CLOSED-CIRCUIT TELEVISION – OPERATIONAL CAMERAS

Intelligent Transport Systems (ITS) Delivery Specification

22 MAY 2023
VERSION 1.0

New Zealand Government

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More information

If you have further queries, contact the Intelligent Transport Systems Standards and Specifications (ITS S&S) team via email: itsspec@nzta.govt.nz

More information about ITS is available on the Waka Kotahi website at https://www.nzta.govt.nz/its

This document is available on the Waka Kotahi website at https://www.nzta.govt.nz/itsspecs

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1 DOCUMENT CONTROL

1.1 Document information

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1.2 Document owner

Role   Head of Technology Engineering

Organisation   Waka Kotahi

1.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
9/03/2023	Endorsed by Technical Standards Committee	Technical Standards Committee	Waka Kotahi
23/03/2023	Recommended by Ratification Group to endorse this document	Ratification Group	Waka Kotahi
24/04/2023	Approved by NMPAS	Delegated approver	Waka Kotahi

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1.4 Version history – major changes

Document version control is the process of tracking and managing different versions (or drafts) of a document to easily identify the current iteration of a file.

This table shows a record of all major (published) versions of this document **(for Waka Kotahi use only)**. To record minor versions (author updates, amendments etc), go to section 9 Full version history.

Version	Date	Updated by	Role and organisation	Reason
0.8	18/10/2022	Gary Nates	Lead author, Beca Ltd	Draft version updated for industry consultation
1.0	24/04/2023	Anandita Pujara	Document Manager, Waka Kotahi	Ratified and approved version released

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2   TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of Waka Kotahi.
FINAL DRAFT (Pending ratification)	The document has been finalised and is pending approval and ratification by Waka Kotahi. It can be used for procurement at this status.
RATIFIED	The document is an official Waka Kotahi document. Waka Kotahi projects and other road controlling authorities connected to Waka Kotahi back-end systems must include this document in the contracts. The obligation to follow the requirements in this document would come from the inclusion of the S&S document in the contract.
RETIRED	The document is obsolete, and/or superseded.
AC	Alternating current
CCTV	Closed-circuit television
dB	Decibels
DC	Direct current
DHCP	Dynamic Host Configuration Protocol
fps	Frames per second
HTTPS	Hypertext Transfer Protocol Secure
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ITS	Intelligent transport system
lux	Luminous intensity
Mb	Megabit
ms	Millisecond
NMPAS	National Manager, Programme and Standards
NTP	Network Time Protocol
ONVIF	Open Network Video Interface Forum
PoE	Power over Ethernet
PTZ	Pan-tilt-zoom (camera)
S&S	Standards and specifications
SCP	Secure Copy Protocol
SFP	Small form-factor pluggable
SFTP	Secure File Transfer Protocol
SNMP	Simple Network Management Protocol

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Term	Definition
SSH	Secure Shell (protocol)
TCP	Transmission Control Protocol
TLS	Transport Layer Security (protocol)
TOC	Transport operations centre
USB	Universal Serial Bus
W	Watts
W/m²	Watts per square metre
WDR	Wide dynamic range

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3   OVERVIEW AND OUTCOMES

This section defines the purpose of the equipment within the operational system.

3.1   Purpose

The purpose of this document is to specify the minimum requirements for the procurement of closed-circuit television (CCTV) cameras used for operational purposes by Waka Kotahi. These cameras are intended to be connected to the Waka Kotahi operations environment and network. The target application of this document is SM031 and SM032 – State highway construction and maintenance contract proforma manuals.

Delivery assurance is managed through a series of delivery specifications that support procurement and systems integration. The specifications are designed to ensure:

i.   the correct equipment is being procured
ii.   the equipment will integrate with operational systems
iii. the equipment will deliver the correct functionality and performance requirements.

3.2   Overview

3.2.1   Definition

CCTV cameras provide transport operation centres (TOCs) with operational visibility of key assets. The type of camera used depends on the functionality requirements:

i.   Pan-tilt-zoom (PTZ) cameras are large, high-quality, high-performance cameras for use on urban and high-volume roading environments. PTZ cameras also have wipers to clear condensation or rain from the lens housing.
ii.   Dome cameras are smaller, cost-effective cameras suited to areas where a full PTZ camera is not required. Dome cameras can be fixed or have PTZ functionality and are intended for shared-use paths or rural roading environments. Dome cameras do not have wipers.
iii. Fixed cameras are high-quality cameras but without PTZ ability.

3.2.2   Waka Kotahi ITS class

Class definitions
006 Cameras. Equipment used to view and capture footage of activity on the transport network.

3.3   Scope

This delivery specification sets out the requirements for the procurement of the following types of CCTV cameras:

i.   PTZ cameras
ii.   dome cameras
iii. fixed cameras.

In general, the contractor shall supply CCTV cameras, camera mounting and appropriate housing as required, in line with this delivery specification.

This delivery specification does not cover web cameras, thermal cameras, infra-red cameras or any other forms of cameras.

3.4 Outcomes

Typical outcomes for operational CCTV cameras are to:

i.   enable TOCs to have operational visibility of the road network and key assets
ii. support incident assessment to allow decision support regarding network conditions
iii. support demand management, especially around queuing and congestion decision support
iv. support optimisation and the systems used to manage them (eg ramp meters, tidal flow systems etc).

3.4.1 Operational

The intended operational outcomes of this delivery specification are to:

i.   ensure the equipment is accessible for use (the reliability of the equipment will ensure that it is out of service for maintenance for very short periods)
ii. provide the ability to view images in varying conditions that are of a high enough quality for situational awareness
iii. ensure the camera is available and operational when required
iv. ensure the camera is compatible with the operations systems used by the TOCs.

3.4.2 For users of the transport network

Operational cameras are intended to provide the TOCs with an operational and safety awareness that allows better decisions to be made that will reduce the impact of events on the transport network.

3.4.3 For road controlling authorities and transport operations centres

Operational awareness of the transport network through CCTV cameras allows management of safety, incidents and demand.

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4 FUNCTIONAL REQUIREMENTS

This section outlines what the equipment and systems need to do (functional), and how they need to do it (non-functional).

4.1 Video image

All cameras must provide the functionality to provide high-quality video images from a range of lighting conditions that may change due to time of day or weather conditions. This may include open-air environments and enclosed tunnel environments.

4.1.1 Resolution

Cameras must provide a density of resolution to display the video image clearly and with an acceptable level of detail for operational requirements.

4.1.1.1 Minimum resolution

Cameras must provide a minimum resolution of 1080 pixels or higher.

4.1.2 Frame rate

Cameras must provide a frame rate that will display a smooth image and allow the tracking of moving vehicles.

4.1.2.1 Minimum frame rate

Cameras must provide a minimum frame rate of 24fps or higher.

4.1.3 Downscaling

Cameras must provide the ability to manually downscale the resolution and frame rate to maintain a sufficient latency and bandwidth.

4.1.3.1 Downscaling resolution range

The camera resolution must be able to be downscaled to 540 pixels or lower.

4.1.3.2 Downscaling frame rate range

The frame rate of the camera must be able to be downscaled to 15fps or lower.

4.1.4 Iris control

The lens must have iris control to maintain the light level as it changes throughout the day.

4.1.4.1 Automatic iris control

Cameras must have automatic iris control.

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4.1.4.2 Manual iris control

Cameras must have the ability to remotely switch to manual iris control.

4.1.5 Wide dynamic range (WDR)

Cameras must display images clearly where the light levels within an image differ significantly.

4.1.5.1 True WDR

Cameras must provide true WDR. Digital WDR is not acceptable.

4.1.5.2 Minimum WDR

Cameras must provide a minimum WDR of 90dB.

4.1.6 Day/night functionality

Cameras must display images clearly in both day- and night-time environments and easily switch between the two environments.

4.1.6.1 Automatic day/night functionality

Cameras must have the ability to switch automatically between day/night functionality.

4.1.6.2 Manual day/night functionality

Cameras must have the ability to switch remotely between day/night functionality.

4.1.7 Illumination

Cameras must display images clearly in low-light environments, including at night-time.

4.1.7.1 Minimum illumination

Cameras must produce a clear image where ambient light levels are at a minimum of 0.7 lux.

4.2 Zoom

4.2.1 Zoom operation

Cameras should provide zoom to enlarge objects beyond the lens focal point.

Fixed cameras do not need to provide zoom operations but must be selected with the correct focal lens to be suitable for its operational purpose.

4.2.1.1 Optical zoom

Cameras must provide a minimum optical zoom of 30x using physical lenses.

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4.2.1.2 Digital zoom

In addition to the optical zoom, cameras must also provide a minimum of 12x digital zoom without distorting the image.

4.2.1.3 Zoom operation response

There shall be a maximum response time of 200ms from when the zoom operation is activated to when the camera begins to zoom.

4.3 Camera movement

Cameras must provide an angular movement in the horizontal plane (pan) and pitch in the vertical plane (tilt).

Fixed cameras do not need to provide camera movement functionality.

4.3.1 Pan operation

To view beyond the camera's angle of coverage in the horizontal plane, cameras must be able to swivel, known as panning. This functionality is actioned remotely.

4.3.1.1 Pan range

Cameras must provide a continuous and endless pan of 360° rotation.

4.3.1.2 Pan speed

Cameras must provide a minimum pan speed of 72° per second (2.5 seconds to pan 180°).

At the end of travel, the camera will come to a soft stop.

4.3.1.3 Pan response

There shall be a maximum response time of 200ms from when the pan operation is activated to when the camera begins to move.

4.3.2 Tilt operation

To view beyond the angle of coverage in the vertical plane, cameras must be able to pitch, known as tilting. This feature is actioned remotely.

4.3.2.1 Tilt range

PTZ cameras must provide +40° (above horizontal) to −90° (below horizontal) of tilt.

Dome cameras must provide +10° (above horizontal) to −90° (below horizontal) of tilt.

4.3.2.2 Tilt speed

Cameras must tilt at a minimum speed of 30° per second (3 seconds to tilt 90°).

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At the end of travel, the camera will come to a soft stop.

4.3.2.3　Tilt response

There shall be a maximum of 200ms response time from when the tilt is activated to when the camera begins to move.

4.3.2.4　Automatic flip image

Cameras need to automatically flip images at the bottom of tilt travel (−90° below horizontal) to prevent the output of an inverted image.

4.3.3　Variable speed functionality

The camera must allow for speed variability depending on the input sensitivity from the operator's controller and also allow for proportional speed based on the level of zoom. This applies to both tilting and panning.

4.3.4　Camera position reporting

Cameras must be capable of displaying the direction the camera is orientated. This should be achieved without the need for calibrating or programming.

4.3.4.1　In-built camera position reporting

Cameras must be able to provide an in-built digital or absolute magnetic compass device to display the direction the camera is orientated. This display should be configurable and be able to be switched off.

4.3.5　Preset positions

A minimum of 15 remotely selectable position presets must be available (one preset entry defines a single XYZ orientation of the camera, including the level of zoom). These presets must be able to be adjusted remotely as required.

4.4　Privacy operations

All cameras must provide the functionality to blur or obscure private property or assets, such as neighbouring buildings.

4.4.1　Privacy zones

All cameras must provide programmable privacy zones, which shall consist of an opaque polygon superimposed over the image to obscure parts of the field of view. The zones should move across the output image as appropriate to keep the desired zone covered as the camera moves and zooms.

4.4.1.1　Minimum number of privacy zones

Each camera must provide a minimum of 12 privacy zones.

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4.5 Water removal from housing lens

PTZ cameras will need a feature to remove the build-up of condensation or rain from the exterior of the housing lens.

4.5.1 Wipers

Cameras must be supplied with integrated wipers as part of the camera housing that can be operated remotely by the TOC video management system.

Functionality such as speed dry or shake off is not an acceptable method of water removal.

Dome and fixed cameras do not need to provide wiper functionality.

4.5.2 Hydrophobic coating

Camera housing lenses may be coated with hydrophobic coating. This may be in addition to the requirements as detailed in section 4.5.1 Wipers.

4.6 Security functions

4.6.1 Username and passwords

All usernames and passwords need to be configurable, including defaults.

Cameras need to allow for the creation of new usernames.

4.6.1.1 Character type

Usernames and passwords need to allow for lower case, upper case, numbers and special characters.

4.6.1.2 Password length

The minimum password length must be 12 characters or more.

4.6.2 Logs

Cameras must provide a record of access logs (to identify each instance that any user has accessed the camera) and fault logs.

4.6.2.1 Timestamps

All logs must be timestamped.

4.6.2.2 Source IP address

All access logs must include the source Internet Protocol (IP) address.

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4.6.2.3   Authentication

All access logs must include whether the authentication was successful or not.

4.6.2.4   Log retention

Logs should be stored for at least three months before being deleted.

4.6.3   Time synchronisation

Cameras must allow time synchronisation through Network Time Protocol (NTP) servers.

4.6.3.1   NTP servers

Cameras must be able to be configured with three NTP servers, as a minimum.

4.6.4   Firmware updates

Cameras must allow for firmware updates remotely and not rely on updates by physical means (eg the use of a Universal Serial Bus (USB) flash drive or direct laptop connection).

4.6.4.1   Firmware rollback

Cameras must allow for roll back to the last previous version (n−1) as a minimum.

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5 PERFORMANCE REQUIREMENTS

This section outlines the reliability and availability requirements of equipment, which may require independent certification and/or declarations of conformity.

5.1 Operational life

Cameras shall be designed with a minimum operational life of not less than six years without degradation of performance quality.

5.2 External protection to dust and moisture

To prevent cameras from exposure to dust and water, camera housing shall provide a minimum IP66 ingress protection based on IEC 60529:1989+AMD1:1999+AMD2:2013 *Degrees of protection provided by enclosures (IP code)*.

5.3 Resistance to the effects of external conditions

The operating environment of cameras can be relatively harsh. Equipment that is deemed fit for purpose is expected to continue to operate effectively exposed to the New Zealand environment. It is essential that materials and manufacturing processes take this into account.

Cameras shall be capable of continuous, normal operation (24 hours, seven days per week) and maintaining performance criteria in the conditions described below:

i.   installed and operated in direct sunlight
ii.   ambient temperature range between −25°C and +55°C
iii. solar radiation with a value of up to 2000W/m² at direct sunlight, incident at an angle of 30° from the vertical
iv.   altitude up to 1000m
v.   humidity between +10% and +90% non-condensing
vi.   conditions, both permanent and temporary, that may be unique to the specified location, eg instances of thick smoke and electromagnetic interference
vii. vibrations expected in the installed location
viii. marine environment.

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6 TECHNICAL REQUIREMENTS

This section outlines specific technical and physical constraints for the equipment.

6.1 General

Cameras must be digital IP cameras.

6.2 Electrical requirements

6.2.1 Electrical supply

Cameras must be able to be powered by either:

i.   alternating current (AC)
ii. direct current (DC).

Cameras may be powered by Power over Ethernet (PoE). PoE should be in addition to either AC or DC.

6.2.1.1 PoE standards

PoE should meet one of the standards listed below in Table 1, based on the power requirements of the camera.

Power requirement	PoE standard
up to 15W	IEEE 802.3af-2003 IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications – Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI)
up to 30W	IEEE 802.3at-2009 IEEE Standard for Information Technology – Local and Metropolitan Area Networks – Specific Requirements – Part 3: CSMA/CD Access Method and Physical Layer Specifications Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements
up to 90W	IEEE 802.3bt-2018 IEEE Standard for Ethernet Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 Pairs

Table 1. Power over Ethernet (PoE) standards

6.3 System integration

6.3.1 Camera protocol support

Cameras must be listed as compliant under the Open Network Video Interface Forum (ONVIF) Profile S Specification v1.3 protocol. The camera manufacturer must be a member of the ONVIF alliance.

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6.3.2 Codecs

Cameras must provide video streaming codecs that meet the ONVIF Profile S Specification v1.3 protocol.

6.3.3 TCP/IP protocols

Cameras must:

i.   be Transmission Control Protocol/Internet Protocol (TCP/IP) network capable
ii. support Dynamic Host Configuration Protocol (DHCP) for IP address assignment.

6.3.4 HTTPS and SSH protocols

Cameras must provide Hypertext Transfer Protocol Secure (HTTPS) and Secure Shell (SSH) protocol.

6.3.5 SNMP

Cameras that use Simple Network Management Protocol (SNMP) must provide SNMPv3.

6.3.6 Network connectivity

Cameras must have the ability to be connected using:

i.   RJ45 copper Ethernet, with a minimum of 100Mb per second (required for all cameras)
ii. small form-factor pluggable (SFP) module (optional).

6.3.7 Unicast and multicast

All cameras must be able to provide full functionality in a unicast-only network environment.

Cameras may provide multicast, but this is not required.

6.4   Security requirements

In addition, cameras must meet the following security requirements:

i.   Secure protocols – Any CCTV camera or system to be used within Waka Kotahi must be capable of using secure protocols like SSH, HTTPS, SNMPv3, Transport Layer Security (TLS) v1.2, and 802.1x port security.
ii. Access management – All CCTV cameras and systems must be capable of complying with Waka Kotahi password criteria (upper case, lower case, special characters, numbers, and long string passwords).
iii. Logging – All CCTV cameras and systems must have the ability to provide access and event logs for security visibility.
iv. Vulnerability management – All CCTV cameras and systems must be supported with software updates for known vulnerabilities and bugs.
v.   Access control – All CCTV cameras and systems must have management access filtering based on source IP addresses.
vi. Secure transfer – All CCTV cameras and systems must have the capability to do secure backup using secure protocols like Secure Copy Protocol (SCP), Secure File Transfer Protocol (SFTP), etc.

6.5 Documentation, software and licensing

6.5.1 Documentation

Camera vendors must supply original equipment manufacturer maintenance, service and operations guidelines and manuals, which will include maintenance schedules and procedures, handling and storage instructions, and a spares list.

6.5.2 Software and licensing

Camera vendors must supply all software and licensing required to configure and manage the CCTV to Waka Kotahi or its agent(s).

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7 REFERENCES

This section lists all external and Waka Kotahi references included in this document.

7.1 Industry standards

Standard number/name	Source	Licence type and conditions
IEC 60529:1989+AMD1:1999+AMD2:2013 Degrees of protection provided by enclosures (IP code)	IEC webstore	Available for purchase
IEEE 802.3af-2003 IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications – Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI)	IEEE Standards Association website	Available for purchase
IEEE 802.3at-2009 IEEE Standard for Information Technology – Local and Metropolitan Area Networks – Specific Requirements – Part 3: CSMA/CD Access Method and Physical Layer Specifications Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements	IEEE Standards Association website	Available for purchase
IEEE 802.3bt-2018 IEEE Standard for Ethernet Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 Pairs	IEEE Standards Association website	Available for purchase
ONVIF Profile S Specification (v1.3 November 2019)	ONVIF website	Publicly available

7.2 Waka Kotahi standards, specifications and resources

7.2.1 Standards and specifications

See the Waka Kotahi website for the latest versions of the ITS design standards, delivery specifications and core requirements listed below.

Document name

7.2.2 Resources

Document name/code	Waka Kotahi website link

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7.3   ITS standard drawings

See the Waka Kotahi website for the latest versions of the ITS standard drawings listed below.

Drawing number

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8 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class

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9   FULL VERSION HISTORY

This table shows the full history of changes made to this document, both minor and major, in chronological order, since the document was first authored.

Minor versions are numbered 0.1, 0.2 etc until such point as the document is approved and published, then it becomes 1.0 (major version). Subsequent edited versions become 1.1, 1.2 etc, or if it's a major update 2.0, and so on.

Version	Date	Author	Role and organisation	Reason
0.1	09/11/2021	Gary Nates	Lead author, Beca Ltd	Draft for Waka Kotahi Expert Panel
0.2	07/12/2021	Final Word	Editorial services	Proofread latest version
0.3	16/03/2022	Gary Nates	Lead author, Beca Ltd	Draft response to Expert Panel workshop
0.4	05/04/2022	Final Word	Editorial services	Proofread latest version
0.5	12/04/2022	Gary Nates	Lead author, Beca Ltd	Response to Final Word comments
0.6	19/04/2022	Final Word	Editorial services	Further queries for author and ITS Working Group
0.7	06/05/2022	Gary Nates	Lead author, Beca Ltd	Response to Final Word comments
0.8	18/10/2022	Gary Nates	Lead author, Beca Ltd	Response to RCA and Security comments
0.9	10/02/2023	Gary Nates	Lead author, Beca Ltd	Response to Industry briefing
0.10	15/02/2023	Matthew Bauer	Editor, Clear Edit NZ	Copyedit
0.11	17/02/2023	Gary Nates	Lead author, Beca Ltd	Response to editorial service
0.12	22/02/2023	Matthew Bauer	Editor, Clear Edit NZ	Proofread
0.13	9/03/2023	Anandita Pujara	Document Manager, Waka Kotahi	Updates as per security and Technical Standard Committee comments
0.14	18/05/2023	Matthew Bauer	Editor, Clear Edit NZ	Proofread
1.0	22/05/2023	Anandita Pujara	Document Manager, Waka Kotahi	Released final approved version 1.0

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