

# QORTEX DTC A&E Specification



## 1. Manufacturer

### a) Contact

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### b) Compliance

This product shall be manufactured by a corporation whose quality system is certified as compliant with ISO 9001:2015.

## 2. Product Overview

The LiDAR-based solution shall use data intelligence to provide three-dimensional perception and volumetric sensing for the detection, tracking, and classification (DTC) of human objects.

The DTC solution shall enable Internet of Things (IoT) applications in different applications such as security and crowd management, where people movement and analytics are important to monitor.

The DTC solution shall leverage a related user-friendly, software-based toolkit for the discovery, management, and calibration of related LiDAR sensors.

The DTC solution shall comprise several components: LiDARs, license, server software on user-preferred host computer, and client software on user-preferred host computer.

The DTC solution may steer cameras, which are an option that shall be provided by the user, not by the manufacturer.

The system architecture shall deploy in a simple distributed scenario where all DTC solution components connect to the installation site's Ethernet local area network (LAN) via Transmission Control Protocol/Internet Protocol (TCP/IP) using industry-standard equipment.

The DTC Server and DTC Client shall connect to the same LAN in order to access the visualization and alert system and to provide output to any third-party applications that consume the Server's output.

The DTC Server shall receive input from multiple LiDARs that have been calibrated through the toolkit.

The DTC Server shall produce output (object, zone event, and point cloud information) to the customer's own network infrastructure, including VMS systems such as Milestone and Genetec.

## 3. Toolkit.

The toolkit shall be a separate software package that can be leveraged to provide necessary information to be consumed by the DTC solution.

The toolkit shall be packaged as a sophisticated Graphical User Interface (GUI) in an eye-soothing color palette with intuitive tabs, menus, tooltips, and dialog boxes for easy use via mouse and keyboard.

The toolkit shall include an automatic LiDAR discovery engine that shall disclose specific data about the network, the LiDARs on it, and their performance.

A manual search mode shall enable the discovery of a particular LiDAR on the network.

The toolkit shall enable connectivity to the LiDAR with a single click of a mouse button.

Connected LiDARs shall report their model, IP address, serial number, and device number.

The toolkit shall provide intuitive click-through buttons and dialogs for visualizing the collected LiDAR data.

The toolkit shall enable and control simultaneous recordings of data collected by multiple LiDARs.

Pairs of connected LiDARs (or LiDARs whose data was previously recorded) may be selected, aligned, and calibrated to each other when the user responds to a series of simple prompts via mouse and keyboard.

The toolkit shall calibrate multiple LiDARs, pair by pair, until all are aligned to each other to produce a fused single view of the area of interest.

The toolkit shall aid the calibration process by helping snap together the two views of the LiDAR pair, but the user shall fine-tune that alignment with mouse clicks of arrow buttons until the view is adequately fused.

Upon completion, the toolkit shall report "Calibration is done," create a calibration map, and save it in a file, to be consumed by the DTC Server.

## 4. Solution Components

The DTC solution shall comprise several components: LiDARs, license, server software on user-preferred host computer, and client software on user-preferred host computer.

### c) LiDARs

The DTC system shall employ multiple LiDARs. That number shall be determined by the size of the area of interest and the specification of the host computer(s) preferred by the user.

Each LiDAR shall employ lasers at a wavelength of 905 nm, which shall be certified as Class 1 Eye Safe, according to IEC 60825-1.

The LiDARs shall be certified to have met the shock and vibration standard of ETSI EN 300 019-2-5, IEC Class 5M3, and have achieved the certifications and compliances of the FDA, FCC, CE, RoHS, WEEE, IEC-60079-15, and ASTM G154.

Each LiDAR shall perform effectively for use indoors and outdoors in all lighting conditions of broad daylight, ambient light, and complete darkness.

Each LiDAR shall withstand extreme weather from the bitter cold of  $-20^{\circ}\text{C}/-4^{\circ}\text{F}$  when operating, and  $-40^{\circ}\text{C}/-40^{\circ}\text{F}$  when in storage, to the baking sun and heat of  $60^{\circ}\text{C}/140^{\circ}\text{F}$  when operating, and  $105^{\circ}\text{C}/220^{\circ}\text{F}$  when in storage.

Each LiDAR shall keep out weather particulates, operating with a IP69K rating of complete ingress protection from mist, rain, snow, and dust.

Each LiDAR shall be connected to the DTC system via local Ethernet over TCP/IP.

Each LiDAR shall have an output connection of 100/1000 Mbps Ethernet.

To collect the data for creating the point cloud, each LiDAR shall employ 8 detection layers, each of which measures distance to object by the Time of Flight (TOF) technique.

Each LiDAR shall have a horizontal Field of View (FOV) of  $360^{\circ}$ , and a vertical FOV of  $20^{\circ}$  (with the 8 layers evenly distributed from  $+3^{\circ}$  to  $-17^{\circ}$ ).

Each LiDAR shall have a variable update frequency (frame rate) of 5-20 Hz, which shall be set at 10 Hz for the purposes of the DTC solution, and which shall therefore result in an angular resolution of  $0.06^{\circ}$ .

At this 10 Hz frequency, each LiDAR shall have an output rate of 420,000 points per second, based on the DTC solution requirement of 1 return.

Each LiDAR shall occupy dimensions of 103 millimeters in diameter by 87 millimeters in height, with a nominal weight of 900 grams.

Each LiDAR shall require nominal power of 18 watts and an input power source of 24 volts DC  $\pm 1.2$  volts.

#### d) Licenses

The DTC solution shall require a license to operate the DTC Server software. The two license options shall be (1) *Premium*, which permits Pan-Tilt-Zoom<sup>1</sup> (PTZ) camera control, and (2) *Essentials*, which does not permit cameras.

#### e) DTC Server Software on Host Computer

The DTC Server shall provide the backend system that shall accomplish three primary tasks: provide essential functionality, process data, and publish output.

To provide essential functionality the DTC Server shall:

- (After initial bootup/login) restart automatically as needed to provide persistent service.
- Connect to multiple LiDARs by IP address. While the DTC software shall have no limit on the number of sensors, in practice the physical limit shall depend on the current processor speed and available memory.
- Accept commands and parameters (if any) from the remote Client via a shared interface.
- Synchronize to the Client settings file and calibration file (if any) upon initialization.

To process data collected by the LiDARs, the DTC Server's artificial intelligence (AI) algorithms shall via configurable parameters and in real time:

- Collect, timestamp, unify, and format all point cloud data from each LiDAR.
- Cluster and group the points into trackable objects.
- Detect objects of various sizes and shapes up to 100 meters away.
- Track each unique object's historical movements through space and time up to 50 meters away.
- Measure the sizes and velocities of objects in the surveillance area.
- Classify objects up to 50 meters away as human or unknown based on motion, size, and velocity.
- Detect if any active objects are in zones of interest.

To make output from its processing action useable, the DTC Server shall:

- Publish streams of object, zone event, and point cloud data in a serialized format on the local Ethernet network. The streamed object data shall include XYZ coordinates, dimensions, direction, and velocity for all objects in the LiDARs field of view (except for those in exclusion zones).
- Allow the DTC Client software and any number of potential third-party listening applications to consume and subscribe to these published data stream outputs for surveillance or visualization.
- Allow its output to serve as the basis for further action, including the notification of external alarm systems via TCP and HTTP GET. By measuring and providing exact 3D coordinates of humans, DTC Server shall reduce or eliminate false positive threats.

The DTC Server shall be hosted on a Linux® Ubuntu® 16.04 certified computer with the following minimum specifications: an i3 processor with 4 gigabytes of memory for indoor, short-range applications (within an area of 50x50 meters), or an i5 processor with 8 gigabytes of memory for outdoor, long-range applications (beyond an area of 50x50 meters). These configurations may employ a Linux virtual machine

<sup>1</sup> *Pan* is a sideways rotation to scan horizontally. *Tilt* is an up/down movement to scan vertically. *Zoom* is an in/out magnification of the observed frame.

(VM) when the computer hosting the VM has at least 2 core processors and 4096 MB virtual memory. VMware ESXi 6.5 is the recommended VM.

If the DTC Server shall record data, the hard drive shall have at least 20 gigabytes of storage.

#### **f) DTC Client Software on Host Computer**

The DTC Client shall connect to the same Ethernet network as the DTC Server.

The DTC Client shall be a standalone application that consumes and visualizes the streams of data published by the DTC Server as a three-dimensional representation of the object, zone, and point cloud published by the Server.

The DTC Client GUI shall include menus, tooltips, and dialog boxes for easy use via mouse and keyboard, in an eye-soothing color palette.

The DTC Client shall be responsible for posting command and data messages that control the Server's behavior, including messages that define event zones (to heed) and exclusion zones (to ignore), and messages for when to start or stop recording.

The DTC Client shall be hosted on a Linux Ubuntu 16.04 certified computer with the following minimum specifications: an i3 processor with 4 gigabytes of memory, and OpenGL-compliant graphics card such as GeForce 8800 or Radeon 4770. This configuration may employ a Linux VM when the computer hosting the VM has at least 2 core processors and 4096 MB virtual memory. VMware ESXi 6.5 is the recommended VM.

The DTC Client visualizer shall enable the user to employ a mouse to draw two types of zones:

- *Event zones* may be defined for areas of heightened interest that are critically important to protect. If desired, the user shall click through menus to define automated actions for the software and optional PTZ cameras to track particular objects and call attention to suspicious activities before problems occur. Automated actions may be assigned, such as highlighting tracked objects in the visualizer or turning devices (lights, alarms, and so on) on and off through a typed HTTP GET network command.
- *Exclusion zones* may be defined for zero-interest areas that pose no threat, but are visually noisy with flapping flags and vegetation, for example. To preserve resources, the software shall not monitor, collect, visualize, or output points within these zones.

The DTC Client shall consume the calibration file produced through the toolkit, and shall then align the overlapping vision of multiple LiDARs into an enriched fused view of the same space. As a result of this distributed vision, the visualization may detect points from one LiDAR's point of view that are blocked from another LiDAR's view.

The DTC Client visualizer shall display in real time the movement and trail of human-sized objects (appearing as bounded boxes) over time, persisting through blockages and crowd gaps.

#### **h) VMS Client Plug-In**

As an alternative to the DTC Client, users who hold a Premium license for using the DTC Server may integrate a VMS solution seamlessly with the DTC solution.

The DTC solution shall boost the surveillance effectiveness when integrated with major Video Management Systems (VMS) solutions.

The manufacturer of the DTC solution shall offer VMS Client plug-ins to Milestone and Genetec to integrate with existing customer security platforms and enhance object tracking and PTZ camera control.

If compatible, LiDARs that integrate into an existing VMS solution may leverage its existing power and communication infrastructure.

Camera compatibility requirements shall be determined by the particular VMS solution.

## 5. Cameras

The manufacturer shall not provide cameras as part of the DTC solution. However, for users who hold a Premium license for using the DTC Server, cameras they provide may be steered either directly through the DTC Client (or through a VMS Client plug-in, as discussed in section 4h) above).

The DTC solution shall control optionally provided PTZ cameras that are compliant with the global standards set by the Open Network Video Interface Forum (ONVIF), Profile S (for “streaming video”). Such compliance ensures the effective interoperability of security products operating under the Internet Protocol (IP).

The DTC solution shall be a client of ONVIF services and shall support Web Services Security (WSS) digest authentication.

The DTC solution output of an object’s XYZ coordinates, dimensions, direction, and velocity shall inform cameras and enable them to:

- Focus attention on an area of interest.
- Track and zoom to specific objects observed in the surveilled area or in special event zones.
- Lock to the track of one specific object, and stay with it until it is lost.
- Use Genetec or Milestone VMS system for camera integration.

DTC Client software shall provide menus that enable users to control camera-to-object behavior:

- Click and drag a mouse to draw event or exclusion zones.
- Click GUI menu options to enable camera following and to reset camera positioning.
- Control the camera manually by clicking a track to lock a camera’s attention on an object.
- Set up menu-driven rules for when and how long a camera shall focus on an object.

**END OF SPECIFICATION**