 2560 x 560<br>PTZ dome camera: Primary stream: 2560 x 1440, 1920 x 1080, 1280 x 960, 1280 x 720<br>Secondary stream: 704 x 576, 640 x 480, and 352 x 288<br>Third stream: 1920 x 1080, 1280 x 960, 1280 x 720 |
| Bit rate control             | CBR/VBR  |
| Video bit rate               | Panorama camera: 112 kbit/s to 37227 kbit/s (H.264) or 44 kbit/s to 22546 kbit/s (H.265)<br>PTZ dome camera:<br>512 kbit/s to 13056 kbit/s (H.264) or 204 kbit/s to 7936 kbit/s (H.265)  |
| Backlight compensation (BLC) | Supported  |
| Highlight compensation (HLC) | Supported  |

|  |   |
|--|---|
| Wide dynamic range (WDR)                   | Panorama camera: N/A<br>PTZ dome camera: 120 dB   |
| Scene adaptation (SSA)                     | Supported   |
| White balance                              | Automatic, natural light, streetlamp, outdoor, manual, and custom area                                    |
| Gain control                               | Automatic or manual   |
| Noise reduction                            | 3D noise reduction  |
| Motion detection                           | Enable/Disable (a maximum of four rectangular areas)  |
| Default bit rate at the default resolution | Panorama camera: 6144 kbit/s (8192 x 1800)<br>PTZ dome camera: 6144 kbit/s (2560 x 1440)                  |
| Region of Interest (ROI)                   | Panorama camera: supported (4 ROIs)<br>PTZ dome camera: supported (8 ROIs)                                |
| Image stabilization                        | Panorama camera: N/A<br>PTZ dome camera: electronic image stabilization                                   |
| Defogging                                  | Panorama camera: N/A<br>PTZ dome camera: optical defogging  |
| Image rotation                             | Panorama camera: N/A<br>PTZ dome camera: supported  |
| Privacy mask area                          | Panorama camera: 4<br>PTZ dome camera: 24 (8 for each preset position)                                    |
| <b>Audio</b>                               |   |
| Audio port                                 | Supported   |
| Audio compression format                   | PCM (default), G.711a, G.711Mu, G.726, G.723, G.711a  |
| Audio sampling rate                        | 8 kHz; 16 kHz; 32 kHz; 48 kHz; 64 kHz   |
| <b>Port</b>                                |   |
| RS-485                                     | One (baud rate range: 1200 bit/s to 115,200 bit/s)  |
| Audio-in port                              | 2 (wiring terminal)   |
| Audio-out port                             | 2 (wiring terminal)   |
| Alarm-in port                              | 7 (3–5 V DC, 5 mA)  |
| Alarm-out port                             | 3 (30 V DC, 1000 mA/50 V AC, 500 mA)  |
| Analog-out port                            | 1 (CVBS output: BNC)  |
| <b>Network</b>                             |   |
| Network port                               | RJ45 (10/100/1000 Mbit/s)   |
| SDK and API                                | Supported   |
| Network protocol                           | IPv4, IPv6, HTTP, TCP, UDP, ARP, RTP, RTSP, RTCP, RTMP, SMTP, FTP, SFTP, DHCP, DNS, DDNS, QoS, UPnP, NTP, |

|   |   |
|---|---|
|   | multicast, ICMP, IGMP, NFS, SAMBA, PPPoE, SNMP  |
| Network security                                    | Stream encryption; firmware encryption; configuration encryption; Digest authentication; WSSE; account lock; security log; IP/MAC address filtering; X.509 certificate generation and import; syslog; HTTPS; 802.1X; trusted boot; trusted execution; trusted upgrade |
| Access protocol                                     | ONVIF (Profile S/Profile G/Profile T), CGI, P2P   |
| Maximum number of concurrent video viewing channels | 20 (total bandwidth: 400 Mbit/s)  |
| Storage   | FTP; SFTP; microSD card (up to 512 GB); NAS   |
| <b>Environment</b>                                  |   |
| Operating temperature                               | –40°C to +70°C  |
| Operating humidity                                  | ≤ 95%   |
| IP rating   | IP66  |

## Video Archive Storage

| Description                   | Quantity  |
|-------------------------------|---|
| Disk slot density             | A single 4 U device provides up to 60 main storage disk slots. At least 36 disks are configured per device and can be expanded to 60 disks. |
| Main storage disk capacity    | Uses 7.2k rpm SATA HDDs as the main storage disks. The single-disk capacity is ≥ 10 TB.   |
| Single-node CPU configuration | Each device is configured with ≥ 2 CPUs (≥ 48 cores per CPU, with a CPU frequency of 2.6 GHz).  |
| Erasur e Coding               | Minimum N+2:1 EC redundancy shall be deployed to tolerate two disk failures or one full-node outage and prevent video recording data loss.  |

### Outdoor access switch specification

| Description           | Quantity   |
|-----------------------|--|
| Performance           | Up to 176 Gbps switching capacity  |
| Port Options          | Available with 8, 16, 24, or 48 Downlink GE ports, plus 2 GE SFP or 4 10GE SFP+ uplink ports   |
| PoE Capability        | Supports PoE+ (802.3at)  |
| Industrial Hardened   | IP40 protection  |
| Operating temperature | –40°C to +70°C   |
| Reliability           | Supports 1+1 redundant power supply input and stack capability                                 |
| Management            | Intelligent network O&M with Telemetry and iMaster NCE-CampusInsight for rapid fault detection |
| Networking            | Supports advanced features like ERPS (20ms fast protection) and various Layer 3 protocols      |

### Access switch specification

| Description        | Quantity  |
|--------------------|---|
| Model Variants     | Available in 24 and 48-port configurations  |
| Downlink Ports     | Support for 24/48 x 100M/1/2.5G Base-T or high-speed 100M/1/2.5/5/10G Base-T auto-sensing ports               |
| Uplink Ports       | 4 x 1/10/25GE SFP28 ports and 2 x 40/100GE QSFP28 ports (40GE can split to 4x10GE; 100GE can split to 4x25GE) |
| PoE Capability     | Supports PoE++ (90W) on many models, facilitating direct power for high-demand APs                            |
| Switching Capacity | Up to 2.4 Tbps  |
| Power Supply       | Pluggable power modules, supporting 1+1 or N+1 redundancy, with AC/DC power options                           |
| Virtualization     | Supports VXLAN and BGP EVPN for creating converged, virtualized campus networks                               |

|                |   |
|----------------|---|
| Security       | MACsec support on all ports provides end-to-end (E2E) encryption for high-security environments |
| Operating Temp | –5°C to +45°C   |

### Bullet camera specifications

| Description              | Quantity  |
|--------------------------|---|
| Computing Power          | 2.5 TOPS (Trillions of Operations Per Second)   |
| Imaging Sensor           | 1/1.8" sensor   |
| Lens                     | 2.8–12mm focal length   |
| Resolution               | Can be upgraded to 4MP, 6MP, or 8MP via licensing   |
| AI Capabilities          | Supports behavior analysis, crowd flow analysis, target detection, person detection, object classification (motor vehicles, non-motorized vehicles, pedestrians), and license plate recognition |
| Wide Dynamic Range (WDR) | 130 dB super WDR for balanced lighting in high-contrast environments  |
| Noise Reduction          | AI HNR (HoloWits Noise Reduction) for improved low-light color performance  |
| Encoding                 | SuperCoding2.0, which reduces bit rates by up to 60% compared to standard H.265   |
| Memory                   | 2.0 GB LPDDR4x  |
| Storage                  | NAND FLASH 512.0 MB   |

### Digital Twin specifications

| Description           | Quantity                                   |
|-----------------------|--|
| Digital Twin platform | ≥30 FPS large-scale digital twin rendering |