

GO & UP Fleet Radio Devices Installation Standard

MX-STC-STD-002

Revision 0
Date: March 2023

GO & UP Fleet Radio Devices Installation Standard

MX-STC-STD-002

Publication Date: March 2023

COPYRIGHT © 2023

Metrolinx,

an Agency of the Government of Ontario

The contents of this publication may be used solely as required for services performed on behalf of Metrolinx or for and during preparing a response to a Metrolinx procurement request. Otherwise, this publication or any part thereof shall not be reproduced, re-distributed, stored in an electronic database or transmitted in any form by any means, electronic, photocopying or otherwise, without written permission of the copyright holder. In no event shall this publication or any part thereof be sold or used for commercial purposes.

The information contained herein or otherwise provided or made available ancillary hereto is provided "as is" without warranty or guarantee of any kind as to accuracy, completeness, fitness for use, purpose, non-infringement of third-party rights or any other warranty, express or implied. Metrolinx is not responsible and has no liability for any damages, losses, expenses, or claims arising or purporting to arise from use of or reliance on the information contained herein.

Preface

This is the first edition of the GO & UP Fleet Radio Devices Installation Standard (MX-STC-STD-002). Radio devices installed on the GO Transit and UP Express (GO & UP) fleet are required to provide to the operating crew safe and reliable means of communication. The purpose of the GO & UP Fleet Radio Devices Installation Standard is to have a document that can be applied during the acquisition of new or refurbished rolling stock that sets the specifications and requirements for the installation of radio communications devices.

The standard will ensure that radio devices meet Metrolinx specifications and are installed properly in an environment free of electromagnetic interference, high temperatures and humid/wet environment for healthy and safe radio operations. This standard is available for external users to download via the Metrolinx public download site at http://www.gosite.ca/engineering_public/

The technical content within the GO & UP Fleet Radio Devices Installation Standard (MX-STC-STD-002) was developed by the Metrolinx Signals & Communication/Radio Systems office within Engineering and Asset Management Division.

Suggestions for revision or improvements can be sent to Metrolinx Signals and Communication, Radio Systems, Attention: Senior Manager, Radio Systems, who will introduce the proposed changes to Metrolinx Radio Systems. The Senior Manager Radio Systems ultimately authorizes the changes. A description of the proposed change should be included along with information on the background of the application and any other useful rationale or justification. Proposals for revisions or improvements shall include your name, company affiliation (if applicable), e-mail address, and phone number.

March 2023

Contents:

Preface	ii
1. Introduction	1
1.1 General.....	1
2. Definitions, interpretation, codes, and standards.....	1
2.1 Definitions.....	1
2.2 Abbreviations	2
2.3 Codes, standards and reference documents.....	4
3. Radio devices installation	5
3.1 Installation requirements	5
3.2 Radio devices and ancillaries specifications and/or part numbers.....	9

List of Tables:

Table 1: List of definitions	1
Table 2: List of abbreviations.....	2

List of Figures:

Figure 1: Radio layout in cab car.....	5
Figure 2: Locomotive ICCU Layout.....	6
Figure 3: Clearance at the Rear of the Equipment	7

1. Introduction

1.1 General

1.1.1 Radio devices on the GO Transit and UP Express rail fleet include UHF mobile radios, VHF mobile radios, handsets/palm microphones, speakers, regulated DC-DC converter power supplies, and additionally for GO Transit fleet Integrated Communications Control Units (ICCU) and volume controls.

Mobile radios on the GO Transit and UP Express rail fleet are to be programmed with radio frequency channels licensed by Innovation, Science and Economic Development Canada (ISED) for any for the purposes of but not limited to emergencies; end to end; train to train; train to track worker; train to dispatch; train to Network Operations Center (NOC); train to Willowbrook Operations Control Center (WOCC)/ Whitby Control Center (YCC); train to signals/crossings; and vice versa communications and for any other need not listed above. Metrolinx Radio Systems owns various radio channels (UHF and VHF) that were licensed by ISED for UHF and Railway Association of Canada (RAC) for VHF to be used throughout most of the Metrolinx operating area. As the channels' licensee, Metrolinx shall program the mobile radios with Metrolinx licensed radio channels for rail fleet communications. This standard will be used to ensure that all radio devices are installed consistently across the rail fleet.

2. Definitions, interpretation, codes, and standards

2.1 Definitions

2.1.1 Capitalized terms used in this standard shall have the meanings prescribed in Table 1.

Table 1: List of definitions

Term	Definition
"Metrolinx"	Means Metrolinx, a non-share capital corporation continued under the Metrolinx Act, S.O. 2006, c.16 and a Crown Agency in accordance with the Crown Agency Act, R.S.O. 1990, c.48 and includes all operating divisions.

Term	Definition
"Radio Systems"	Metrolinx business unit responsible for providing and maintaining the radio network and services across the Metrolinx operating area.

2.2 Abbreviations

2.2.1 The abbreviations used in this standard shall have the meaning prescribed in Table 2.

Table 2: List of abbreviations

Abbreviation	Definition
AAR	The Association of American Railroads
APTA	American Public Transportation Association
ASTM	American Society for Testing and Materials
AUX	Auxiliary
dBm	Decibel milliwatts. is a unit of level used to indicate that a power level is expressed in decibels (dB) with reference to one milliwatt (mW)
CAI	Common Air Interface
DC	Direct Current
DMUs	Diesel Multiple Units
GPS	Global Positioning System
ICCU	Integrated Communications Control Unit
ICEA	The Insulated Cable Engineers Association
IEC	International Electrotechnical Commission. It creates Standards for electrical and electronic technologies
ISED	Innovation, Science and Economic Development Canada, (formerly IC - Industry Canada). It is the government agency that among other things is in charge of licensing the radio spectrum and resolve interference disputes of licensed frequencies.
KHz	1000 Hertz or cycles/second. A unit used to measure the frequency of an audio or electrical signal.

Abbreviation	Definition
LVPS	Low Voltage Power Supply
MHz	1,000,000 Hertz or cycles/second. A unit used to measure the frequency of an audio or electrical signal.
MIL	Military Specification/Standard
NEC	National Electrical Code
NEXEDGE	The digital radio brand from Kenwood which uses the NXDN Common Air Interface.
NOC	Network Operations Center
NXDN	New Digital Radio Standard adopted by the Railway Operators in North America to have a more efficient use of radio waves.
OEM	Original Equipment Manufacturer
PA/IC	Public Address and Intercom
RAC	Railway Association of Canada
RFEAM	Rail Fleet Engineering Asset Management
TDMA	Time Division Multiple Access. A technology that permits a more efficient use of a radio channel by splitting it in two fully functional digital channels.
Tx/Rx	Transmit and Receive
UHF	UHF, which means Ultra High Frequency, is the designation for radio frequencies in the range between 300 megahertz (MHz) and 3 gigahertz (GHz).
VHF	VHF, which means Very High Frequency, is the designation for radio frequencies in the range between 30-300 megahertz (MHz)
WOCC	Willowbrook Operations Control Center
YCC	Whitby Control Center

2.3 Codes, standards and reference documents

2.3.1

All systems, equipment and materials for work relating to this standard, shall be provided by the rolling stock vendor in accordance with the most current edition of applicable federal, provincial, municipal, and industry codes, and standards including but not limited to the following or their equivalent or substitutions as approved by Metrolinx Rail Fleet Engineering Asset Management (RFEAM):

- a) Canadian Centre for Occupational Health and Safety;
- b) Canadian Standards Association (CSA);
- c) French Language Services Act;
- d) IEC 60529 Degrees of protection provided by enclosures (IP Code)
- e) IEC 60571 Railway applications - Electronic equipment used on rolling stock
- f) IEC 61000-4-2 Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
- g) IEC 61000-4-3 Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radiofrequency, electromagnetic field immunity test
- h) IEC 61000-4-4 Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
- i) IEC 61000-4-5 Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
- j) IEC 61000-4-6 Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
- k) IEC 61373 Railway applications - Rolling stock Equipment - Shock and vibration tests
- l) IEC 60068-2-1 Environmental testing - Part 2-1: Tests - Test Ad
- m) IEC 60068-2-2 Environmental testing - Part 2-2: Tests -Test Bd
- n) IEC 60068-2-30 Environmental testing - Part 2-30: Tests -Test Db
- o) IEC 62236-3-2 Railway Applications - Electromagnetic Compatibility - Part 3-2: Rolling stock - Apparatus
- p) EN 50121-3-2 Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus

APTA Standard SS-E-001-98

3. Radio devices installation

3.1 Installation requirements

- 3.1.1 The radios, ICCUs, speakers, handsets, volume controls and associated DC to DC converter power supplies as specified shall be installed in a location easily accessible for maintenance, attaching test equipment during testing and device changeouts at a working height that does not cause undue strain due to overstretching or bending to maintenance personnel and shall not be installed in low lying or overhead compartments.
- 3.1.2 The radios, ICCUs and associated DC to DC converter power supplies shall be installed in a location with an ambient temperature that shall not exceed the range of -25° to 35° Celsius contrary to IEC 60571 and shall not have any objects blocking air flow around these devices during operation. Radio and ICCU displays shall be clearly visible and fasciae shall be easily accessible for operators and maintenance personnel, as seen in figures 1 and 2.

Figure 1: Radio layout in cab car

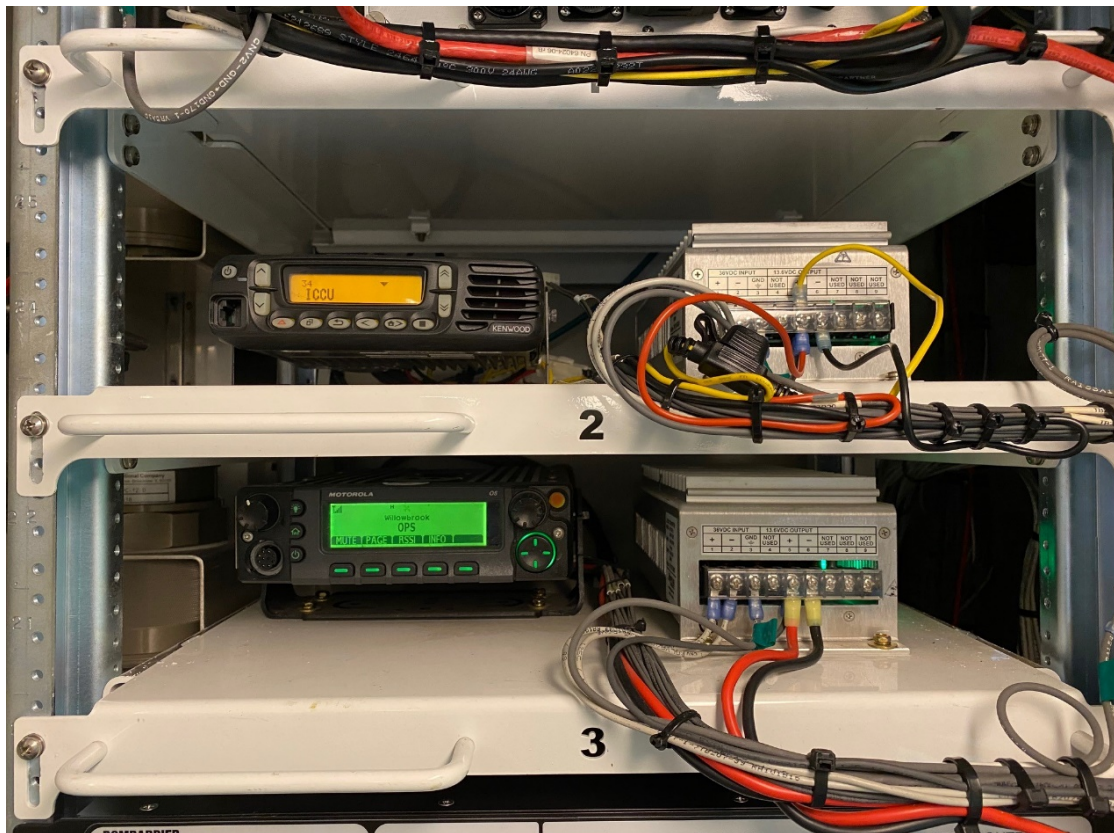


Figure 2: Locomotive ICCU layout

- 3.1.3 The radios, ICCUs and associated DC to DC converter power supplies shall be installed in a location free of exposure to the elements such as water, ice, snow and dust.
- 3.1.4 The DC to DC converter power supplies as specified in 3.2 shall be supplied for each UHF and VHF radio and the outputs of the converters shall be connected in parallel for redundancy at the fuse boxes. (Paralleling shall not apply to UP Fleet). These power supplies are custom designed for Metrolinx and substitutions shall require express approval from Radio Systems and RFEAM.
- 3.1.5 The fuse boxes as specified in 3.2 shall be provided to the outputs of the DC to DC converter power supplies and the power supply lines to the radios shall be fused at the fuse boxes at the recommended OEM values. The OEM in-line fuse holders supplied with the radios shall not be used.
- 3.1.6 All cable and harness connectors at the rear of equipment shall be easily accessible and shall have at least 6 in of clearance room for repeated disconnect and reconnect operations due to the nature of tests and software upgrades required for maintaining the equipment in a state of good repair, as shown in figure 3.

Figure 3: Clearance at the rear of the equipment

- 3.1.7 All interconnections between radios, handsets, speakers, volume controls to ICCUs shall not have any intermediate connectors or terminal blocks except for those required to interface with PA/IC trainlines, voice alarm inputs and train LVPS power sources.
- 3.1.8 Where it is required for example analog PA/IC trainlines, microphone/earpiece audio or Tx/Rx audio signals wiring twisted shielded pair cables shall be deployed and included in the cable harnesses.
- 3.1.9 All wire and cables shall be insulated, cross-linked polyolefin materials or equal and shall meet the requirements of APTA Standard SS-E-001-98 or as approved by RFEAM.
- 3.1.10 The selection of wire size shall be based on the required current carrying capacity, voltage drop, physical strength, temperature, radio frequency, losses and flexibility requirements in accordance with applicable APTA, AAR, ICEA, ASTM, NEC or MIL Standards and Specifications and Section F of the AAR Manual of Standards and Recommended Practices or as agreed upon between rolling stock vendor and RFEAM.
- 3.1.11 The UHF antennas shall be mounted in top of the locomotive, cab cars or DMUs in the center of a metal area of minimum 30 in x 30 in to act as its own ground plane. For other mounting solution and location, rolling stock vendor shall provide certification that the antenna is performing to the specifications in collaboration with

manufacturer of the antenna. Antenna selection and location shall be approved by Radio Systems.

- 3.1.12 The VHF antennas shall be mounted in top of the locomotive in center of a metal area of minimum 48 in x 48 in to act as its own ground plane. For other mounting solution and location, rolling stock vendor shall provide certification that the antenna is performing to the specifications in collaboration with manufacturer of the antenna. Antenna selection and location shall be approved by Radio Systems.
- 3.1.13 All antennas mounted on steel surfaces shall be galvanically protected with conductive gaskets and sealants as specified. The horizontal distance between antennas shall be greater than 1/4 of the wavelength of the lowest frequency i.e. 160 MHz (absolute minimum separation) and shall not be located at the exact multiples of its wavelength (avoiding the first 3-4 multiples). Antenna selection and location shall be approved by Radio Systems.
- 3.1.14 The coaxial cables shall only be deployed as specified in 3.2 and shall have at least two service loops at each end with radiuses as recommended by OEM.
- 3.1.15 The coaxial connectors shall be crimped and soldered and shall be deployed as specified in 3.2 and substitutions shall only be approved by Radio Systems.
- 3.1.16 All soldered or crimped wire ends into connector or receptacle pins or sockets shall be protected with heat shrink tubing. The soldering workmanship shall meet J-STD-001 standard.
- 3.1.17 The noise floor level within any rolling stock resulting from any electrical, electronic devices, power supplies and lighting systems shall not exceed individually values of negative 106 dBm +/- 5%. Nor shall the Noise floor level of any electrical, electronic devices, power supplies and lighting systems shall not exceed values of negative 106 dBm +/- 5% cumulatively (sum effect) in the following radio spectrum and bandwidths:
 - a) Digital trunked UHF (P25 TDMA) - 410 to 420 MHz @ 6.25kHz
 - b) Digital VHF conventional (NXDN) 160.17 to 161.58 MHz @ 6.25kHz analog
VHF conventional 160.17 to 161.58 MHz @ 12.5 and 25 kHz

3.2 Radio devices and ancillaries specifications and/or part numbers

3.2.1 The following are the minimum specifications and/or part numbers of all the Radio Devices and Ancillaries:

UP Fleet

- a) UHF radio Motorola model M25QSS9PW1AN - APX6500 UHF R1 mid power GA00317AC.
 - 1) Canada five-year essential G90AC
 - 2) No microphone needed APX G996AS
 - 3) Over the air provisioning G806BE
 - 4) Astro digital CAI operation GA00235AA
 - 5) No GPS antenna needed APX GA00580AA
 - 6) TDMA operation G51AU
 - 7) SmartZone operation APX6500 G142AD
 - 8) No speaker APX G89AC
 - 9) No RF antenna needed G442AJ
 - 10) APX O5 control head G444AE
 - 11) APX control head software G66AM
 - 12) Dash mount 05
- b) VHF Radio Kenwood Model NX5700K
 - 1) 136-174 MHz, NXDN/conv/digital/analog / type - C trunking 1024 ch, w/n/vn,
 - 2) 5-50 watt, BT V3, GPS mobile w/control head
 - 3) MicroSD memory card slot activation in NX-5000 series and licenses
 - 4) Capable of recording all audio transmitted and received
 - 5) Equipped with function ports (AUX input/ AUX output) that can be programmed for use with the D-sub, 25-pin connector located on the rear panel of the transceiver.
 - 6) Compatible with voice and data networks based on NXDN protocol and NEXEDGE equipment.
- c) Power supply - DC to DC converter Absopulse Electronics model RWY 500-72/14PT-R8332 Part No. K003369, input 72Vdc (43-101V) 15A max, output 13.8Vdc 36A (500W)

- d) External speaker kit for UHF radio Motorola Part No. HSN9008A
- e) Palm microphone UHF radio Motorola Part No. HMN1090D
- f) Palm microphone VHF radio Kenwood Part No. KMC 28A
- g) Sinclair UHF antenna ST321-SF2SNF.
- h) Sinclair VHF antenna ST221- SF1SNF(F1614).
- i) VHF antenna conductive gasket - CorrSolve Corrosive Solutions Part No. RG901000-09
- j) UHF antenna conductive gasket - CorrSolve Corrosive Solutions Part No. RG901000-11
- k) Sealant Corr-Form black sealing injectable 50cc CorrSolve Corrosive Solutions Part No. RS8771-50 for UHF and VHF antennas.
- l) Coaxial cables for UHF and VHF radios LMR-400 Ultraflex FR.
- m) Coaxial RF connectors - UHF/VHF antenna ends RFI-RFN 1006 3I crimped and soldered.
- n) Coaxial RF connectors - UHF radio end TC-400-MUHF, VHF radio end RFU-507SI crimped and soldered.

GO Fleet

- a) UHF radio Motorola model M25QSS9PW1AN - APX6500 UHF R1 mid power GA00317AC.
 - 1) Canada five-year essential G90AC
 - 2) No microphone needed APX G996AS
 - 3) Over the air provisioning G806BE
 - 4) Astro digital CAI operation GA00235AA
 - 5) No GPS antenna needed APX GA00580AA
 - 6) TDMA operation G51AU
 - 7) SmartZone operation APX6500 G142AD
 - 8) No speaker APX G89AC
 - 9) No RF antenna needed G442AJ
 - 10) APX O5 control head G444AE
 - 11) APX control head software G66AM
 - 12) Dash mount 05
- b) VHF radio Kenwood model NX5700K

- 1) 136-174 MHz, NXDN/conv/digital/analog / type - C trunking 1024 ch, w/n/vn,
 - 2) 5-50 watt, BT V3, GPS mobile w/control head
 - 3) MicroSD memory card slot activation in NX-5000 series and licenses
 - 4) Capable of recording all audio transmitted and received
 - 5) KAP-2 external speaker board
 - 6) Equipped with function ports (AUX input/ AUX output) that can be programmed for use with the D-sub, 25-pin connector located on the rear panel of the transceiver.
 - 7) Compatible with voice and data networks based on NXDN protocol and NEXEDGE equipment.
- c) Locomotive power supplies - DC to DC converter Absopulse Electronics BAP 236RTH-72-14FT-S1031A, input 72Vdc (43-101V) 5.6A max, output 13.6Vdc 14A (200W) for each UHF and VHF radio.
 - d) Cab car power supplies - DC to DC converter Absopulse Electronics BAP 236TH-36-14FT-S2071, input 36Vdc (22-51V) 11A max, output 13.6Vdc 14A (200W) for each UHF and VHF radio.
 - e) Handsets Audiosears Part No. GO0901-IQU05 each for engineer and conductor sides.
 - f) Handset cradles Audiosears Part No. CD0223-NBN each for engineer and conductor sides.
 - g) Handset receptacles Amphenol 97-3102A-14S-6S each for engineer and conductor sides
 - h) Speakers ISC Applied Systems Part No. 2000-0061-2 each for VHF and UHF engineer side and UHF conductor side.
 - i) Speaker with volume control ISC Applied Systems Part No. 1050-0004-1 for VHF conductor side. (locomotives only).
 - j) Volume control box for conductor side ISC Applied Systems Part No. 1100-0220-1 (cab cars only).
 - k) Sinclair UHF antenna ST321-SF2SNF.
 - l) Sinclair VHF antenna ST221- SF1SNF(F1614).
 - m) VHF antenna conductive gasket - CorrSolve Corrosive Solutions Part No. RG901000-09 (locomotives only)
 - n) UHF antenna conductive gasket - CorrSolve Corrosive Solutions Part No. RG901000-11 (locomotives only)
 - o) Sealant Corr-Form black sealing injectable 50cc CorrSolve Corrosive Solutions Part No. RS8771-50 for UHF and VHF antennas (locomotives only).

- p) Coaxial cables for UHF radios LMR-400 Ultraflex FR (locomotives only).
- q) Coaxial cables for VHF radios LMR-400 Ultraflex FR
- r) Coaxial RF connectors - UHF/VHF antenna ends RFI-RFN 1006 3I crimped and soldered.
- s) Coaxial RF connectors - UHF radio end TC-400-MUHF, VHF radio end RFU-507SI crimped and soldered.
- t) Coaxial cables for UHF radios LMR-240 Ultraflex FR (cab cars only)
- u) Coaxial RF connectors - UHF radio end TMC-TC-240 MUHF, antenna end Amphenol Connex 172135 (cab cars only)
- v) Cable harnesses required for locomotives (by vendor):
 - 1) ICCU to VHF radio
 - 2) ICCU to UHF radio
 - 3) Auxiliary equipment (PA and Intercom)
 - 4) ICCU 74VDC power and voice alarm inputs
 - 5) Speaker UHF engineer side
 - 6) Speaker VHF engineer side
 - 7) Speaker and volume control assembly for conductor VHF
 - 8) Speaker for conductor UHF
 - 9) ICCU to conductor cradle
 - 10) ICCU to engineer cradle
 - 11) ICCU to conductor handset receptacle
 - 12) ICCU to engineer handset receptacle
 - 13) 74VDC to VHF radio power supply DC to DC converter
 - 14) 74VDC to UHF radio power supply DC to DC converter
- w) Cable harnesses required for cab cars (by vendor):
 - 1) ICCU to VHF radio
 - 2) ICCU to UHF radio
 - 3) Auxiliary equipment (PA/IC)
 - 4) ICCU 36VDC power
 - 5) Speaker UHF engineer side
 - 6) Speaker VHF engineer side

- 7) Volume control to ICCU
 - 8) Speaker for conductor UHF
 - 9) Speaker for conductor VHF
 - 10) ICCU to conductor cradle
 - 11) ICCU to engineer cradle
 - 12) ICCU to conductor handset receptacle
 - 13) ICCU to engineer handset receptacle
 - 14) 36VDC to VHF radio power supply DC to DC converter
 - 15) 36VDC to UHF radio power supply UHF DC to DC converter
- 3.2.2 Fuse boxes shall be of type ST Blade 6 position Blue Sea Systems model 32085-05025 or equivalent.
- 3.2.3 As system requirements can change Radio Systems shall be consulted before purchasing any radio equipment.