PROCESS, INSTRUMENTATION AND CONTROLS

Operational Technology Environment Data Cabling Standard

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Watercare

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More information
If you have further queries, please contact the **Digital Control Systems** team at: DigitalControlSystems@water.co.nz

DOCUMENT CONTROL

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Version	Description of revision	Released by	Date
1.0	First release	W Strydom	3/12/2024

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1. Purpose

1.1 Background

1.1.1 Objectives

The objectives of this standard are to ensure the following for the Watercare's operational technology (OT) environment:

- Ethernet data cabling infrastructure solutions are fit for purpose and maintainable.
- Ethernet data cabling infrastructure solutions follow a defined pattern, simplifying the overall support of Watercare's OT communications infrastructure solutions.
- Visual inspection of Ethernet data cabling infrastructure components allows easy identification of key characteristics (i.e. asset name, cable type, cable source and destination, etc).
- Reduced risk to site operations by allowing clear identification of cabling paths and reducing the requirement for physical cable tracing.
- Provide guidance to project design, procurement and installation decisions to ensure alignment with the above.

1.1.2 Audience

Watercare staff, contractors or third-party suppliers responsible for specifying, designing and/or installing Ethernet data cabling solutions for use within Watercare's OT environment.

1.1.3 Scope

Specification and installation of fibre optic and copper Ethernet data cabling infrastructure solutions for Watercare's OT environment (control environment), including:

- Control networks.
- Field (aka Plant, aka IO, aka PLC) networks.
- DeltaV ACN networks.

1.1.4 Out of Scope

This standard is not intended to cover any of the following:

- Watercare data centre environments.
- Any other type of cabling within the control environment other than fibre optic (single-mode [SMF] and multi-mode [MMF]) or copper (unshielded twisted pair [UTP] and shielded twisted pair [STP]).
- Watercare's corporate network environment.

1.2 Compliance requirements

Compliance with this standard is required when specifying, designing, and/or during the installation of ethernet data cabling solutions in Watercare's OT environment.

Exceptions to this standard are permitted only in the following circumstances:

- Development and test equipment.
- Vendor owned infrastructure not managed by Watercare.

Requests for validation of exceptions shall be confirmed with Watercare's **Digital Control Systems** team at: DigitalControlSystems@water.co.nz.

1.3 Supporting documentation

This document shall be read in conjunction with Watercare's Data and Asset information Standard.

1.4 Abbreviations

***Table 1**: Glossary*

Term	Meaning
OT (Operational Technology)	Hardware and software that detects or causes a change, through the direct monitoring and/or control of industrial equipment, assets, processes and events.
Control Network	Data networks that provide SCADA, data acquisition or remote operator communications required for visibility and/or manual control of an operational process / asset.
Field	Data networks that provide machine-to-machine process control communications required for automated control of an operational process / asset.
DeltaV	Emerson's Distributed Control System (DSC).
ACN (Area Control Network)	DeltaV's redundant Field networks.
STP	Shielded Twisted Pair ethernet data cable, which includes an earthed shield to provide protection against interference.
UTP	Unshielded Twisted Pair ethernet data cable.
SMF	Single-mode optical fibre cable. OS1 and OS2 are variants of SMF with different attenuation and therefore transmission capabilities.
MMF	Multi-mode optical fibre cable. OM1 through OM5 are variants of MMF with different attenuation

2. Overarching Principles

2.1 Component Overview

The following diagram provides an overview of the data cabling infrastructure components that are relevant to this standard.

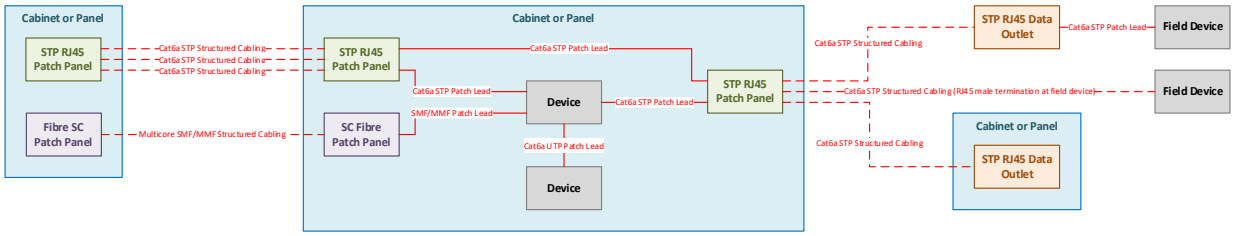


***Figure 1**: Data Cabling Infrastructure Component Overview*

2.2 Ethernet Data Cabling Specification and Design

1. Where Ethernet data cabling leaves a cabinet, it must use structured cabling.

   ***NOTE:** Where cabinets are immediately adjacent and a path for cabling exists through the adjacent cabinet sides (no cabinet walls or penetrations through walls) the use of patch cables run between these cabinets is permitted.*

2. Where Ethernet data cabling is local to (i.e. "within") a cabinet it will use a patch cable.

3. Where copper Ethernet data cabling leaves a cabinet, it must use STP cabling, with one end earthed at a cabinet using local a protected earth rail.

4. An individual instance of a patch panel should only be used to terminate one type of cabling (i.e. STP or UTP or SMF or MMF).

5. Cable management should be used in the following situations.

   a. <u>Communications Cabinet (19-inch rail mounted equipment):</u>

      i. A horizontal cable management bar should be installed immediately above or below any network switch or patch panel.

      ii. For items with a high interface density (> 24 interfaces) a horizontal cable management bar should be installed above and below the equipment.

      iii. Multiple cable management rings should be installed on the outside of the 19 rails for vertical cable management.

   b. <u>Field Cabinets (DIN rail mounted equipment):</u>

      i. Slotted and capped wire ducting should be installed both horizontally and vertically as required to provide a secured path for all data cabling within the cabinet.

ii. The ducting should be appropriately sized to allow the capping to be secured along the entire length with all required cabling inside.

6. All cabling components (cables, patch leads, patch panels and data outlets) must have a unique identifier.

7. The unique identifier of all cabling components is derived from an associated cabinet.

2.3 Ethernet Data Cabling Installation

1. The following cabling components **must** have a physical label:
    a. Cables
    b. Patch panels
    c. Data outlets
2. The following cabling components **may** have a physical label:
    a. Patch leads

3. Architectural Context

This standard covers the following networks:

- **Control Networks:** Data networks that provide SCADA, data acquisition or remote operator communications required for visibility and/or manual control of an operational process / asset (treatment plant, transmission pump station, etc).
- **Field Networks:** Data networks that provide machine-to-machine process control communications required for automated control of an operational process / asset (treatment plant, transmission pump station, etc).
- **DeltaV ACN (Area Control Network):** A specific instance of redundant primary / secondary Field networks for the Emerson DeltaV distributed control system

4. OT Environment Data Cabling Standard

4.1 Specification and Design

***Table 2**: Data Cabling Specification & Design*

Component	Equipment Name	WSL Asset	Examples	Form Factors
Structured Cabling	<Source Cabinet with dashes removed>-<Destination Cabinet with dashes removed>-<Type Code><Instance> <Source Cabinet with dashes removed>-<Destination Device>-<Type Code><Instance> *<u>Type Code Options:</u>* • *S = signal / data cable*	Fibre cabling = Yes Copper cabling = No	01FCAB011-01FCAB012-S01 *The first instance of a data cable that runs between 01-FCAB-011 and 01-FCAB-012* 01FCABX01-45PU43VSD431-S01 *The first instance of a data cable that runs between 01-FCAB-X01 and the VSD 45-PU43-VSD431*	• Cat6a STP (shielded twisted pair) copper data cabling • OM3 / OM4 / OM5 Multi-mode multicore fibre cable • OM1 / OM2 Multi-mode multicore fibre cable ***NOTE:** only if required to integrate with existing legacy cabling* • OS2 Single-mode multicore fibre cable • OS1 Single-mode multicore fibre cable ***NOTE:** only if required to integrate with existing legacy cabling*

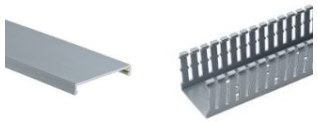
Component	Equipment Name	WSL Asset	Examples	Form Factors
Patch Panel – Fibre	01-FOP-<Process Area><Cabinet Instance><Patch Panel Instance within Cabinet>	Yes	01-FOP-X012 *The second fibre patch panel in control (01) cabinet 01-FCAB-X01*	• 19-inch mounted fibre patch panel with 'SC female' connectors.  ***Example:*** *AFL Fibre Optic Enclosures (https://www.aflglobal.com/en/au/Products/Fibre-Enclosure-Racks/Rackmount-Enclosures/FRE-Sliding-Enclosure1RU-2RU-3RU)* • DIN rail mounted fibre patch panel with 'SC female' connectors.  ***Example:*** *AFL Mini DIN Rail Mounted Enclosures (https://www.aflglobal.com/en/au/Products/Fibre-Enclosure-Racks/Industrial-DIN-Rail-Mounted-Enclosures/Mini-DIN-Rail-Mounted-Enclosure)*

Component	Equipment Name	WSL Asset	Examples	Form Factors
Patch Panel - Copper	01-CPP-<Process Area><Cabinet Instance><Patch Panel Instance within Cabinet>	Yes	01-CPP-4811 *The first copper patch panel in UV (48) cabinet 01-FCAB-481*	• 19 inch mounted copper patch panel with 'RJ45 female' connectors  ***Example:*** *Panduit Cat 6 Punchdown Patch Panel, 24 Ports, 1 RU, Black (https://www.panduit.com/en/products/copper-systems/patch-panels-accessories/populated-patch-panels/dp24688tgy.html)* • DIN rail mounted copper patch panel with 'RJ45 female' connectors  ***Example:*** *Panduit Mini-Com® 8-port DIN Rail Shielded Patch Panel (https://www.panduit.com/en/products/copper-systems/industrial-copper-systems/industrial-copper-faceplates-outlets-panels/cdpp8rg-s.html)*

Component	Equipment Name	WSL Asset	Examples	Form Factors
Data Outlet – Copper	Not assigned	No	n/a	• Wall mounted data outlet  • DIN rail mounted data outlet  ***Example:*** *LAPP EPIC® Rail mount adapter with RJ45 coupler (https://products.lappgroup.com/online-catalogue/data-communication-systems-for-ethernet-technology/industrial-ethernet-cat6a/rj45-connectors/epic-data-hs-rj45f-cat6a.html)* • Direct STP cable terminated as male RJ45 connector 

Component	Equipment Name	WSL Asset	Examples	Form Factors

Patch Lead	<Cabinet with dashes removed>-<Network Type>-<Instance>
	
	<u>Network Type Options:</u>
	• *C = Control Network*
	• *F = Field Network*
	• *AA = DeltaV ACN Primary*
	• *AB = DeltaV ACN Secondary*
		No	01FCAB011-AA-1
			
			The first instance of a DeltaV primary ACN network patch lead within control (01) DCS cabinet 01-FCAB-011
				• STP/UTP Patch Leads with RJ45 male connector
				  ○ Blue (Control Network)
				  ○ White (Field Network)
				  ○ Orange (DeltaV ACN Primary)
				  ○ Grey (DeltaV ACN Secondary)
				  ○ Yellow (Uplink / Critical Link)
				  ○ Red (Cross Over Cable)
				
				• Multi-mode Fibre Patch Leads with SC male connector
				  ○ OM5 (Lime Green)
				  ○ OM3 / OM4 (Aqua Blue)
				  ○ OM2 (Orange)
				  ○ OM1 (Orange)
				
				• Single-mode Fibre Patch Leads with SC male connector
				  ○ OS1/OS2 (Yellow)

Component	Equipment Name	WSL Asset	Examples	Form Factors
Cable Management	Not assigned	No	n/a	• 19-inch rail mounted horizontal cable management bar.  ***Example:*** *Panduit Wiring Duct & Duct Covers (https://www.aflhyperscale.com/products/cable-management-bars/)* • Slotted and capped Wire ducting  ***Example:*** *Panduit Wiring Duct & Duct Covers (https://www.panduit.com/en/products/wire-routing-management-protection/wiring-duct-accessories/wiring-duct-duct-covers.html)*

4.2 Installation – Physical Labelling

***Table 3**: Data Cabling Installation – Physical Labelling*

Component	Physical Label	Examples	Physical Labelling Specifications
Cabinet or Panel	<Equipment Name>	01-FCAB-X01 *The a general control systems cabinet (01) at a facility* 01-FCAB-451 *The first instance of an ASR specific (45) control systems cabinet at a facility*	• Printed or laser engraved adhesive label located on the body or door of the cabinet. • Identical labels front of cabinet and rear of cabinet (unless wall mounted). • Where possible, ensure the cabinet label is still visible when the is door open. ***Example:** Phoenix Contact Adhesive Plastic Label (https://www.phoenixcontact.com/en-nz/products/marking-material/equipment-marking)*   ***Example:** Laser Engraved Adhesive Label (https://www.laserin.co.nz/)*
Structured Cabling	<Equipment Name> [<Cable Type>] *<u>Cable Type Options:</u>* • *STP = Shielded twisted pair copper* • *UTP = Unshielded twisted pair copper* • *MMF = Multi-mode fibre* • *SMF = Single-mode fibre*	01FCAB011-01FCAB012-S01 [MMF] *The first instance of a multi-mode fibre cable that runs between 01-FCAB-011 and 01-FCAB-012*	• Printed label secured (sleeve, cable-tie, etc) to cable. • Identical labels to be attached on either end of cable. ***Example:** Phoenix Contact Cable Marker (https://www.phoenixcontact.com/en-nz/products/marking-material/conductor-and-cable-marking)* 

Component	Physical Label	Examples	Physical Labelling Specifications
Patch Panel – Fibre	**Patch Panel Label** <Equipment Name> [<Cable Type>] *<u>Cable Type Options:</u>* • *MMF = Multi-mode fibre* • *SMF = Single-mode fibre*	01-FOP-X032 [MMF] *Second patch panel in 01-FCAB-X03 terminating multi-mode fibre cabling*	• Printed adhesive label located on front of patch panel ***Example:*** *Phoenix Contact Adhesive Plastic Label (https://www.phoenixcontact.com/en-nz/products/marking-material/equipment-marking)*  ***Example:*** *Brother Laminated Tze Tape (https://www.brother.co.nz/supplies/tapes-and-labels)*
	Patch Panel Port Label Uses the connected multicore cable number plus fibre cores: <Source Cabinet with dashes removed>-<Destination Cabinet with dashes removed>-<Type Code><Instance><cores>	01FCAB011-01FCAB013-S01-13/14 *A fibre patch panel port within cabinet 01-FOP-011 that is connected to cores 13 and 14 of the first instance of a multi-core fibre cable to cabinet 01-FOP-013*	• Printed label adhesive label located next to patch panel port ***Example:*** *Phoenix Contact Adhesive Plastic Label (https://www.phoenixcontact.com/en-nz/products/marking-material/equipment-marking)*  ***Example:*** *Brother Laminated Tze Tape (https://www.brother.co.nz/supplies/tapes-and-labels)*
Patch Panel – Copper	**Patch Panel Label** <Equipment Name> [<Cable Type>] *<u>Cable Type Options:</u>* • *STP = Shielded twisted pair copper* • *UTP = Unshielded twisted pair copper*	01-CPP-X022 [UTP] *Second patch panel in 01-FCAB-X02 terminating UTP cabling*	• Adhesive label located on front of patch panel ***Example:*** *Phoenix Contact Adhesive Plastic Label (https://www.phoenixcontact.com/en-nz/products/marking-material/equipment-marking)*  ***Example:*** *Brother Laminated Tze Tape (https://www.brother.co.nz/supplies/tapes-and-labels)*

Component	Physical Label	Examples	Physical Labelling Specifications
	Patch Panel Port Label Uses the connected cable number: <Source Cabinet with dashes removed>-<Destination Cabinet with dashes removed>-<Type Code><Instance>	01FCAB011-01FCAB012-S01 *The first instance of a copper patch panel port within cabinet 01-FCAB-011 that is cabled to a copper data outlet within cabinet 01-FCAB-012* 01FCABX02-01FCABX04-S06 *The sixth instance of a copper patch panel port within cabinet 01-FCAB-X02 that is cabled to a copper patch panel within cabinet 01-FCAB-X04* 01FCAB013-45PU43VSD431-S01 *The first instance of a copper patch panel port within cabinet 01-FCAB-013 that is cabled to a VSD 45-PU43-VSD431* 01FCABX02-ControlRoom-S02 *The second instance of a copper patch panel port within cabinet 01-FCAB-X02 that is cabled to a copper data outlet in the Control Room*	• Adhesive label located next to patch panel port ***Example:*** *Phoenix Contact Adhesive Plastic Label (https://www.phoenixcontact.com/en-nz/products/marking-material/equipment-marking)*  ***Example:*** *Brother Laminated Tze Tape (https://www.brother.co.nz/supplies/tapes-and-labels)*
Data Outlet - Copper	**Patch Panel Port Label** Uses the connected cable number: <Source Cabinet with dashes removed>-<Destination Cabinet with dashes removed>-<Type Code><Instance>	01FCABX01-01FCABX02-S01 *The first instance of a copper data outlet within cabinet 01-FCAB-X02 that is cabled to a copper patch panel within cabinet 01-FCAB-X01* 01FCAB011-ControlRoom-S03 *The third instance of a copper data outlet within the Control Room that is cabled to a copper patch panel within cabinet 01-FCAB-011*	• Adhesive label located next to data outlet port ***Example:*** *Phoenix Contact Adhesive Plastic Label (https://www.phoenixcontact.com/en-nz/products/marking-material/equipment-marking)*  ***Example:*** *Brother Laminated Tze Tape (https://www.brother.co.nz/supplies/tapes-and-labels)*

Component	Physical Label	Examples	Physical Labelling Specifications
Patch Lead	<Equipment Name>	05FCAB012-C-7 *The seventh instance of a Control network patch lead within cabinet 05-FCAB-012*	• Printed label secured (sleeve, cable-tie, etc) to cable. • Optional. • Identical labels to be attached on either end of each patch lead. ***Example:*** *Phoenix Contact Cable Marker (https://www.phoenixcontact.com/en-nz/products/marking-material/conductor-and-cable-marking)*  ***Example:*** *Phoenix Contact Conductor Marker (https://www.phoenixcontact.com/en-nz/products/marking-material/conductor-and-cable-marking)*