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Standard Technical Architecture for Shipboard Computer Systems

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Standard

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STA FOR SHIPBOARD COMPUTER SYSTEMS STANDARD

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Document Management

1. Authority

This document is issued by the Director General, Integrated Technical Services (ITS), Canadian Coast Guard's National Technical Authority, under delegation from the Deputy Minister, Fisheries and Oceans Canada, and the Commissioner of the Canadian Coast Guard (CCG).

2. Responsibility

a) The Director, Engineering Services is responsible for:

i) creating and promulgating the document; and

ii) identifying an Office of Primary Interest (OPI) who is responsible for the coordination and the content of the document.

b) The OPI is responsible for:

i) verifying the validity and accuracy of the content;

ii) ensuring the availability of this information;

iii) updating the information as needed;

iv) reviewing this document on a regular basis; and

v) following up all requests, comments, or suggestions.

3. Inquiries or Revision Requests

All inquiries regarding this document, including suggestions for revision and requests for interpretation, shall be addressed to the OPI:

Position Title: Manager, Engineering Services Electronics
Address: Fisheries and Oceans Canada – Canadian Coast Guard
200 Kent Street, 7th Floor
Ottawa, Ontario
K1A 0E6

All requests should:

i) be clear and concise; and

ii) reference the specific chapter, section, figure, or table.

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Foreword

1. Purpose

This document, *Standard Technical Architecture for Shipboard Computer Systems*, defines the technical requirements for computer systems and networks onboard Department of Fisheries and Oceans/Canadian Coast Guard vessels, as well as the standards with which these computer systems and networks must comply. The Standard Technical Architecture (STA, or the Standard) should be used in conjunction with the applicable documents and referenced standards specified in this document.

2. Scope

This Standard provides details of the computer and networking equipment, network architecture, software, fibre-optic, and copper cabling requirements for shipboard computer systems and networks. It specifies the criteria to follow for the procurement and installation of new equipment and cabling, for upgrades to existing equipment and cabling, and for assessments of the compliance of current equipment and cabling onboard Canadian Coast Guard vessels.

3. Notice to Users

Because of the rapidly changing nature of information technology, this Standard is subject to frequent revisions. Any inquiries, corrections, or suggestions should be forwarded to the Technical Authority identified in the section *Document Management*.

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Chapter 1 THE USE OF STANDARDS

This chapter provides information on the use of standards within the Standard Technical Architecture (STA) and other general information.

1.1 RELATED POLICIES AND DOCUMENTATION

The requirements within this document are fully compatible with the policies for STAs and other related policies promulgated by Treasury Board, Transport Canada, and CCG.

1.2 STANDARDS

1.2.1 General

Throughout this document, references are made, both directly and indirectly, to international, national, and corporate standards and guidelines (listed in Annex A). These standards and guidelines are henceforth referred to as standards in this document. Where appropriate, specific standards are reproduced in this document to clarify how to apply them.

The standards listed in Section 1.2.2 apply to all subsequent chapters, as they form the primary specifications for ship safety or construction, or both.

Mandatory requirements are identified by the words ***must***, ***shall***, and ***will***. All mandatory requirements ***must*** be satisfied. Desirable requirements are identified by the words ***should*** and ***may***. Desirable requirements should be satisfied whenever possible.

1.2.2 Precedence of Standards

The precedence of standards within this document and the standards in use within CCG are as follows:

1) contract documents that reference this Standard;

2) detailed installation specifications or ship's specifications;

3) all regulations concerning ship safety or construction or both, including:

   a) Ships Electrical Standards (TP 127 E, available at http://www.tc.gc.ca/MarineSafety/TP/Tp127/menu.htm);

   b) Regulations under the Canada Shipping Act; and

   c) International Maritime Organization (IMO) regulations.

4) CCG Specification for the Installation of Shipboard Electronic Equipment (70-000-000-EU-JA-001, available from the CCG Technical Authority;

5) test instructions from the equipment manufacturer; and

6) installation instructions from the equipment manufacturer.

1.2.3 Conflicts between Standards

For upgrades to existing networks or new installations, any perceived conflicts in requirements between standards are to be brought to the attention of the OPI (refer to the *Document Management* section).

Chapter 2 COMPUTER EQUIPMENT SPECIFICATIONS

This chapter presents specifications for the hardware components onboard CCG vessels. These specifications cover hardware standards, tests and acceptance procedures, environmental requirements, and the installation of computers and monitors.

2.1 HARDWARE COMPONENTS

2.1.1 Local Area Network

New shipboard Local Area Network (LAN) installations shall use 1 Gigabit per second (Gbps) Ethernet or 10 Gbps Ethernet as the network backbone. One Gbps Ethernet shall be implemented using either fibre-optic cabling (IEEE 802.3 standard) or copper cabling (IEEE 802.3 standard). For workstations or other network devices, such as printers, the IEEE 802.3 standard for 1 Gbps Ethernet or Fast Ethernet (100 Megabits per second [Mbps]) will be consulted for interconnection to Ethernet switches. Workstation links shall be implemented using either fibre-optic cabling or copper cabling.

2.1.2 Shipboard Workstation – Fixed/Desktop Personal Computer

This workstation shall be a permanently fitted desktop personal computer (PC) connected to the LAN. The minimum specifications of the desktop computer to be used onboard CCG vessels are described in Annex B.

2.1.3 Shipboard Workstation – Portable/Notebook Computer

This workstation shall be a portable/notebook computer connected to the LAN. The minimum specifications of the portable/notebook computer to be used onboard CCG vessels are described in Annex C.

2.1.4 Shipboard Workstation – Standalone PC

If requirements dictate that certain CCG vessels will not host a LAN or that a workstation requires isolation from the existing shipboard network, a standalone computer may be used to provide a standalone computing environment. The minimum specifications of the standalone PC to be used onboard CCG vessels are described in Annex D.

2.1.5 Shipboard Server

The functional requirements of the shipboard network will determine the number of servers required. A server with a rack-mount chassis/form-factor shall be provided and mounted in a standard shipboard 19" rack. The hardware required to fit all server-related equipment into the rack (cable management rails, equipment rails, etc.) shall also be provided. The rack shall comply with EIA/ECA-310 for internal dimensions and mounting hole spacing. The specifications of the server that shall be used onboard CCG vessels are described in Annex E.

2.1.6 Hardware Spares

Maintaining a supply of hardware spares may be necessary to handle any hardware failures that occur. A list of recommended hardware spares is included in Annex F. The acquisition of hardware spares is at the discretion of the regional Technical Authority (TA).

2.1.7 Shipboard Back-up System

The LAN shall be equipped with a Wide Ultra 3 Small Computer System Interface (SCSI), Ultra 320 SCSI, or 2 Gbps fibre channel tape back-up system to facilitate the automatic back-up and restore of the server operating system, as well as application and user data. This tape back-up system shall be either an internal unit on a shipboard server or an external unit connected via a SCSI or fibre connection to a server. The tape media technology shall be selected based on the estimated amount of data that will be stored on the server, as well as the desired back-up speed.

2.1.8 Shipboard Uninterruptible Power Supply

A marine-grade Uninterruptible Power Supply (UPS) shall be used to protect the server(s), along with all related server and network equipment. The server(s) will be configured to communicate with the UPS to ensure that, in the event of a power failure, the server(s) will perform a graceful shutdown, minimizing the possibility of data corruption.

A marine-grade UPS shall conform to the requirements specified in Section 3.2.8.

2.2 HARDWARE STANDARDS

All hardware should be proven Commercial Off-the-Shelf (COTS) equipment that offers a good performance-to-price ratio. In general, it should be the technology most commonly used in industry and government. This approach should ensure that there is commercial support for the hardware, including spare parts, for the foreseeable future.

2.2.1 Industry Standard Hardware

All hardware and hardware components shall conform to accepted industry standards for computer and networking equipment. For example, all computer Network Interface Cards (NICs) shall be compatible with the Peripheral Connection Interface (PCI) computer bus standard defined by PCI-SIG.

2.2.2 Software/Hardware Compatibility

Software must operate as expected on the hardware system. Expected results are defined by the software documentation, as well as by how the product operates on other industry-standard hardware systems. To ensure compatibility, the software specifications in this Standard reflect the hardware specifications in the Standard.

2.3 SOFTWARE STANDARDS

For interoperability within the CCG fleet, operating system software and applications used on shipboard networks must conform to a set standard. All software that involves network communication will implement the Transmission Control Protocol/Internet Protocol (TCP/IP), where applicable.

While the software and applications included in this Standard are based on the software currently installed on CCG vessels, more current versions are identified in some cases. The software and applications used should ensure the greatest compatibility possible with private organizations and government offices. The preferred software baseline for CCG vessels is provided in Annex G.

2.4 TESTS AND ACCEPTANCE PROCEDURES

All computer system and network software and hardware must pass functional tests to demonstrate compliance with the requirements of this document and of the referenced standards, including the standards set out in Section 1.2.

2.4.1 Environmental Conditions

For computer systems and networking equipment to be suitable for use onboard CCG vessels, they must meet the environmental conditions described in Section 2.5. In addition, the computer and network hardware must be suitable for marine use and comply with CCG specification 70-000-000-EU-JA-001, Specification for the Installation of Shipboard Electronic Equipment.

2.5 ENVIRONMENTAL CONDITIONS

COTS computer and networking components onboard CCG vessels must be constructed to withstand a shipboard marine environment and must meet the minimum requirements in each of the categories listed below. A marine-grade UPS must be used to protect shipboard computer equipment from fluctuations and power surges in the electrical supply.

2.5.1 Electromagnetic Interference/Radio Frequency Interference

COTS equipment must comply with the Interference-Causing Equipment Standard (ICES) Digital Apparatus (ICES-003) as follows:

Conducted Low Frequency Interference	Ability to connect to a marine-grade UPS.
Conducted High Frequency Interference	Ability to connect to a marine-grade UPS.
Radiated Susceptibility (Electric Field)	Computer and server enclosures to be constructed entirely of metal. Internal components may be made of plastic.

2.5.2 Shipboard Temperature and Humidity

Specification 70-000-000-EU-JA-001, Section 3.7, contains criteria for the environmental conditions that must be maintained for manned and unmanned compartments that will host electronic equipment. An excerpt from this specification follows:

Manned Compartments

a) Room temperature: 20º to 25º C

b) Relative Humidity: 50% to 70%

Unmanned Compartments

a) Room temperature: 20º to 25º C

b) Relative Humidity: 40% to 70%

Given the environmental conditions maintained in manned and unmanned compartments, shipboard computer systems and network equipment that will reside in these compartments must be capable of operating within the above specifications.

2.5.3 Heat Generation

Heat generation of shipboard computer systems and network equipment must not exceed the guidelines below:

PC or Server	Less than or equal to 3000 British Thermal Units (BTUs)/hr
Monitor	Less than or equal to 300 BTU/hr
UPS	Less than or equal to 500 BTU/hr
Router/Switch	Less than 500 BTU/hr
Printers	Less than or equal to 300 BTU/hr
(External) Tape Back-up Unit	Less than or equal to 300 BTU/hr

2.5.4 Radiated Noise

While operating continuously, computer systems and network equipment must radiate a noise level less than or equal to 70 dB(A), measured at approximately the centre of the compartment and at ear height as specified in Section 5.8 of CCG specification 30-000-000-EG-TE-001.

2.5.5 Vibration

Shipboard computer systems shall be isolated from vibration, as specified in Section 2.6. When thus isolated, shipboard computer systems and network equipment shall comply with the vibration-testing standard in the 70-000-000-EU-JA-001 specification. Vibration-isolated equipment shall function under the following conditions:

Vibration Standard				
Computer/System Operation	**Frequency (Hz)**	**Amplitude (mm)**	**Amplitude (inch)**	**Peak to Peak (inch)**
Non-continuous	5-15	0.75	0.030	0.060
Non-continuous	15-25	0.50	0.020	0.040
Non-continuous	25-33	0.25	0.010	0.020
Continuous	5-20	0.50	0.020	0.040

2.5.6 Pitch and Roll

In accordance with specification 70-000-000-EU-JA-001, shipboard computer systems and network equipment must be able to withstand the following onboard pitch and roll conditions, where pitch and roll apply to either direction from the vertical:

1) pitch for a period of at least 15 minutes ± 20º;

2) pitch indefinitely ± 5º;

3) roll for a period of at least 15 minutes ± 45º; and

4) roll indefinitely ± 15º.

The cycle time for pitch and roll shall be between 5 and 20 seconds.

2.6 PHYSICAL INSTALLATION OF COMPUTERS AND MONITORS

Computers, computer monitors, and printers shall be secured by means that restrain movement in all three orthogonal directions, with particular attention paid to the vertical direction. Using the vibration displacement amplitudes of specification 70-000-000-EU-JA-001 as a guideline, protection of computer equipment against the inherent motion of a vessel is required; restraint systems are therefore mandatory.

Computer peripherals with no continuously moving parts shall be restrained using strapping or binding material that is anchored to immoveable fixtures within the vessel. The generic strapping must not interfere with the functioning of the peripheral.

For computer equipment with rotating elements (e.g., hard disks) that are deemed essential for continuous operational access, isolation from vibration is recommended. The total weight of the chassis housing the hard disks plus the platform and its restraint system must be supported by isolation mounts secured to an immoveable fixture on the vessel. The individual mounts must be loaded to 90% of their design load, but they must collectively share the total weight of the isolated item.

The isolation-mounting fixtures will, without further support, protect computer equipment from the ship's pitch and roll.

Chapter 3 LOCAL AREA NETWORK EQUIPMENT SPECIFICATIONS

This chapter contains the technical specifications for requirements relating to fibre-optic and copper cabling associated with network hardware. The requirements apply to Ethernet switches, shipboard routers (if fitted), NICs, transceivers (media converters), and all other associated components identified in subsequent paragraphs.

3.1 NETWORK CONFIGURATION

The network shall consist of a star topology with either a 1 or a 10 Gbps Ethernet backbone and either 1 Gbps or Fast Ethernet to the workstations, as shown in Figure 3-1. The Ethernet backbone shall interconnect the server(s) and a 1 or a 10 Gbps Ethernet core switch using 50 µm multimode fibre-optic cabling. Gigabit Ethernet over fibre-optic cabling shall follow the IEEE 802.3 standard. One Gbps or Fast Ethernet connections shall uplink all workstations to 1 Gbps Ethernet distribution switches. One Gbps and Fast Ethernet over fibre-optic (or copper) cabling shall also follow the IEEE 802.3 standard. The workstations shall connect to the fibre-optic wall plate using either a Category 6 copper patch cord via a fibre-to-copper 10/100/1000 auto-sensing transceiver (media converter) or a 10/100/1000 fibre NIC and fibre patch cable.

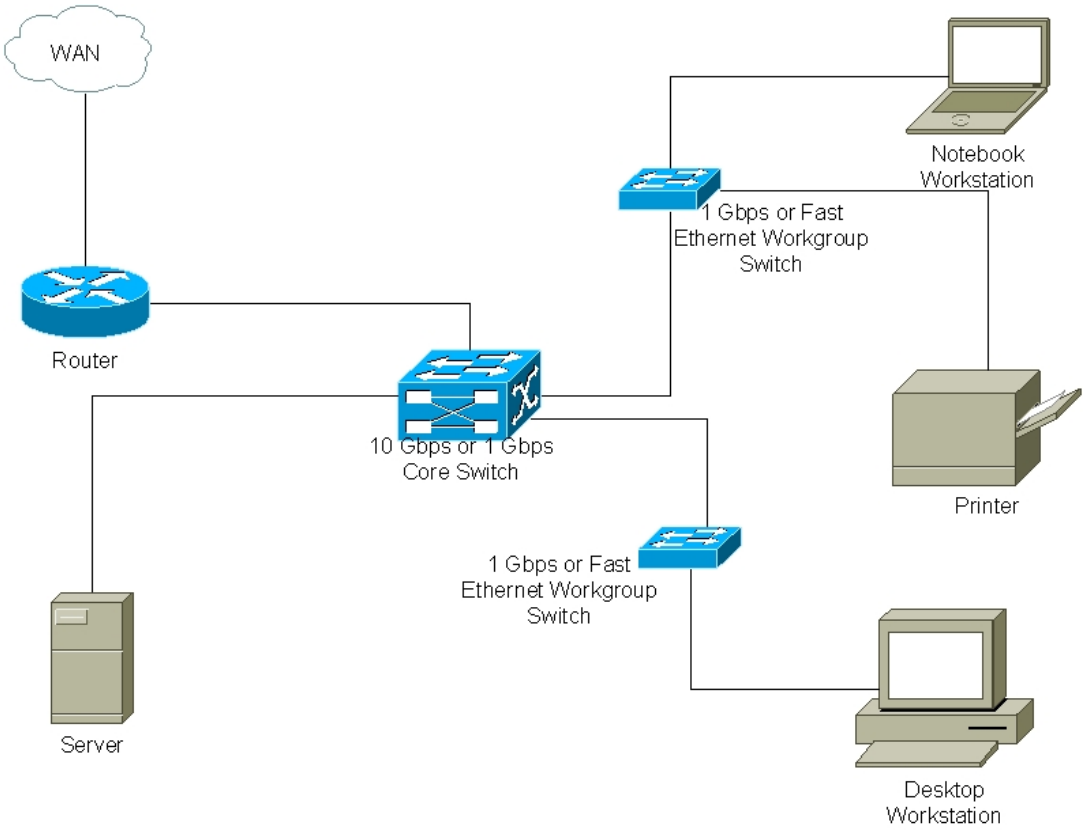

Figure 3-1 Typical Network Topology

3.2 HARDWARE REQUIREMENTS

This section describes the technical requirements for the hardware. The hardware must conform to and support the computer systems described in this document; it must also support standard software packages and protocols recommended by CCG. Hardware must have all the features required to fully support the software used in the system.

All hardware must be of production quality, must consist of industry standard and approved equipment requiring no further development, and shall be part of an existing product line that has been proven in the field. Demonstrated prior use within marine environments is desirable.

Unless otherwise specified, all auxiliary equipment such as equipment enclosures, mounting hardware, cables, connectors, power regulators, protection devices, and interfaces necessary for the hardware to function in its entirety must be installed as part of the hardware.

3.2.1 Networking Hardware

The core Ethernet switch shall be configured with fibre-optic duplex ports and a management port for configuration purposes. The core Ethernet switch will be the hub of the star topology and will host the server(s) and shipboard router (if fitted); the switch shall therefore be fitted with a redundant power supply and redundant fans. The redundant power supply can be either internal or external to the switch; however, internal is desirable, as it reduces rack-space requirements.

The distribution switches must be fitted with 1 Gbps or Fast Ethernet capable ports to uplink the workstations and other network peripherals (e.g., printers).

If the shipboard LAN requires a connection to a shore network, the shipboard network shall be configured with a shipboard router. This router shall have a 1 Gbps or Fast Ethernet port to connect to the core Ethernet switch. Additional interfaces may be required to connect the shipboard router to other devices (satellite, High Frequency (HF), Wi-Fi, Ethernet, etc.) to achieve the connection to the shore network.

All switches should be either modular or of the fixed-chassis type. Switches must be equipped with status Light Emitting Diodes (LEDs) to facilitate troubleshooting; switches must also have remote management features. If the switches must be mounted in shipboard racks, additional mounting hardware must be provided.

3.2.2 Network Scalability

Using a star topology, with a backbone consisting of a core switch and workgroup switches to provide connectivity to the workstations, this architecture shall accommodate as many workgroup switches as there are ports available in the core switch. Additional core switches shall be added to accommodate supplementary workgroup switches as capacity is reached. Smaller vessels will have the same network topology but will use fewer workgroup switches. The core Ethernet switch will be fitted with sufficient fibre uplinks to support the initial requirements for workgroup switches in all vessels, as well as approximately 25% scalability in case additional workgroup switches, servers, or other core networking equipment is added in the future.

3.2.3 Network Management

Networking equipment, such as switches, routers, and servers, shall be manageable via the Simple Network Management Protocol (SNMP) and shall implement the protocol respecting *Request for Comments (RFC) 1157*. An SNMP application shall be implemented respecting *RFC 2573* to provide network management for all SNMP-enabled hardware.

3.2.4 Network Interface Cards

Ethernet NICs will be required for the server(s), desktop workstations, portable notebooks, and other networking peripherals such as printers. These cards must meet the following minimum requirements:

1) The cards must be IEEE 802.3 Ethernet compliant.

2) The cards must be available in 64-bit for server(s) and 32-bit for desktop workstations and portable notebooks. These NICs can either be integrated or provided as separate daughter cards (PCI or PC card).

3) PCI cards will be compliant with the standards set by PCI-SIG, including Conventional PCI v3.0, PCI Express, or PCI-X 2.0, and PC cards will be compliant with the Personal Computer Memory Card International Association (PCMCIA) PC Card Standard 5.0 Release – February 1995 or later.

4) The server NIC will connect to the core 1 or 10 Gbps Ethernet switch.

3.2.5 Fibre-to-Copper Transceiver/Media Converter

When there is a need to use a landline (e.g., a shore-based kiosk) to connect a shore network to a docked CCG vessel, a fibre-optic cable shall connect the shore-based connection box or other network uplink to a shipboard connection box containing the appropriate fibre termination. This shipboard connection shall then connect to a shipboard router via either a fibre interface in the router or a fibre-to-copper transceiver and a copper patch cable. An auto-sensing 10/100/1000 transceiver is preferred, as it permits connecting to shore networks running at different speeds.

3.2.6 Wireless Shore-Connection

Connections to shore-based networks may be accomplished using digital spread-spectrum or wireless connections. The wireless transceiver or wireless access point shall be connected to a shipboard 1 Gbps or Fast Ethernet distribution switch via a Category 6 patch cable.

3.2.7 Power Conditioning / Uninterrupted Power Supply

To maintain the integrity of the shipboard server(s) and related server equipment, as well as the availability of the network, the following must all be connected to a marine-grade Uninterrupted Power Supply (UPS):

1) server(s);

2) related server equipment;

3) the core Gigabit Ethernet switch; and

4) the router (if fitted).

Marine-grade UPSs are designed for installations that operate from a delta-wired power distribution source. The UPS units must meet the UL 1778 standard and provide input/output power isolation for complete protection. The UPS units must also meet these requirements:

1) be marine-grade units with no ground fault interrupter (GFI) compensation/suppression;

2) maintain normal operation of the attached equipment for at least 20 minutes during power outages;

3) be equipped with UPS software that can communicate with the server(s) to perform a safe shutdown to protect applications and data;

4) be equipped with diagnostic software that can test and monitor UPS units; and

5) use batteries that can be replaced in the field (i.e., that do not have to be returned to a vendor or third party for replacement).

Laser printers must never be connected to a UPS, as they significantly increase the load on the UPS during start-up and could prevent the UPS from delivering adequate power to the other attached equipment. Laser printers can also cause UPS units to go into fault mode if the power required during start-up overloads the UPS.

Marine-grade UPS units typically have these parameter values:

Nominal input voltage	120 V
Nominal output voltage	120 V
Input frequency	50/60 Hz ± 3 Hz (auto-sensing)
Input voltage range	92 V – 147 V, adjustable to 86 V – 154 V
Output Receptacle Type	NEMA 5-15R
No Ground Fault Interrupter/Indicator (GFI)	Corrected for no GFI

3.2.8 Network Diagnostic Test Devices

CCG regions shall be equipped with network diagnostic test devices that allow an onboard technician to diagnose problems related to physical cabling. The network diagnostic test tool must be capable of the following:

1) determine whether a NIC is performing a broadcast storm;

2) determine whether a server is reachable and what delay is involved (Packet InterNet Grouper [PING] test);

3) display network utilization, network errors, and broadcasts;

4) identify duplicate IP addresses and protocols in use;

5) automatically detect network devices; and

6) diagnose common errors/faults on both fibre-optic cabling and copper cabling.

The test devices must also have these characteristics:

1) be hand-held and equipped with commercially available rechargeable batteries;

2) be compatible with 10/100/1000/10000 Mbps Ethernet networks; and

3) have an RJ-45 connector for copper cabling and a duplex connector for the fibre-optic cabling installed on CCG vessels.

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Chapter 4 LOCAL AREA NETWORK CABLING SPECIFICATIONS

This chapter contains the specifications for shipboard fibre-optic cabling, copper cabling, and physical layer hardware. The requirement is for a fibre-optic backbone and fibre to the workstation (or copper cabling to the workstation via a transceiver), including connectors, patch panels, patch cables, and all other associated components identified in subsequent paragraphs.

4.1 NETWORK CONFIGURATION

The shipboard network must be configured in accordance with the following guidelines:

1) The access method used on CCG vessels for the backbone will be 1 Gbps or 10 Gbps Ethernet over fibre-optic cabling that is compliant with IEEE 802.3; the access method to connect all workstations will be 1 Gbps or Fast Ethernet over fibre-optic (or copper) cabling, also compliant with IEEE 802.3.

2) The physical medium will be fibre-optic cabling for the backbone and workstations, with either fibre or copper patch cabling to the workstation NIC.

3) One core 1 Gbps or 10 Gbps Ethernet switch shall be used to connect the servers(s) and 1 Gbps or Fast Ethernet distribution switches. Workstations and other network peripherals such as printers shall connect to the 1 Gbps or Fast Ethernet switches.

4) The fibre-optic cable run to each 1 Gbps or Fast Ethernet switch shall be multimode, shall run as one continuous length, and shall consist of 6 or 12 fibre strands (3 or 6 fibre-optic pairs). All fibre-optic strands shall be terminated in a multiple-fibre management tray for redundancy and future expandability. The first pair shall be the live uplink, while the others shall be used for redundancy or growth.

4.1.1 Standards

Standards for fibre-optic and copper cabling will adhere to the requirements set out in Section 1.2 of this document. Specifications for network cabling are identified in subsequent sections and are listed in Annex A.

4.2 CABLING REQUIREMENTS

4.2.1 Fibre-Optic Cabling

The Ethernet backbone shall consist of multimode 6- or 12-strand fibre-optic cabling terminated with duplex connectors. If copper cabling is used to the workstation as the last leg of the uplink, fibre-optic multimode cabling shall be used for the run from the 1 Gbps or Fast Ethernet switches to the workstation transceiver.

4.2.1.1 Fibre-Optic Cabling Specification

The fibre cabling installed on vessels shall comply with installation standard TP 127 E, as defined by Transport Canada. The fibre optic cable shall meet the ANSI-TIA/EIA-472E000 standard, Sectional Specification (Adopted ICEA S-104-696-2001) Standard for Indoor-Outdoor Optical Fiber Cable, for cable construction. In addition, the fibre core of the cable shall comply with ANSI TIA/EIA-492AAAB standard, Detail Specification for 50-µm Core Diameter/l25-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibres. It must also meet the requirements of the Low-Smoke Zero-Halogen – Applicable Flame-Smoke Test in UL 1685 and the FT4 Vertical Flame Test — Cables in Cable Trays (see Paragraph 4.11.4, CSA C22.2 No. 0.3-92).

New installations of shipboard fibre-optic cabling shall be 50 µm multimode fibre in a loose tube, which provides stable and reliable transmission, for both indoor (backbone) and outdoor (jetty connection) applications; such installations shall also be rated for low-smoke, zero-halogen emission requirements when exposed to flame. New fibre installations shall use 50 micron multimode fibre to support future network growth and network speeds up to Gigabit Ethernet and 10 Gigabit Ethernet. Existing installations may retain the 62.5/125 micron fibre-optic cabling.

The fibre optic cabling shall have been tested against standard TIA/EIA 568-B.3, Commercial Building Telecommunications Cabling Standard, Part 3: Optical Fibre Cabling Components Standard, which verifies the following characteristics of the cables:

a) connectorization;

b) colour coding;

c) mechanical tests; and

d) intermateability.

In summary, fibre-optic cabling shall comply with the following standards:

a) ANSI-TIA/EIA-472E000, Sectional Specification (Adopted ICEA S-104-696-2001) Standard for Indoor-Outdoor Optical Fiber Cable, 02/2005;

b) ANSI TIA/EIA-492AAAB, Detail Specification for 50-µm Core Diameter/l25-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers, 09/2002;

c) ANSI TIA/EIA-568-B.3, Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components Standard, 05/2001;

d) FT4 Vertical Cable Tray Flame Test — Cables in Cable Trays (see Paragraph 4.11.4, CSA C22.2 No. 0.3-92), 2001;

e) TP 127 E, Ship Electrical Standards; and

f) UL 1685, Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fibre Cables.

4.2.1.2 Fibre-Optic Cable Construction

Fibre-optic cables used in CCG vessels shall meet the following construction guidelines:

a) Optical fibres' shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be 3.0 mm;

b) Each buffer tube shall contain up to 12 fibres;

c) The fibres shall not adhere to the inside of the buffer tube;

d) Each fibre shall be distinguishable by means of colour coding in accordance with TIA/EIA-568-B.3;

e) The fibres shall be coloured with ultraviolet (UV) curable inks;

f) Buffer tubes containing fibres shall be colour-coded with distinct and recognizable colours in accordance with TIA/EIA-568-B.3;

g) In buffer tubes containing multiple fibres, the colours shall be stable across the specified storage and operating temperature range and not subject to fading or smearing into one another or into the gel filling material. Colours shall not cause fibres to stick together;

h) The buffer tubes shall be resistant to developing kinks;

i) Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes;

j) The central anti-buckling member shall consist of a dielectric, Glass Reinforced Plastic (GRP) rod. The purpose of the central member is to prevent the cable from buckling. When required, the GRP rod shall be over-coated with a thermoplastic to achieve the dimensions needed to accommodate buffer tubes/fillers;

k) Buffer tubes shall be fitted around the dielectric central member. Water-blocking yarn(s) shall be applied longitudinally along the central member during stranding;

l) Two polyester yarn binders shall be applied around and with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage;

m) For single-layer cables, a water-blocking tape shall be applied longitudinally around the outside of the stranded tubes/fillers. The tape shall be held in place by a single polyester binder yarn. The water-blocking tape shall be non-nutritive to fungus and electrically non-conductive. It shall also be free of dirt and foreign matter;

n) Cables shall contain at least one ripcord under the sheath for easy sheath removal. Armoured cables shall contain at least one ripcord under the steel armour for easy sheath removal;

o) Tensile strength shall be provided by yarns with high tensile strength. The yarns shall be helically stranded evenly around the cable core;

p) Cables shall be sheathed with Flame-Retardant Polyethylene (FRPE) with a minimum nominal jacket thickness of 1.95 mm. Jacketing material shall be applied directly over the tensile-strength members and water-blocking tape. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus;

q) The jacket shall be continuous, as well as free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service;

r) The outer cable jacket shall be marked with the manufacturer's name or file number, date of manufacture, fibre type, product description, flame and smoke rating, listing mark, and sequential length markings every two feet. The print marking shall be white; and

s) The cable shall be all-dielectric and non-conductive.

4.2.1.3 Cable Performance Parameters

Cable performance shall meet the requirements of standards TIA/EIA 568B.3 and ANSI-TIA/EIA-472E000. The notable parameters in the construction standards are as follows:

a) Temperature range, as outlined in Section 7.20 of the ANSI-TIA/EIA-472E000 standard. The cable's attenuation shall be ≤ 0.60 db/km at 1300 nm while being subjected to temperatures of -40 ºC and + 70 ºC;

b) Crush resistance, as outlined in Section 7.25 of the ANSI-TIA/EIA-472E000 standard. The fibre-optic cable shall have an attenuation of ≤ 0.60 db/km at 1300 nm when subjected to a load of 220 N/cm (125lbs/in) at a rate of 2.5 mm (0.1 in) per minute for one minute, followed by a load of 110 N/cm that is maintained for ten minutes;

c) Cyclic flexing, as outlined in Section 7.20 of the ANSI-TIA/EIA-472E000 standard. The cable shall be able to withstand flexure through a 180º arc for 25 cycles using a mandrel of less than 20 times the cable's outer diameter. No visible cracks larger than 5 mm shall be found, and the increase in attenuation shall be ≤ 0.60 db/km at 1300 nm;

d) High- and low-temperature bend, as outlined in Section 7.17 of the ANSI-TIA/EIA-472E000 standard. The cable shall withstand four turns in a mandrel of 150 mm at temperatures of 0ºC and 60ºC. Attenuation shall remain ≤ 0.60 db/km at 1300 nm, and no visible cracks, splits, or tears shall be found;

e) Impact resistance, as outlined in Section 7.22 of the ANSI-TIA/EIA-472E000 standard. The cable shall withstand an impact of at least 4.4 N-m while keeping an attenuation of ≤ 0.60 db/km at 1300 nm and no cracks, splits, tears, or other openings shall be found on the cable, for 3 times 2 cycles 150 mm apart;

f) Temperature cycling, as outlined in Section 7.20 of the ANSI-TIA/EIA-472E000 standard. The cable's attenuation shall be ≤ 0.60 db/km at 1300 nm while being subjected to temperatures of -40 ºC and + 70 ºC during two complete full-range temperature cycles; and

g) Water blocking, as outlined in Section 7.28 of the ANSI-TIA/EIA-472E000 standard. The cable shall withstand one hour in tap water, and there shall be no evidence of fluid leaking from the exposed end of the cable.

4.2.2 Cable Peripherals

4.2.2.1 Fibre-Optic Wiring Closets

Wiring closets rather than patch panels shall be used, as they typically include:

a) Integral strain-relief cable-attachment points. By contrast, patch panels rely for support on the structure of a rack that it is fitted in;

b) An integral support shelf for the unsheathed strands of the cable on which the individual cable may be laid;

c) An integral support shelf for the mating of the fibre-patch cords; and

d) Integral jumper-routing guides (saddles).

The closet shall be rack-mountable in a standard-width (19") rack. The closet shall be available in a wall-mounted version for remote switch locations.

4.2.2.2 Fibre-Optic Fan-Out Assemblies

A tube fan-out kit shall be used for the field termination of loose-tube fibre-optic cable to protect individual strands during the termination process. The kit shall have colour-coded tubes matching the coloured strands of the cable. The kit shall have an epoxy-less furcation unit to separate and secure the strands. The kit shall facilitate connectorization and shall be compact so that it can be used with field-installed wiring closets.

4.2.2.3 Connectorization

Fibre-optic fan-out assemblies should have Lucent Connector (LC) multimode connectors (or SC, ST, FC or MTRJ connectors, depending on the supplier or CCG TA).

4.2.2.4 Packing and Shipping

The cable shall be packaged in cartons or wound on spools. Each package shall contain only one continuous length of cable. The packaging shall be constructed to prevent damage to the cable during shipping and handling.

Test tails shall be at least two metres long. The inner end shall be fastened to prevent the cable from coming loose during shipping and installation.

The attenuation shall be measured at 850 nm and 1300 nm for multimode fibre. These values should be available on request.

The reel marking and labelling of every cable shall include all pertinent specifications, including the safety certifications met as well as a length count.

4.2.3 Copper Patch Cable

When fibre-optic patch cable is not used, copper cabling shall be used to interconnect workstations to the fibre-optic wall plate via a fibre-to-copper transceiver. Copper patch-cord cabling shall consist of Category 6 cabling and be terminated with Category 6 approved RJ-45 connectors.

Category 6 copper patch-cord cabling will also support Gigabit Ethernet to the workstation for future growth capability. Although Category 5/5e can be used, industry standards recommend that Category 6 copper cabling be used for all new applications.

4.2.3.1 Specification for Copper Patch Cable

Copper cabling used to connect the workstation to the 1 Gbps or Fast Ethernet workgroup switches via a fibre-to-copper transceiver shall:

a) comply with ANSI TIA/EIA 568B.2 standard specifications;

b) use 500 MHz Category 6 copper cabling;

c) consist of shielded twisted pair (STP) copper cabling;

d) use a low-smoke zero-halogen (LSZH) jacket;

e) use 24 AWG 4-pair stranded copper cabling; and

f) be terminated with Category 6 rated RJ-45 connectors.

4.2.4 Ship-to-Shore Connectivity

If ship-to-shore connectivity (a jetty link) is required, a fibre-optic cable shall be routed from a weatherproof shore-based connection box (kiosk) to a weatherproof shipboard connection box. The shipboard connection box will have a fibre-optic run to a 10/100/1000 Mbps transceiver (media converter), which in turn will connect to a shipboard router with a Category 6 copper patch cord, as described in Section 4.2.3.1. The fibre-optic cable used to providing the shore connection

shall be identical to that described in Section 4.2.1.1. If this fibre-optic cable needs to be repaired or replaced, it can easily be disconnected from both weatherproof connection boxes (shore-based and shipboard) to be repaired or replaced.

4.2.5 Rack-Mounted Patch Panel or Wiring Closet

In larger installations, each workstation fibre-optic cable will be terminated on a rack-mounted patch panel or wiring closet. The patch panel or wiring closet must provide the following:

1) fibre multimode couplers;

2) rack-mounting capability;

3) the ability to terminate 6, 12, 24, 72 and 96 strands;

4) the ability for one rack unit (U) to accommodate all the strands of the fibre-optic distribution cable;

5) the ability to terminate at least one distribution cable per 1.75-inches of rack space;

6) access from the front, via a metal or polycarbonate door; and

7) enough room for working around the connectors inside the unit.

For installation considerations, refer to Appendices C and E of *Specification for the Installation of Shipboard Electronic Equipment* (70-000-000-EU-JA-001.

4.2.6 Wall-Cabinet-Mounted Patch Panel or Wiring Closet

In smaller installations, each strand in a fibre-optic cable will be terminated on a patch panel or wiring closet mounted in a wall cabinet. This patch panel or wiring closet must provide the following:

1) fibre multimode couplers;

2) rack-mounting capability;

3) the ability for one rack unit (U) to accommodate all the strands of the fibre-optic distribution cable;

4) the ability to terminate at least one distribution cable per 1.75-inches of rack space; and

5) enough room to work around the connectors inside the unit.

For installation considerations, refer to Appendices C and E of *Specification for the Installation of Shipboard Electronic Equipment* (70-000-000-EU-JA-001).

4.2.7 Bulkhead-Mountable 19-inch Cabinet

For locations in which a patch panel or wiring closet and switch must be mounted on a bulkhead, a cabinet meeting the following requirements shall be used:

1) provides at least 21 inches (12 U) of vertical height of usable 19-inch rack space;

2) provides at least 18 inches of inside clearance (front to rear) behind the rails;

3) has a lockable metal door;

4) is equipped with vertical cable management at each side to control patch-cable slack;

5) can be fitted with horizontal cable-management units; and

6) can be fitted with horizontal shelves.

4.2.8 Switch Fibre Patch Cable

The fibres terminated in the interconnect panel will be connected to the switch using duplex patch cables. These patch cables will be factory assembled using LSZH fibre-optic cable and terminated at both ends with duplex fibre connectors. Switch patch cables must meet the requirements specified in Section 4.2.3.1.

4.2.9 Workstation Outlet

The workstation outlet, including boxes, faceplates, and couplers, will be of modular design. The outlet will be mountable on the wall or on a surface-mount box. A single faceplate will be used to terminate all strands in the cable. Workstation outlets shall:

1) provide multimode fibre couplers;

2) fully terminate the distribution cable;

3) contain an effective strain-relief fitting to anchor the distribution cable;

4) contain guides capable of storing 2m lengths of all distribution sub-cables;

5) prevent sub-cables from being bent at less than the minimum bend radius; and

6) provide adequate room to work around the connectors inside the unit.

4.2.10 Workstation Fibre Patch Cable

The workstation transceiver will be connected to the workstation outlet using a duplex patch cable. These single-sheath duplex-fibre patch cables will be factory assembled using LSZH fibre and terminated at both ends with duplex-fibre connectors. Workstation patch cables must meet the requirements specified in Section 4.2.1.1.

Chapter 5 FIBRE-OPTIC CABLING INSTALLATION

This chapter describes the standards for installing and testing of fibre-optic and copper cabling onboard CCG vessels.

5.1 INTRODUCTION

5.1.1 Contractor Criteria

If a contractor is used to install cable, the contractor shall provide proof of training in the installation of fibre-optic cable, as well as experience in the installation of this cable by their installers or immediate supervisors. At a minimum, cable installers shall be Building Industry Consulting Service International (BICS) or Association of Cabling Professionals (ACP) certified.

The contractor shall provide a list of references for work previously performed. Before work starts, the CCG TA may audit the contractor's references. The contractor shall perform work in accordance with specification Section 1.6.2 of *Specification for the Installation of Shipboard Electronic Equipment* (70-000-000-EU-JA-001).

5.1.1.1 Contractor Site Survey with CCG Technical Authority

Before any work starts, the CCG TA and the contractor will conduct a site survey of the proposed cabling installation. All discrepancies between the proposed plan and the ship configuration shall be noted and rectified before works starts.

5.1.1.2 Noted Deviations from Approved Installation Plan

Pre-installation deviations are to be redlined on the installation document. Any post-installation deviations are to also be noted and approved on the same document before final acceptance of the work performed.

5.1.1.3 Final Inspection/Receipt of Test Sheets from Contractor

The installation shall be considered complete with the receipt of all test sheets, red-lined drawings, and a final walk-through by both the CCG TA and the contractor.

5.1.1.4 Acceptance

The contractor will contact the CCG TA to arrange for formal acceptance of the work performed.

5.1.2 Standards for Cable Installation

Fibre-optic and copper-cabling installations shall adhere to the general requirements set out in Section 1.2 of this document. Individual specifications for network cabling are identified in subsequent paragraphs of this section and listed in Annex A.

5.2 CABLE TESTING REQUIREMENTS

This section contains the requirements for testing copper and fibre-optic cabling. All test results shall be documented using the sample test sheets included in Annex H and Annex I shall be retained by the CCG TA.

5.2.1 Fibre-Optic Cabling

5.2.1.1 Tests

Fibre-optic cable tests shall be performed by the fibre-optic installer in three phases, as described below. The test sheets in Annex H shall be used. If the Optical Time Domain Reflectometer (OTDR) provides pre-formatted test reports, they may be attached to the Annex H test sheets and only the missing information need be provided on the test sheets.

Phase One

This phase consists of testing the fibre-optic cable as received on the reel. Because of the length of the cable and its unterminated condition, an OTDR shall be used to check for anomalies such as bends, kinks, or faults. The results shall be documented.

Phase Two

This phase consists of testing the fibre-optic cable installed onboard ship before termination. This test will be conducted using an OTDR with a filter box to compensate for the short cable runs (under 100 feet). Test results shall be documented.

Phase Three

This phase consists of testing the fibre-optic cable onboard ship after termination. This test will be conducted using a power loss meter. The test shall be an end-to-end test and be repeated in the opposite direction for each terminated fibre strand tested. The test results shall be documented.

5.2.1.2 Test Results

All test results shall be documented and kept by the CCG TA to provide a baseline for any future troubleshooting or upgrades. The contractor shall ensure that the CCG TA receives the required test results in good order and in a timely fashion.

5.2.1.3 Fault Rectification by the Contractor

All faults found shall be rectified by the contractor and retested to certify that the fault has been corrected. The results of fault rectification shall be documented. The contractor shall ensure that the CCG TA receives the test results following fault rectification in good order and in a timely fashion.

5.2.2 Copper Cabling

5.2.2.1 Tests

Copper-cable testing shall include, as a minimum, the following tests:

a) end-to-end continuity testing;

b) mapping of the cable at the connector interface; and

c) crosstalk losses at the connector interface.

5.2.2.2 Test Results

The testing of the copper cable shall be documented using the test sheet in Annex I. The number or type of tests may be reduced with a waiver from the CCG TA. With approval from the CCG TA, the test output from the test equipment may be attached to the test sheet with only the cable identification indicated on the covering test sheet.

All test results shall be documented and kept by the CCG TA to provide a baseline for any future troubleshooting or upgrades. The contractor shall ensure that the CCG TA receives the required test results in good order and in a timely fashion.

5.2.2.3 Fault Rectification by the Contractor

All faults found shall be rectified by the contractor and retested to certify that the fault has been corrected. The results of fault rectification shall be recorded and documented using the test sheet in Annex I. The contractor shall ensure that the CCG TA receives the test results following fault rectification in good order and in a timely fashion.

5.2.3 Generic Specification for Fibre-Optic Jetty Communication Box

Enclosures used for the storing and protecting fibre-optic connections and splices in outdoor environments shall:

1) be made of composite material that is resistant to chemical and temperature extremes and has excellent weatherproof qualities;

2) be made of low-smoke zero-halogen material;

3) be made of material that facilitates punching, drilling, filing, or sawing of cable-entry holes;

4) have an enclosure cover that can be secured with corrosion-resistant, captive screws or quick-release latches that will accept a user-supplied padlock if required;

5) have mounting hardware (i.e., hardware to mount on a pole or wall);

6) be National Electrical Manufacturers Association (NEMA) 4X rated;

7) be suitable for a variety of fibre cable, including loose-tube, tight-buffer, and ribbon cable; and

8) accept interface panels for connectors supplied with the cable, splices (mechanical or fusion), or fan-out kits.

5.3 DOCUMENTATION

It is important that the test sheets in Annexes H and I be completed and kept for future reference. If an installed fibre cable is believed to be causing network problems, these records can help diagnose or troubleshoot the problem.

5.3.1 Records to be provided by Installer

The installer must complete the test forms in Annexes H and I. In addition, for each cable run, the installer must show:

1) end-to-end loss, in both directions, as measured by an optical power meter;

2) OTDR traces; and

3) connector and splice losses, as measured by the OTDR.

The above test results will include the following:

1) the cable and fibre strand number;

2) the wavelength used for the test (850 nm/1300 nm);

3) the measurement direction;

4) the date;

5) the test equipment make and model;

6) the reference set-up; and

7) the operator name.

5.3.2 Cable Routing Diagrams

Cable routing diagrams provided by the installer must show, at minimum:

1) endpoints;

2) cable route; and

3) splice locations (only if a repair is necessary).

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Annex A STANDARDS AND SPECIFICATIONS REFERENCED

Standard	Description
ANSI TIA/EIA-492AAAB	Detail Specification for 50-µm Core Diameter/l25-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibres (09/2002). Available for purchase online at www.tiaonline.org.
ANSI TIA/EIA-568-B.2	Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components (05/2001). Available for purchase online at www.tiaonline.org.
ANSI TIA/EIA-568-B.3	Commercial Building Telecommunications Cabling Standard Part 3: Optical Fibre Cabling Components Standard (05/2001). Available for purchase online at www.tiaonline.org.
ANSI-TIA/EIA-472E000	Sectional Specification (Adopted ICEA S-104-696-2001) Standard for Indoor-Outdoor Optical Fibre Cable Indoor-Outdoor Optical Fibre Cable (02/2005). Available for purchase online at global.ihs.com.
C22.2 No. 0.3	Test Methods for Electrical Wires and Cables (Sixth Edition, 03/2001). Available for purchase online at global.ihs.com.
CCG 30-000-000-EG-TE-001	Noise Measurement and Acceptance Criteria for Canadian Coast Guard Vessels (10/2003).
CCG 70-000-000-EU-JA-001 (formerly DGTE-69)	Specification for Installation of Shipboard Electronic Equipment (Second Edition, 07/2003).
EIA/ECA-310	Cabinets, Racks, Panels, and Associated Equipment (12/2005). Available for purchase online at global.ihs.com.
ICES-003, Issue 4	Industry Canada, Department of Communications Management and Telecommunications Policy, Interference-Causing Equipment Standard: Digital Apparatus (02/2004). Available online at http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf00020e.html.
IEEE 802.3	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, (03/2002). Available online at www.standards.ieee.org/getieee802.
PC Card Standard 8.0 Release – February 1995 or later	Personal Computer Memory Card International Association, PC Card Standard 8.0 Release, (02/1995 or later). Available for purchase at http://www.pcmcia.org/bookstore.htm#pc.

Standard	Description
Request for Comments 1157	Internet Engineering Task Force, A Simple Network Management Protocol (05/1990). Available online at http://www.ietf.org/rfc/rfc1157.txt or http://www.ietf.org/rfc/rfc1157.txt?number=1157.
Request for Comments 2573	Internet Engineering Task Force, SNMP Applications, (04/1999). Available o Online at http://www.ietf.org/rfc/rfc2573.txt?number=2573.
TP 127 E	Ships Electrical Standards, (02/2002). Available online at http://www.tc.gc.ca/MarineSafety/TP/Tp127/menu.htm.
UL 1685	Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fibre Cables (02/1997). Available for purchase online at global.ihs.com.
UL 1778	Standard for Safety Uninterruptible Power Systems. Available for purchase online at global.ihs.com.

Annex B HARDWARE SPECIFICATIONS FOR A SHIPBOARD WORKSTATION – FIXED/DESKTOP

The following table contains the ***minimum*** requirements for a desktop workstation connected to a shipboard LAN. Where appropriate, capacities or sizes may be exceeded.

B.1	One Intel, or AMD, 2.00 GHz processor with 800 MHz system bus.
B.2	256-KB level 2 cache.
B.3	2 GB DDR400 Non-ECC SDRAM.
B.4	One 1.44 MB 3 1/2" diskette drive.
B.5	One IDE bootable DVD-ROM drive.
B.6	One 80 GB IDE hard drive (UltraATA or SATA).
B.7	One AGP video adapter with a minimum of 64 MB of RAM.
B.8	One 17” CRT monitor with an analog RGB connector (with at least 1280 x 1024 @ 75 Hz resolution) or a 17” LCD monitor.
B.9	One parallel port.
B.10	One serial port.
B.11	Six USB ports (2 front accessible).
B.12	One additional mouse port (USB or PS/2).
B.13	One additional keyboard port(USB or PS/2).
B.14	One two-button optical wheel mouse (USB or PS/2).
B.15	One enhanced AT style keyboard (USB or PS/2).
B.16	One 16-bit sound card (integrated or PCI).
B.17	One 100 or 1000 Mbps NIC (integrated or PCI), with appropriate fibre or RJ-45 connector.
B.18	One free PCI expansion slot.
B.19	An internal 350 Watt, CSA-approved power supply.
B.20	An all-metal enclosure (plastic components are allowed internally).

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Annex C HARDWARE SPECIFICATIONS FOR A SHIPBOARD WORKSTATION – PORTABLE/NOTEBOOK

The following table contains the ***minimum*** requirements for a portable notebook computer connected to a shipboard LAN or operating as a standalone computer. Where appropriate, capacities or sizes may be exceeded.

C.1	One Intel, or AMD, 1.20 GHz processor with 512 KB level 2 cache.
C.2	2 GB DDR Non-ECC SDRAM.
C.3	One IDE bootable DVD-ROM drive.
C.4	One 30 GB IDE internal hard drive.
C.5	One integrated video adapter with a minimum of 32 MB of video RAM.
C.6	One 12.1-inch XGA active matrix display (with at least 1024 x 768 @ 60 Hz resolution).
C.7	One parallel port.
C.8	Four USB ports.
C.9	One external video port.
C.10	One additional external mouse port
C.11	One additional external keyboard port.
C.12	One docking station port (if the computer is to be used in a docking configuration).
C.13	One integrated pointing device.
C.14	One integrated full-size enhanced AT style keyboard.
C.15	One integrated 16-bit sound card with speakers.
C.16	One integrated 100 or 1000 Mbps NIC with appropriate fibre or RJ-45 connector.
C.17	Two PC Card slots capable of supporting Type I, Type II, or Type III cards.
C.18	One integrated high-capacity lithium-ion battery capable of operating for a minimum of 3 hours.
C.19	The total weight of the system, with battery, must not exceed 3 kg (6.6 lb.).
C.20	One carrying case.

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Annex D HARDWARE SPECIFICATIONS FOR A SHIPBOARD WORKSTATION – STANDALONE PC

The following table contains the ***minimum*** requirements for a standalone desktop workstation. Where appropriate, capacities or sizes may be exceeded.

D.1	One Intel, or AMD, 2.00 GHz processor with 800 MHz system bus.
D.2	256-KB level 2 cache.
D.3	2 GB DDR400 Non-ECC SDRAM.
D.4	One 1.44 MB 3 1/2" diskette drive.
D.5	One IDE bootable DVD-RW drive.
D.6	One 80 GB IDE hard drive (UltraATA or SATA).
D.7	One AGP video adapter with a minimum of 64 MB of RAM.
D.8	One 17” CRT monitor with an analog RGB connector (with at least 1280 x 1024 @ 75 Hz resolution) or a 17” LCD monitor.
D.9	One parallel port.
D.10	One serial port.
D.11	Six USB ports (2 front accessible).
D.12	One additional mouse port (USB or PS/2).
D.13	One additional keyboard port (USB or PS/2).
D.14	One two-button optical wheel mouse (USB or PS/2).
D.15	One enhanced AT style keyboard (USB or PS/2).
D.16	One 16-bit sound card (integrated or PCI).
D.17	One free PCI expansion slot.
D.18	An internal 350 Watt, CSA-approved power supply.
D.19	An all-metal enclosure (plastic components are allowed internally).

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Annex E HARDWARE SPECIFICATIONS FOR A SHIPBOARD SERVER

A server must meet the following ***minimum*** requirements. Where appropriate, capacities or sizes may be exceeded.

E.1	Two Intel XEON 2.40 GHz with 533 MHz system bus.
E.2	512 KB second-level ECC cache.
E.3	1 GB ECC DDR SDRAM, expandable to 4 GB.
E.4	One 1.44 MB 3.5” diskette drive.
E.5	One IDE bootable DVD-ROM drive.
E.6	One 64-bit/66-MHz PCI RAID array controller with dual Wide Ultra3 SCSI channels (for hard drives) that support RAID Levels 0, 1, 5, 10 with a minimum of 32 MB of battery-backed RAM.
E.7	One 64-bit/66-MHz PCI SCSI controller with dual Wide Ultra3 SCSI channels (for tape drives).
E.8	Five 36 GB, hot-plug hard drives (2 x 36 GB for the network operating system in a RAID Level 1, and 3 x 36 GB for applications and data in a RAID Level 5), Wide Ultra3 or Ultra 320 SCSI disks.
E.9	One integrated video adapter with minimum of 8 MB of video RAM.
E.10	One 15-inch Liquid Crystal Display (LCD) capable of 1024 x 768 @ 60 Hz resolution.
E.11	One parallel port.
E.12	One serial port.
E.13	Two USB ports.
E.14	One additional mouse port (USB or PS/2).
E.15	One additional keyboard port (USB or PS/2).
E.16	One enhanced AT style keyboard with integrated trackball/pointing device.
E.17	One set of front-panel LEDs to display server status.
E.18	One 1000 or 10000 Mbps NIC (integrated or in PCI slot).
E.19	Two hot-plug power supplies (redundant).
E.20	Hot-plug and redundant fans.
E.21	Two free 64-bit/33-MHz PCI expansion slots.

E.22	An all-metal case, in a standalone or rack-mounted configuration, as required by the system architecture.

Annex F HARDWARE SPARES

Hardware spares may be required if failures occur. These may be permanent spares or they may be on loan to the vessel during operations. Quantities are to be determined by the Technical Authority on the basis of the overall network size, the type and quantity of equipment onboard, and the vessel's expected operational requirements.

This annex lists the ***minimum*** spares required for different workstation and network configurations.

F.1 FOR DESKTOP WORKSTATIONS

1) 40 GB IDE internal hard drives (UltraATA or SATA).

2) 10/100/1000 Mbps NICs (PCI) (connector type suited for shipboard cabling).

3) Copper or fibre patch cords.

F.2 FOR PORTABLE NOTEBOOKS

1) 30 GB IDE internal hard drives.

2) 10/100/1000 PC Card NICs (connector type suited for shipboard cabling).

3) Copper or fibre patch cords.

4) Internal high-capacity lithium-ion batteries capable of operating for a minimum of 3 hours.

F.3 FOR STANDALONE PCS

1) 80 GB IDE hard drives (UltraATA or SATA).

F.4 FOR SERVER(S)

1) 36 GB hot-plug hard drives, Wide Ultra3 or Ultra 320 SCSI disks.

2) 10/100/1000 Mbps NICs (PCI) (with appropriate fibre connector).

3) Fibre-optic duplex zip cords.

4) Hot-plug redundant power supplies.

5) Hot-plug redundant fans.

6) Back-up media tapes.

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Annex G STANDARD AND PREFERRED SOFTWARE PRODUCTS

G.1	Server Operating System	Microsoft Windows Server 2003.
G.2	Workstation Operating System	Microsoft Windows XP Professional.
G.3	Office Automation	Microsoft Office XP Professional or later.
G.4	Database Management System	High Level: Oracle 10 or later. Mid Level: Microsoft SQL 2003 or later.
G.5	Electronic Mail	Microsoft Outlook and Microsoft Exchange 2003 or later.
G.6	Electronic Forms	Delrina Form Flow.
G.7	Document Viewer	Folio Views. World View. Frame 4 View. Adobe Acrobat Reader.
G.8	Development Tools	Microsoft: Visual Basic. Hyperion: Essbase. Cognos: Business Intelligence. Sybase: Power Builder.
G.9	Geographic Information Systems	High-Mid Level: Caris. Mid-Low Level: Map Info, Caris/Access.
G.10	Project Management	MS Project 2000 or later.
G.11	Document Management	OpenText eDocs DM.
G-12	Back-Up	Symantec BackupExec

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Annex H FIBRE-OPTIC CABLE - TEST SHEETS

Each phase of the testing of fibre-optic cable shall be documented with the test sheets in this annex.

H.1 PHASE ONE: TEST FOR FIBRE-OPTIC CABLE ON REEL

Phase One testing is conducted with the cable on the reel, as received from the supplier, using an OTDR. This step may be omitted if all of the following conditions are met:

1) The reel has a manufacturer's test certificate;

2) The reel is in good condition and there are no visible signs of damage; and

3) The reel has not been in unattended storage for a period of 2 years.

Phase One test results shall be recorded on the test sheet in Section H.4 of this annex.

H.2 PHASE TWO: TEST FOR INSTALLED FIBRE-OPTIC CABLE (UNTERMINATED)

Once in place onboard ship (possibly with glands secured), an OTDR shall be used to test fibre-optic cables for severe bending, breaks, or crushing caused by the installation. Phase Two test results shall be recorded on the test sheet in Section H.5 of this annex.

H.3 PHASE THREE: TEST FOR INSTALLED FIBRE-OPTIC CABLE (TERMINATED)

Once the cable is terminated, it shall be tested using a power loss meter (this function may be incorporated in an OTDR) to measure the losses through the connectors (end-to-end). This shall be repeated from each end of the cable. Phase Three test results shall be recorded on the test sheet in Section H.6 of this annex.

H.4 TEST SHEET FOR FIBRE-OPTIC CABLE ON REEL

Fibre-Optic Test on Cable Reel			
Test Equipment – OTDR			
Manufacturer:		Model:	
Serial No.:		Calibration Date: By:	
Launch Cable (Pigtail):	☐ 50/125 µm	☐ 62.5/125 µm	
Mechanical Splice Unit:			
Manufacturer:		Model:	
Serial No.:			
Test Wavelength:	☐ 850 nm	☐ 1300 nm	
Markings on Cable:			
Optical Test Data Attached:	☐ Yes	☐ No	
Length:	Size (diameter):	☐ 4	☐ 6 Fibres
Date Of Manufacture:		Reel No.:	
Contract / P.O. No.:			
Fibre Colour / No.		Event/ Break (Nil, Pass)	Result
Blue	1		☐ Pass ☐ Fail
Orange	2		☐ Pass ☐ Fail
Green	3		☐ Pass ☐ Fail
Brown	4		☐ Pass ☐ Fail
Slate	5		☐ Pass ☐ Fail
White	6		☐ Pass ☐ Fail
N.B. Attach OTDR Traces			
Comments:			
Tested By:		Date:	

H.5 TEST SHEET FOR INSTALLED FIBRE-OPTIC CABLE

Fibre-Optic Test of Installed Cable (Unterminated)			
Test Equipment – OTDR			
Manufacturer:		Model:	
Serial No.:		Calibration Date: By:	
Launch Cable (Pigtail):	☐ 50/125 µm	☐ 62.5/125 µm	
Mechanical Splice Unit:			
Manufacturer:		Model:	
Serial No.:			
Test Wavelength:	☐ 850 nm	☐ 1300 nm	
Cable Tag / No.:		Cable Path From: _____ To: _____	
Test Location:			
Length (approx.):		☐ 4	☐ 6 Fibres
Fibre Colour / No.		Event/ Break (Nil, Pass)	Result
Blue	1		☐ Pass ☐ Fail
Orange	2		☐ Pass ☐ Fail
Green	3		☐ Pass ☐ Fail
Brown	4		☐ Pass ☐ Fail
Slate	5		☐ Pass ☐ Fail
White	6		☐ Pass ☐ Fail
N.B. Attach OTDR Traces			
Comments:			
Tested By:		Date:	

H.6 TEST SHEET FOR INSTALLED FIBRE-OPTIC CABLE (TERMINATED)

Fibre-Optic Test (End-to-End) Of Installed Cable (Terminated)

Test Equipment – Power Loss Meter

Manufacturer: Model:

Serial No.: Calibration Date:
By:

Launch Cable: ☐ 50/125 µm ☐ 62.5/125 µm

Test Wavelength: ☐ 850 nm ☐ 1300 nm

Cable Tag / No.: Cable Path From: _____
To: _____

Test Location: Near End: Far End:

Length (approx.): ☐ 4 ☐ 6 Fibres

Fibre Colour / No.		Source At Near End dB ref. Reading (P1)	True Value (P2) (P1-P2)	Result (≤ 2.0 dB, Pass)	
Blue	1			☐ Pass	☐ Fail
Orange	2			☐ Pass	☐ Fail
Green	3			☐ Pass	☐ Fail
Brown	4			☐ Pass	☐ Fail
Slate	5			☐ Pass	☐ Fail
White	6			☐ Pass	☐ Fail

		Source At Far End dB ref. Reading (P1)	True Value (P2) (P1-P2)	(≤ 2.0 dB, Pass)	
Blue	1			☐ Pass	☐ Fail
Orange	2			☐ Pass	☐ Fail
Green	3			☐ Pass	☐ Fail
Brown	4			☐ Pass	☐ Fail
Slate	5			☐ Pass	☐ Fail
White	6			☐ Pass	☐ Fail

Note: dB ref. obtained with source, launch cable, and power loss meter connected.

Comments:

Tested By: Date:

Annex I TEST SHEET FOR COPPER CABLE (TERMINATED)

The testing of copper cable shall be documented with the test sheet in this annex.

Twisted Pair Test (End-to-End) of Installed Copper Cable (Terminated)

Test Equipment – Digital Cable Tester

Manufacturer: Model:

Serial No.: Calibration Date:
By:

Cable Tag No.:

Cable Type:

Cable Path From: _____ (Near End) To: _____ (Far End))

Length (approx.):

Colour Of Strand	Pair Number	Mapping	Propagation Delay (ns)	Delay Skew (ns)	Insertion Loss	Return Loss	NEXT	ELFEXT	ACR	PSNEXT	PSELFEXT	PSACR
White/Green	1											
Green	2											
White/Blue	3											
Blue	4											
White/Orange	5											
Orange	6											
White/Brown	7											
Brown	8											

Applicable Standard: ANSI TIA/EIA-568-B.2

Attach Test Equipment Outputs

Comments:

Tested By: Date:

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Annex J ABBREVIATIONS AND ACRONYMS

ACP	Association of Cabling Professionals
ANSI	American National Standards Institute
AWG	American Wire Gauge
BICS	Building Industry Consulting Service International
BTU	British Thermal Unit
C	Celsius
CCG	Canadian Coast Guard
COTS	Commercial Off-the-Shelf
CSA	Canadian Standards Association
dB	Decibel
DFO	Department of Fisheries and Oceans
ECA	Electronic Components, Assemblies & Materials Association
EIA	Electronic Industries Association
FC	Ferrule Connector
FRPE	Flame-Retardant Polyethylene
Gbps	Gigabit per second
GFI	Ground Fault Interrupter
GRP	Glass Reinforced Plastic
Hz	Hertz
ICES	Interference-Causing Equipment Standard
IMO	International Maritime Organization
Km	Kilometre
LAN	Local Area Network
LC	Lucent Connector
LED	Light Emitting Diode
LSZH	Low Smoke Zero Halogen
Mbps	Megabit per second
MTRJ	Mechanical Transfer Registered Jack
NEXT	Near End Cross-talk
NIC	Network Interface Card

NEMA	National Electrical Manufacturers Association
OPI	Office of Primary Interest
OTDR	Optical Time Domain Reflectometer
PC	Personal Computer
PCI	Peripheral Connection Interface
PCMCIA	Personal Computer Memory Card International Association
PING	Packet InterNet Grouper
RFC	Request for Comments
RJ	Registered Jack
SC	Subscriber Connector / Standard Connector
SCSI	Small Computer System Interface
SNMP	Simple Network Management Protocol
ST	Standard Tip
STA	Standard Technical Architecture
STP	Shielded Twisted Pair
TA	Technical Authority
TCP/IP	Transmission Control Protocol/Internet Protocol
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories
UPS	Uninterruptible Power Supply
UV	Ultraviolet
WAN	Wide Area Network