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SPECIFICATIONS DEFINING THE JOINT DISMOUNTED SOLDIER SYSTEM INTEROPERABILITY NETWORK (JDSSIN) – LOANED RADIO

Edition A Version 3

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NORTH ATLANTIC TREATY ORGANIZATION

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NATO LETTER OF PROMULGATION

20 March 2023

1.   The enclosed Allied Engineering Publication AEP-76, Volume III, Edition A, Version 3, SPECIFICATIONS DEFINING THE JOINT DISMOUNTED SOLDIER SYSTEM INTEROPERABILITY NETWORK (JDSSIN) – LOANED RADIO which has been approved by the nations in the NATO ARMY ARMAMENTS GROUP, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 4677.

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS

Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Documents Database for the complete list of existing reservations.

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]

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CHAPTER 1   INTRODUCTION

1.1   AIM

Standardization Agreement (STANAG) 4677 [1] on Dismounted Soldier Systems (DSS) Standards and Protocols for Command, Control, Communications and Computers (C4) Interoperability (DSS C4 Interoperability STANAG) aims at enabling interoperability through a standardized exchange of information between C4 systems used by dismounted soldiers across North Atlantic Treaty Organization (NATO) or Partners for Peace (PFP) force boundaries. The DSS C4 Interoperability solution is depicted in Figure 1.
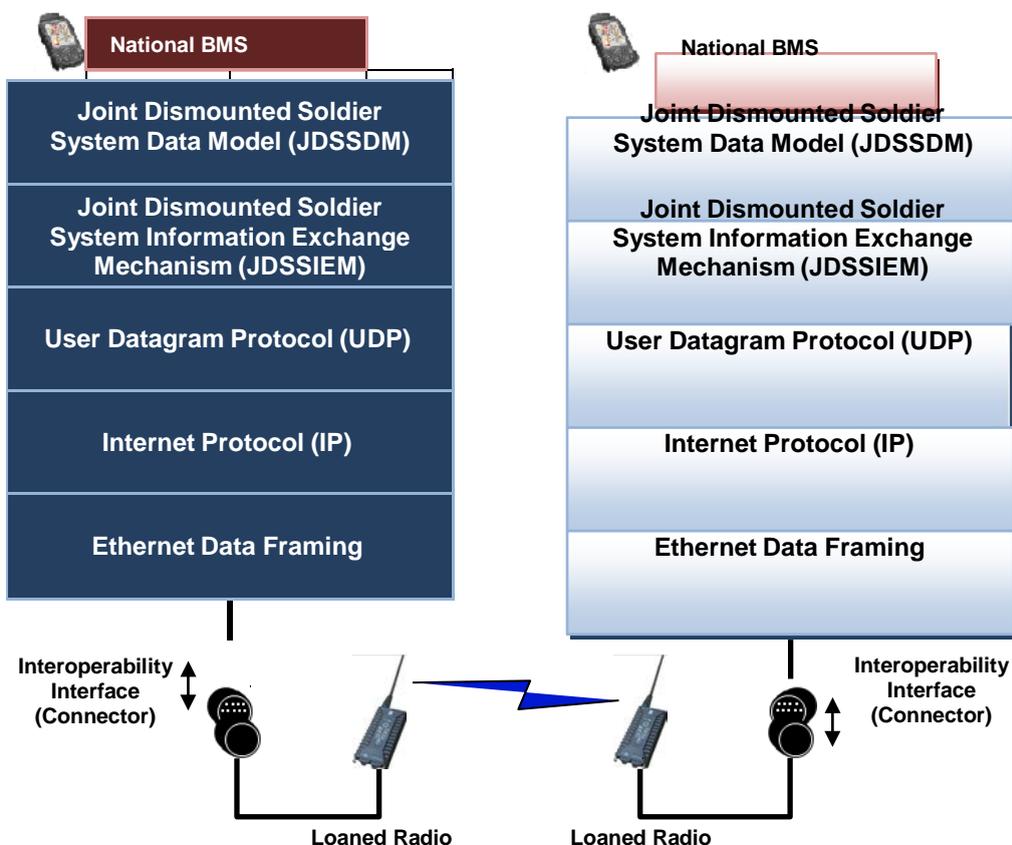

Figure 1: Dismounted Soldier System C4 Interoperability Solution

The DSS C4 Interoperability solution contains:
- A Joint Dismounted Soldier System (JDSS) Gateway, acting as a message translator, added to each C4 sub-system of a national DSS consisting of:
  - Joint Dismounted Soldier System Data Model (JDSSDM)
  - Joint Dismounted Soldier Information Exchange Mechanism (JDSSIEM)

> o User Datagram Protocol (UDP)
> o Internet Protocol (IP)
> o Ethernet
- A physical connection between the JDSS Gateway and the Loaned Radio based on STANAG 4851 in conjunction with the use of Ethernet over USB.
- A Loaned Radio.

1.2 OBJECTIVE

This AEP defines standard interfaces and minimal requirements to ensure that Coalition forces can exchange information over the Interoperability Network using a Loaned Radio. It also gives guidelines for the selection and configuration of a Loaned Radio and defines the responsibilities for the loaning and receiving nations

The Interoperability Network constituted by the JDSS Gateways and interconnected by the Loaned Radios is totally separated from the national wireless networks and is only connected to the national DSS through the Gateway Soldiers as shown in Figure 2. The JDSS Gateway is not a part of the Loaned Radio, but will reside in either the national C4 computer or a dedicated soldier computer.
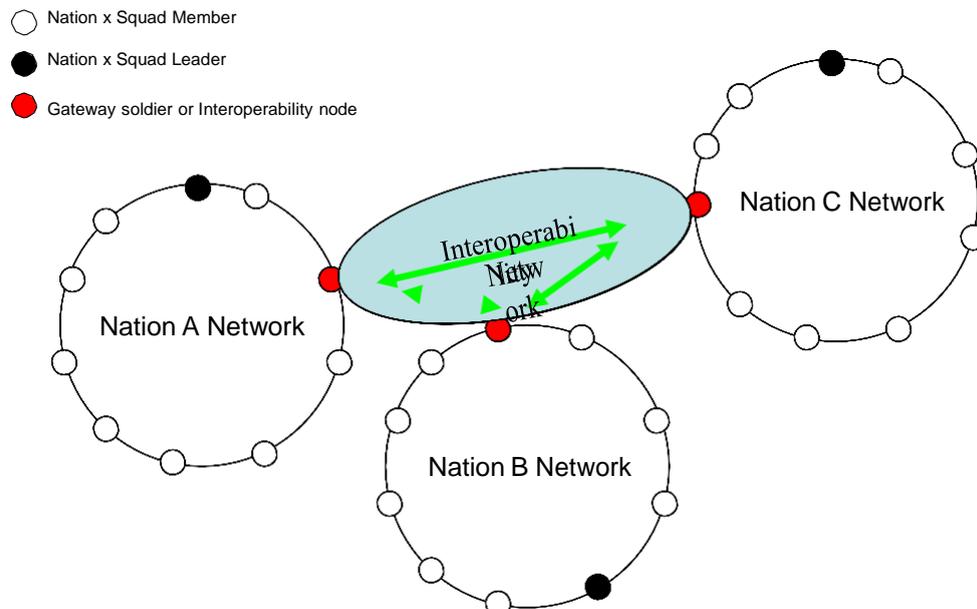

Figure 2: The Interoperability Network Approach

1.3   SCOPE

The Loaned Radio is typically carried by the Gateway Soldiers, constituting an additional radio network which connects the participating national DSS to the Interoperability Network. The Loaned Radio is to be provided by one of the participation nations which is also in charge for the management and configuration aspects of the radio when used in the Interoperability Network.

For each national squad within an agreed area of interoperability, there will be at least one Gateway Soldier connecting the national DSS to the Interoperability Network. Since this area may join more than two nations, each with more than one squad, it is expected that the Interoperability Network will be formed by more than two Gateway Soldiers.

The Loaned Radio will be connected to the national DSS through the JDSS Interoperability Interface. Radios that are not fully compliant with the JDSS Interoperability Interface shall make use of a NATO Radio Adapter [2] fulfilling the missing functionalities.

At present, the Interoperability Network only deals with the data traffic identified in the JDSSDM AEP [6]. Voice communication between the participating nations through the Interoperability Network is not handled in this implementation of the STANAG.

1.4   REFERENCED DOCUMENTS

LCGDDS Documentation

Ref	Document ID	Title	Revision
[1]	STANAG 4677 Edition A	Dismounted Soldier Systems Standards and Protocols for Command, Control, Communications and Computers (C4) Interoperability Standardisation Agreement (DSS C4 Interoperability STANAG)	Ed A
[2]	STANAG 4851	STANAG 4851 COMBINED POWER AND DATA ACCESSORY CONNECTOR FOR DISMOUNTED SOLDIER SYSTEMS (DSS)	Ed A
[3]	STANAG 5048	THE MINIMUM SCALE OF CONNECTIVITY FOR COMMUNICATIONS AND INFORMATION SYSTEMS FOR NATO LAND FORCES	Ed 5
[4]	AEP-76, VOL. V	AEP-76, VOL.V Specifications Defining the Joint Dismounted Soldier System Interoperability Network (JDSSIN) – Network Access (STANAG 4677) Edition A	Ed A
[5]	AEP-76, VOL. IV	AEP-76, VOL.IV Specifications Defining the Joint Dismounted Soldier System Interoperability Network (JDSSIN) - Information Exchange Mechanism (STANAG 4677) Edition A	Ed A
[6]	AEP-76, VOL. II	AEP-76, VOL.II Specifications Defining the Joint Dismounted Soldier System Interoperability Network (JDSSIN) Data Model (STANAG 4677)	Ed A

Ref	Document ID	Title	Revision
		Edition A	
[7]	AEP-76, VOL. I	AEP-76, VOL. I Specifications Defining the Joint Dismounted Soldier System Interoperability Network (JDSSIN) – Security (STANAG 4677) Edition A	Ed A

1.5 RELATED DOCUMENTS

	Document ID	Title	Revision
[9]	IEEE 802.3	IEEE set of standards for Ethernet based LANs	
[10]	RFC 791	Internet Protocol Specification	
[11]	RFC 792	Internet Control Message Protocol	
[12]	RFC 1122	Host Extensions for IP Multicasting	
[13]	USB 2.0	https://www.usb.org/document-library/usb-specification	
[14]	CDC-ECM	CDC Subclass Specification for Ethernet Emulation Model Devices 1.0, 02/02/2005, https://www.usb.org/document-library/cdc-subclass-specification-ethernet-emulation-model-devices-10	
[15]	MS-RNDIS	Remote Network Driver Interface Specification (RNDIS) Protocol Rev 5.0, dated 15/05/2014, http://download.microsoft.com/download/5/0/1/501ED102-E53F-4CE0-AA6B-B0F93629DDC6/Windows/[MS-RNDIS].pdf	
[16]	NIAG Study SG103 Annex F	Radio Aspects	
[17]	NIAG Study SG103 Annex D	Overall Interoperability Architecture	
[18]	NIAG Study SG123 Annex B	White Paper on Security in Joint Dismounted Soldier Systems Information Handling and Exchange	

1.6 GLOSSARY

Gateway Soldier	The designated soldier within a national squad interfacing the Loaned Radio with the national DSS.

Interoperability Network	The IP network formed by the JDSS Gateways interconnected by the Loaned Radios in order to exchange information between the national DSS.
JDSS Gateway	A message translator added to each C4 sub-system of a national DSS including the JDSSDM, JDSSIEM, UDP, IP and Ethernet.
JDSS Interoperability Interface	Defines the physical interface between the Loaned Radio and the JDSS Gateway.
Loaned Radio	The radio provided by one of the participating nations enabling the Interoperability Network.
Radio Adapter	Adapter between the Loaned Radio and the JDSS Interoperability Interface shall adapt a Loaned Radio not fulfilling all mandatory requirements defined in this AEP to be fully compliant

CHAPTER 2   OVERVIEW

This AEP has been developed to formalise the specifics of the Loaned Radio concept and is organised as follows:

The first section describes the requirements regarding the Loaned Radio, including the Radio Adapter requirements when the Loaned Radio does not fulfil the mandatory requirements.

The next section describes the deployment concept. In general for Coalition and NATO operations a so called Supporting nation / Supported nation framework is applied. The Supporting nation is given the full responsibility to establish the Command and Control (C2) structures for its own forces, including the troops provided by other nations within its area of responsibility.

Finally, the Statement of Loaned Radio Conformance provides the selection guidelines for the Loaned Radio.

Throughout the requirements the words 'shall', 'should' and 'may' are used to state the nature of the requirements. Shall is used to identify mandatory requirements, while should is used to identify guidelines for the selection that are desirable but not mandatory. May is used to indicate a freedom of choice to be implemented on a bilateral basis between the participating nations.

CHAPTER 3   LOANED RADIO REQUIREMENTS

3.1   LAN INTERFACE REQUIREMENTS

Requirement 1.   The Loaned Radio <u>shall,</u> at the Local Area Network (LAN) interface towards the JDSS Gateway, meet the following gateway functionality and hardware specifications:

- Level 0: Mechanical connector
- Level 1: Physical USB Protocol
- Level 2: Ethernet Data Link Protocol

If the Loaned Radio is not compliant on one of these requirements the Supporting nation can provide a Radio Adapter to be fully compliant. The Radio Adapter is further described in section 3.2 of this AEP.

3.1.1   Level 0: Mechanical Connector

Requirement 2.   The Loaned Radio <u>shall</u> be connected to the national DSS using the connector defined in the STANAG 4851 [2].

Rationale: The Allied Engineering Publication AEP- 4851 defines the NATO standard interface between a nation's dismounted soldier systems and (another) nation's ancillary devices such as loaned radios, sensors, GPS, Night Vision Goggles (NVG), Laser Range Finder (LFR) etc. (Figure 3)

It defines the connector physical characteristics and the electrical and data format characteristics to allow interoperability.

This interface provides both data and power interconnectivity.

In this context it is unlikely that one nation will connect their host device to another nation's soldier system. The primary aim is to allow interoperability of devices wishing to share data, however it is possible to use this interface to provide power only to a device if required.

It should be noted that this AEP 4851 interface uses the same physical connector as AEP 4695 (SOLDIER POWER CONNECTOR - ELECTRICAL CONNECTIVITY STANDARDS BETWEEN NATO POWER SOURCES AND DISMOUNTED SOLDIER SYSTEMS (DSS)). The two differ in the pin assignments only.

The primary purpose of the AEP 4851 interface is to allow sharing of data although it can also provide power to ancillary devices. It can therefore be used to provide power only to ancillary devices using either the 5 V or 10-20 V power lines described later if required.
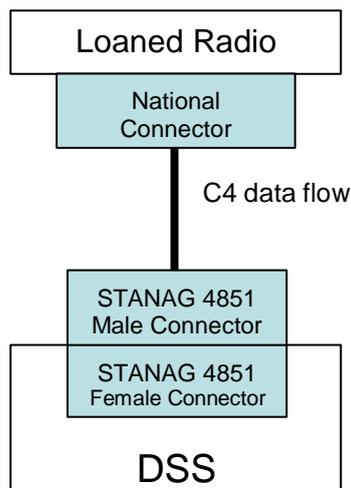

Figure 3: Loaned Radio connection on national DSS

3.1.2   Level 1: Physical USB Protocol

Requirement 3.   The Loaned Radio <u>shall</u> have a physical USB layer interface as defined in STANAG 4851 (USB 2.0 [13] or USB 1.X, the DDS must provide USB 2.0)

Requirement 4.   The USB pin assignment <u>shall</u> be as described in STANAG 4851.

The STANAG 4851 provides an option to supply externally connected equipment with Direct Current (DC) power from a DSS. This ability has to be agreed on a bilateral basis between nations, otherwise the physical level will not provide DC power to the Loaned Radio from the DSS of the Gateway soldier. If required, the patch cable may need a split to power the Loaned Radio from another source during the operation.

3.1.3 Level 2: Ethernet Data Link Protocol

Requirement 5.   The Loaned Radio <u>shall</u> support the following Ethernet over USB protocols:
- MS-RNDIS [15]
- CDC-ECM [14]

Rationale: To ensure maximum compatibility with a wide range operating systems that may be used by a DDS, the loaned radio is required to support both protocols. The loaned radio will be configured to use the appropriate protocol for the connected DSS.

3.2 IP RADIO

The Loaned Radio may be an IP radio operating on OSI layer 3.

Requirement 6.   If an IP radio has been selected as the Loaned Radio, it <u>shall</u> have an IPv4 layer functionality corresponding to RFC 791 [10] and as an IP host <u>should</u> implement
- the source quench on the local interface in conformance with RFC 792 [11] "Internet Control Message Protocol".
- the rules corresponding to RFC 1122 [12] – specifically the rules for UDP with IP Unicast and Multicast.

Rationale: Two versions of the Internet Protocol are in use, IPv4 and IPv6, each defining an IP address differently. Most IP based DSS radios only implement IPv4. Internetworking between IPv4 and IPv6 is not an aim of this AEP.

The IP addressing plan specification for the Loaned radios is described in the Network Access AEP [4].

3.3 RADIO ADAPTER

Several types of legacy radios may be candidate Loaned Radios, but will have one or more limitations in fulfilling the whole set of listed requirements in this AEP. Those limitations can be eliminated by inserting a Radio Adapter in between the Loaned Radio and the Interoperability Interface as shown in Figure 4.

Requirement 7.   In the likelihood of not having the defined connector either on the Loaned Radio or the national DSS, a Radio Adapter is a patch cable that shall act as a converter between different types of connectors or different pin configurations.

Requirement 8.   The Radio Adapter in combination with the Loaned Radio shall fulfill the full set of mandatory requirements defined in section 3.1.

Requirement 9.   The JDSS interoperability interface of the Radio Adapter shall have a STANAG 4851 connector.

Rationale: based on the Loaned Radio capabilities the Radio Adapter may provide a conversion cable or a simple patch cable with the appropriate connector and pin configuration.
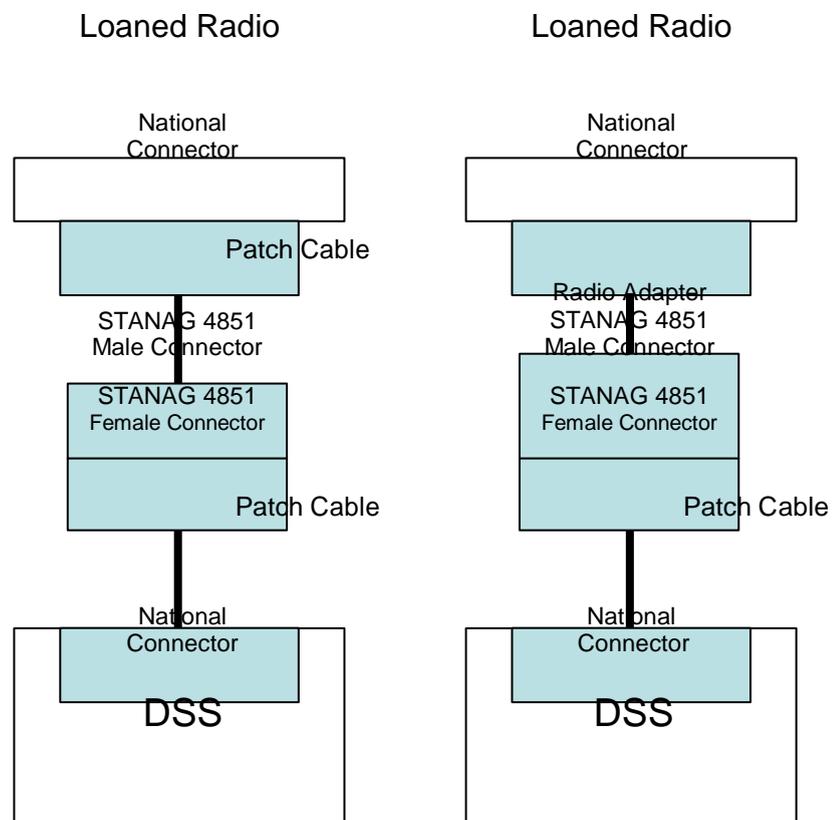

Figure 4:Radio Adapter configurations

This adapter needs only to be used to adapt the Loaned Radio candidate to the full set of mandatory (shall) requirements in this AEP and will vary in functionality and complexity depending on the agreed type of Loaned Radio.

CHAPTER 4   DEPLOYMENT CONCEPT

4.1   GENERAL PRINCIPLE

The Loaned Radio selection depends on the availability of appropriate radios that can be shared between the nations participating in the Interoperability Network. The responsibility for providing the required connectivity is governed by the general principles of STANAG 5048 and follows the rules:

- Higher formation to lower formation
- Supporting formation to supported formation
- Left formation to right formation

It is quite likely that the Gateway Soldier will be carrying two radios; the Loaned Radio and the soldier's national DSS radio. Having two radios on one soldier can cause collocation problems where the radios will interfere with each other, hence reducing the performance of one or both radios. It is recommended that the participating nations perform an analysis of both radios' Electro Magnetic Compatibility (EMC) / Electro Magnetic Interference (EMI) characteristics to determine optimal radio and antenna positioning on the soldier. Special operating procedures need to be followed to optimize radio performance. The two main aspects to consider are:

- Physical distance between the antennas
- Frequency separation for the two radios.

4.2   SUPPORTING NATION RESPONSIBILITY

The Supporting Nation is the nation providing the Loaned Radio, including:

- Patch cable between the Loaned Radio and the JDSS Interoperability Interface
- Radio Adapter if required
- Battery and spare battery to power the Loaned Radio and Radio Adapter if required
- Battery charging equipment
- Pouches or carrying system
- Any auxiliary equipment necessary to run the Loaned Radio if required
- Spare units

Due to the close proximity of two radios and various electronic systems mounted on a soldier, there is a risk that one of the DSS devices could interfere or reduce the sensitivity of the national DSS radio and the Loaned Radio. Therefore, the patch cable and Radio Adapter (if required) must provide proper conducted and radiated radio frequency (RF) shielding precautions.

The Supporting Nation is also responsible for the configuration of the Loaned Radio:
- Configure RF settings
- Configure IP settings in accordance with a coalition agreed IP addressing plan specification.

- Define, load and configure the security settings (crypto keys and hop nets if applicable).
- Maintenance.

4.3   SUPPORTED NATION RESPONSIBILITY

The Supported Nation is the nation receiving the Loaned Radio in order to connect its national DSS to the Interoperability Network and is responsible for:

- Providing the Patch cable between the JDSS Interoperability Interface and the national DSS if required.
- Minimising collocation issues between the Loaned Radio and the national DSS by maximising the distance between the two radio antennas and provide proper RF-shielding of all electronic devices.

4.4   THE HIGHER MULTINATIONAL COMMAND HEADQUARTERS RESPONSIBILITY

The higher multinational command headquarters are responsible for the units at the border and will specify the deployment of the Interoperability Network and is responsible for providing:

- Coordination measures.
- Frequencies for the Interoperability Network implementing a maximal separation between the national networks and the Interoperability Network to reduce EMI.
- IP addressing plan specification.
- Organise pre-deployment / pre-mission tests.
- Organise in theatre training on the Loaned Radio.

CHAPTER 5   TEST AND VERIFICATION

5.1   STATEMENT OF LOANED RADIO CONFORMANCE

Prior to the deployment of the Interoperability Network, the best radio has to be selected from all available radios. The Loaned Radio selection should be based on its functional capabilities, safety and security measures.

Therefore, prior to the radio network tests the coalition nations that can provide a Loaned Radio must complete the Statement of the Loaned Radio Conformance in Annex A. This statement lists all mandatory requirements including some selection criteria. The radio fulfilling most of the selection criteria should be selected as the Loaned Radio. Instructions to complete this statement are described in the following sections.

5.1.1   Mandatory Requirements

Indicate YES when the corresponding requirement is fulfilled. Requirements 7 through 9 are only applicable when a Radio Adapter is needed.

5.1.2   Multi hop and single hop range

The Loaned Radio should have an operational one hop range of typical 1500 m in line of sight (LOS) conditions and 500 m in urban terrain. Radios that create a physical link over multiple hops can increase the operational range.

Indicate YES when the radio supports a physical link over multiple hops and the one hop LOS range in the comment field.

5.1.3   Distributed MAC

The Loaned Radio should have a MAC protocol able to handle multiple radio nodes on the Interoperability Network in order to avoid collisions and frequent retransmissions. Furthermore, a Loaned Radio may be temporally isolated from the Interoperability Network for many reasons including distance, relief and urban terrain. Therefore, the Radio should dynamically allocate RF resources between the nodes and support leaving and re-entering of nodes.

Indicate YES when the radio MAC protocol relies on distributed decisions when forming a conflict free schedule and that no master node is needed.

5.1.4   Forward Error Correcting

The Interoperability Network has to face potential survivability troubles due to the tactical environment. Links and nodes may be degraded or jammed at any moment.

Indicate YES when the radio has a Forward Error Correcting (FEC) capability in order to be less vulnerable to intended and unintended burst jamming.

5.1.5   Maximum Permission Exposure Level

The IEEE C95.1 standard defines the Maximum Permissible Exposure (MPE) Levels with respect to RF electromagnetic fields. The MPE from 100 to 300 MHz is 0.2 mW/cm².

Indicate Yes when the RF power is compliant with the MPE levels defined in IEEE C95.1 and indicate the RF power in the comment field.

5.1.6   TRANSEC – COMSEC

The total security concept and requirements for the JDSS Gateway are described in the Security AEP [7]. The Loaned Radio should provide some security measures, including:

- Transmission Security (TRANSEC): the Loaned Radio should have capabilities for deterring jamming, avoid detection and denial of service. Indicate YES when the radio has TRANSEC capability and indicate the avoidance measure for jamming (e.g. Narrowband Frequency Hopping or Broadband Spread Spectrum) in the comment field.
- Communication Security (COMSEC): the Loaned Radio should provide some COMSEC measures to protect the confidentiality and integrity of the information content. Indicate YES when the radio has a COMSEC capability and indicate the link encryption, tampering protection or zeroizing functionality in the comment field.

5.2   TEST OF THE RADIO LINK

All Loaned Radios in the JDSS Interoperability Network must have RF connectivity.

Set up all Loaned Radios (minimum 2) at an agreed/given frequency. Verify that the RF link is operational.

	ANNEX A ABBREVIATIONS

AEP	Allied Engineering Publication
BMS	Battle Management System
C2	Command and Control
C4	Command, Control, Computer, Communication
COMSEC	Communication Security
DSS	Dismounted Soldier System
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
FEC	Forward Error Correction
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
JDSSDM	Joint DSS Data Model
JDSSIEM	Joint DSS Information Exchange Mechanism
JDSS	Joint Dismounted Soldier System
LAN	Local Area Network
LCGDDS	Land Capability Group on Dismounted Soldier Systems
LOS	Line Of Sight
MAC	Medium Access Control
MPE	Maximum Permissible Exposure
NATO	North Atlantic Treaty Organization

OSI	Open System Interconnection
PfP	Partners for Peace
RADHAZ	Radiation Hazards
RF	Radio Frequency
RFC	Request for Comment
SAR	Specific Absorption Rate
STANAG	Standardization Agreement
STD	Standard
TRANSEC	Transmission Security
UDP	User Datagram Protocol
USB	Universal Serial Bus

Statement of Loaned Radio Conformance

Nation		
Radio type		
Mandatory Requirements	**Statement [Yes/No]**	**Comments**
Loaned Radio Requirement 1		
Loaned Radio Requirement 2		
Loaned Radio Requirement 3		
Loaned Radio Requirement 4		
Loaned Radio Requirement 5		
IP radio Requirement 6		On applicable for an IP radio
Radio Adapter Requirement 7		Only applicable if one of the mandatory statements 1-5 are not fulfilled (i.e. only if a radio adapter is required)
Radio Adapter Requirement 8		
Radio Adapter Requirement 9		
Selection criteria	**Statement [Yes/No]**	**Comments**
Layer 3 radio		
Multi hop / Single hop range		
Distributed MAC		
FEC		
MPE		
TRANSEC		
COMSEC		

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