RETURN BIDS TO:
RETOURNER LES SOUMISSIONS À:
Bid Receiving Public Works and Government Services Canada/Réception des soumissions Travaux publics et Services gouvernementaux Canada
11 Laurier St. / 11, rue Laurier
Place du Portage, Phase III
0B2-103
Gatineau, Québec K1A 0S5
Bid Fax: (819) 997-9776

REQUEST FOR PROPOSAL / DEMANDE DE SOUMISSION

Proposal To: Public Works and Government Services Canada

We hereby offer to sell to Her Majesty the Queen in right of Canada, in accordance with the terms and conditions set out herein, referred to herein or attached hereto, the goods, services, and construction listed herein and on any attached sheets at the price(s) set out therefor.

Proposition aux: Travaux Publics et Services Gouvernementaux Canada

Nous offrons par la présente de vendre à Sa Majesté la Reine du chef du Canada, aux conditions énoncées ou incluses par référence dans la présente et aux annexes ci-jointes, les biens, services et construction énumérés ici sur toute feuille ci-annexée, au(x) prix indiqué(s)

Comments - Commentaires

THIS DOCUMENT CONTAINS A SECURITY REQUIREMENT / **DOCUMENT CONTIENT DES EXIGENCES RELATIVES À LA SÉCURITÉ**

Vendor / Firm Name and Address
Raison sociale et adresse du Fournisseur /de l'entrepreneur

Issuing Office - Bureau de distribution
Science Procurement Directorate/Direction de l'acquisition
de travaux scientifiques
11C1, Phase III
Place du Portage
11 Laurier St. / 11, rue Laurier
Gatineau, Québec K1A 0S5

Title-Sujet
Tactical Edge Cyber Command and Control / Commandement de contrôle de l'avantage tactique dans le cyberespace (TEC3)

Solicitation No. - N° de l'invitation	Date
W7714-145970/B	2017-09-25 Amendment: 2

Client Reference No. - N° de référence du client
W7714-145970

GETS Reference No. - N° de référence de SEAG
PW-17-00785744

File No. – N° de dossier	CCC No./N° CC – FMS NO. / N° VME
W7714-145970	

Solicitation Closes – L'invitation prend fin	Time Zone / Fuseau horaire
at – à 14:00 on – le 2017-11-01	Eastern Daylight Time (EDT) / Heure avancé de l'est (HAE)

F.O.B. – F.A.B

Plant-Usine : ☐   Destination: ☐   Other-Autre: ☐

Address Enquiries to: - Adresser toutes questions à:	Buyer Id – Id de l'acheteur
Ian Potvin	007SL

Telephone No. - N° de téléphone	FAX No. - N° de FAX
873-469-4831 / ian.potvin@tpsgc-pwgsc.gc.ca	

Destination of Goods, Services and Construction:
Destinations des biens, services et construction :

Specified Herein
Précisé aux présentes

Instructions : See Herein

Instructions : voir aux présentes

Delivery Required - Livraison exigée	Delivery Offered - Livraison proposée
See Herein – voir aux présentes	

Vendor/Firm Name and Address
Raison sociale et adresse du fournisseur/de l'entrepreneur

Telephone No. - N° de téléphone
Facsimile No. - N° de télécopieur

Name and title of person authorized to sign on behalf of Vendor/Firm (type or print)
Nom et titre de la personne autorisée à signer au nom du fournisseur/de l'entrepreneur (taper ou écrire en caractères d'imprimerie)

Signature   **Date**

Travaux publics et
Services gouvernementaux
Canada

Public Works and
Government Services
Canada

Request for Proposal (RFP) - Tactical Edge Cyber Command and Control – TEC3
PWGSC Solicitation No. W7714-145970/B

REQUEST FOR PROPOSAL (RFP)
W7714-145970/B

Tactical Edge Cyber Command and Control (TEC3)

IMPORTANT INFORMATION REGARDING THIS RFP:

Due to its classified nature, general public distribution of Appendix 3 to Annex A is restricted. This means that it contains information that cannot be published to BuyandSell.gc.ca and can only be distributed upon request to Bidders who meet the security requirements for both document access and document safeguarding capability. For more information, please consult PART 6 - SECURITY, FINANCIAL AND OTHER REQUIREMENTS.

If not already done, we encourage Bidders to consult the section 6.0, Engagement Process W7714-145970/A of Part 1 – General information for information about the Engagement process conducted under this requirement and also to consult the Questions and Answers compendiums before asking question(s) about the bid solicitation.

Amendment #2 to the RFP document:

The Crown has made changes to this RFP, identified in red text (including those made on previous versions). Changes to this version can be found on the following pages: Cover page and 12.

Summary of changes:
1- Closing date of the solicitation postponed to Nov 01, 2017;
2- Updates of information for submission of a bid containing classified information.

PART 7 - RESULTING CONTRACT CLAUSES

1.0   Statement of Requirements
2.0   Standard Clauses and Conditions
3.0   Security Requirement
4.0   Term of Contract
5.0   Authorities
6.0   Proactive Disclosure of Contracts with Former Public Servants
7.0   Payment
8.0   Invoicing Instructions
9.0   Certifications
10.0   Applicable Laws
11.0   Priority of Documents
12.0   Defence Contract
13.0   Foreign Nationals (Canadian Contractor)
14.0   Insurance
15.0   Controlled Goods Program
16.0   Progress Reports
17.0   Canadian Forces Site Regulations

List of Annexes:

Annex "A"   Statement of Requirements

   Appendix 1 to Annex "A", Statement of Optional Requirements
   Appendix 2 to Annex "A", Functional Specification
   Appendix 3 to Annex "A", Specifications for advanced capabilities of the Tactical Edge Cyber
                    Command and Control (TEC3) project (classified Appendix)

Annex "B"   Basis of Payment
Annex "C"   Security Requirements Check List
Annex "D"   Non-disclosure Agreement
Annex "E"   Form DND 626, Task Authorization Form

PART 1 - GENERAL INFORMATION

1.0   Introduction

The bid solicitation document is divided into seven parts plus attachments and annexes as follows:

Part 1   General Information: provides a general description of the requirement;

Part 2   Bidder Instructions: provides the instructions, clauses and conditions applicable to the bid solicitation;

Part 3   Bid Preparation Instructions: provides bidders with instructions on how to prepare their bid;

Part 4   Evaluation Procedures and Basis of Selection: indicates how the evaluation will be conducted, the evaluation criteria that must be addressed in the bid, and the basis of selection;

Part 5   Certifications: includes the certifications to be provided;

Part 6   Security, Financial and Other Requirements: includes specific requirements that must be addressed by bidders; and

Part 7   Resulting Contract Clauses: includes the clauses and conditions that will apply to any resulting contract.

The Annexes include the Statement of Requirements (inclusive of the Statement of Optional Requirements, the Functional Specification document and the Specifications for advanced capabilities of the Tactical Edge Cyber Command and Control (TEC3) project document), the Basis of Payment, the Security Requirement and Check List, the Non-disclosure Agreement, and the Task Authorization form.

2.0   Summary

Defence Research and Development Canada (DRDC) has a requirement for the supply of a Tactical Edge Cyber Command and Control (TEC3) demonstrator. TEC3 aims to demonstrate a set of software tools to enhance the security and effectiveness of future Canadian Armed Forces (CAF) tactical edge networks. Specifically, TEC3 will demonstrate network security, situational awareness, and management tools necessary to enable the protection of sophisticated high-bandwidth tactical networks. In a fully net-enabled tactical battlespace, commanders or analysts near the network edge will need to be able to answer cyber-related questions such as:

•   How do I know I can trust the nodes in my network?
•   Is the network under attack—and where are the attackers?
•   What level of assurance do I have in my communications?

To this end, TEC3 is a fully integrated tactical edge network situational awareness and security tool suite that will enable improved decision-making and will facilitate the effective management and protection of a tactical network by relying on both automated algorithms and protocols and informed human-in-the-loop decisions.

TEC3 is ultimately a suite of plug-ins or apps running on, potentially modified, commercial off-the-shelf (COTS) or Military Off the Shelf (MOTS) "smartphone" type hardware. These graphical display devices will connect to one another via internal or external radios, forming a mobile ad

hoc network (MANET) that includes COTS PCs, simulating a forward operating base. It is expected that TEC3 applications or plug-ins can be added or removed as necessary for any particular TEC3 deployment.

While the components of the demonstrator are not to be militarized for field operations, there is a minimal requirement that components be sufficiently robust that demonstrations can be performed outdoors in a variety of reasonable weather conditions (light rain, the wind) in temperature ranges from 10 to 30 degrees Celsius.

The TEC3 system is expected to be delivered at a technology readiness level (TRL) of at least 6.

The period of any resulting Contract will be for a period of three (3) years, with up to three (3) additional two (2) year optional periods.

2.1   Security Requirements

There is a security requirements associated with this requirement. Contractors and sub-contractors must have a security clearance at the SECRET level for facility, document safeguarding capability and staff, including a requirement to restrict the release of information to members of the "Five Eyes" only. All details about security requirement are included in Part 6 - Security, Financial and Other Requirements, and Part 7 - Resulting Contract Clauses. Security requirements identified in Part 6 and Part 7 take precedence over this paragraph.

Due to its classified nature, general public distribution of Appendix 3 to Annex A is restricted. This means that it contains information that cannot be published to BuyandSell.gc.ca and can only be distributed upon request to Bidders who meet the security requirements for both document access and document safeguarding capability. For more information, please consult Part 6.

For more information on personnel and organization security screening or security clauses, bidders should refer to the Industrial Security Program (ISP) of Public Works and Government Services Canada (http://ssi-iss.tpsgc-pwgsc.gc.ca/index-eng.html) website.

2.2   Key information

Bidders must provide a list of names, or other related information as needed, pursuant to section 01 of Standard Instructions 2003.

For services requirements, Bidders in receipt of a pension or a lump sum payment must provide the required information as detailed in Article 3 of Part 2 of the bid solicitation.

This procurement is subject to the Controlled Goods Program, as the delivered TEC3 demonstrator or a portion of will be Controlled Goods (CG) and will have to be treated according to the rules and regulation surrounding CG of the Government of Canada.

This procurement is set aside from the North American Free Trade Agreement (NAFTA) under Annex 1001.2b, Section B – Sub section A: Research and Development, All classes; and is not listed under Appendix 1, article 1(d) of the World Trade Organization - Agreement on Government Procurement (WTO-AGP).

The requirement is subject to the provisions of the Canadian Free Trade Agreement (CFTA), formerly known as the Agreement on Internal Trade (AIT).

The requirement is limited to Canadian goods and/or services.

There is a Federal Contractors Program (FCP) for employment equity requirement associated with this procurement; see Part 5 - Certifications, Part 7 - Resulting Contract Clauses and the Attachment 1 to Part 5 named <u>Federal Contractors Program for Employment Equity - Certification</u>.

3.0 Debriefings

After contract award, bidders may request a debriefing on the results of the bid solicitation process. Bidders should make the request to the Contracting Authority within 15 working days of receipt of the results of the bid solicitation process. The debriefing may be in writing, by telephone or in person.

4.0 Communications

As a courtesy and in order to coordinate any public announcements pertaining to this contract, the Government of Canada requests that successful Bidders notify the Contracting Authority 5 days in advance of their intention to make public an announcement related to the recommendation of a contract award, or any information related to the contract. The Government of Canada retains the right to make primary contract announcements.

5.0 Conflict of Interest

The Work described herein and the deliverable items under any resulting Contract specifically exclude the development of any statement of work/requirements, evaluation criteria or any document related to a bid solicitation. The Contractor, its subcontractor(s) or any of their agent(s) directly or indirectly involved in the performance of the Work and/or in the production of the deliverables under any resulting Contract will not be precluded from bidding on any potential future bid solicitation related to the production or exploitation of any concept or prototype developed or delivered under any resulting Contract.

6.0 Engagement Process W7714-145970/A

Canada conducted an Engagement process for the TEC3 Project. Key information disclosed during the Engagement process may be relevant for any Bidders who want to submit a Bid under this solicitation. We encourage Bidders to consult the following link for further information about the Engagement process and also to consult its Questions and Answers compendiums: https://buyandsell.gc.ca/procurement-data/tender-notice/PW-15-00668957

The Questions and Answers documents are entitled as follows:

- "*question_and_answer_compendium_-_issue_2_2016-04-03.pdf*"; and,

- "*engagement_process_questions_and_answers_questions_et_reponses_de_la_consultation_publique_-_fr_en_-_tec3.pdf*" – *Version 2*

PART 2 - BIDDER INSTRUCTIONS

1.0   Standard Instructions, Clauses and Conditions

All instructions, clauses and conditions identified in the bid solicitation by number, date and title are set out in the Standard Acquisition Clauses and Conditions Manual (https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) issued by Public Works and Government Services Canada.
Bidders who submit a bid agree to be bound by the instructions, clauses and conditions of the bid solicitation and accept the clauses and conditions of the resulting contract.

The 2003 (2016-04-04) Standard Instructions - Goods or Services - Competitive Requirements, are incorporated by reference into and form part of the bid solicitation.

Subsection 5.4 of 2003, Standard Instructions - Goods or Services - Competitive Requirements, is amended as follows:

Delete: 60 days
Insert: 180 days

2.0   Submission of Bids

Bids must be submitted only to Public Works and Government Services Canada (PWGSC) Bid Receiving Unit by the date, time and place indicated on the cover page of the bid solicitation.

3.0   Former Public Servant – Competitive Bid A3025T (2014-06-26)

Contracts awarded to former public servants (FPS) in receipt of a pension or of a lump sum payment must bear the closest public scrutiny, and reflect fairness in the spending of public funds. In order to comply with Treasury Board policies and directives on contracts awarded to FPSs, bidders must provide the information required below before contract award. If the answer to the questions and, as applicable the information required have not been received by the time the evaluation of bids is completed, Canada will inform the Bidder of a time frame within which to provide the information. Failure to comply with Canada's request and meet the requirement within the prescribed time frame will render the bid non-responsive.

Definitions

For the purposes of this clause, "former public servant" is any former member of a department as defined in the *Financial Administration Act*, R.S., 1985, c. F-11, a former member of the Canadian Armed Forces or a former member of the Royal Canadian Mounted Police. A former public servant may be:

a. an individual;
b. an individual who has incorporated;
c. a partnership made of former public servants; or
d. a sole proprietorship or entity where the affected individual has a controlling or major interest in the entity.

"lump sum payment period" means the period measured in weeks of salary, for which payment has been made to facilitate the transition to retirement or to other employment as a result of the implementation of various programs to reduce the size of the Public Service. The lump sum payment period does not include the period of severance pay, which is measured in a like manner.

"pension" means a pension or annual allowance paid under the *Public Service Superannuation Act* (PSSA), R.S., 1985, c. P-36, and any increases paid pursuant to the *Supplementary Retirement Benefits Act*, R.S., 1985, c. S-24 as it affects the PSSA. It does not include pensions payable pursuant to the *Canadian Forces Superannuation Act*, R.S., 1985, c. C-17, the *Defence Services Pension Continuation Act*, 1970, c. D-3, the *Royal Canadian Mounted Police Pension Continuation Act* , 1970, c. R-10, and the *Royal Canadian Mounted Police Superannuation Act*, R.S., 1985, c. R-11, the *Members of Parliament Retiring Allowances Act*, R.S. 1985, c. M-5, and that portion of pension payable to the *Canada Pension Plan Act*, R.S., 1985, c. C-8.

Former Public Servant in Receipt of a Pension

As per the above definitions, is the Bidder a FPS in receipt of a pension? **Yes** ( ) **No** ( )

If so, the Bidder must provide the following information, for all FPSs in receipt of a pension, as applicable:

  a. name of former public servant;
  b. date of termination of employment or retirement from the Public Service.

By providing this information, Bidders agree that the successful Bidder's status, with respect to being a former public servant in receipt of a pension, will be reported on departmental websites as part of the published proactive disclosure reports in accordance with Contracting Policy Notice: 2012-2 and the Guidelines on the Proactive Disclosure of Contracts.

Work Force Adjustment Directive

Is the Bidder a FPS who received a lump sum payment pursuant to the terms of the Work Force Adjustment Directive? **Yes** ( ) **No** ( )

If so, the Bidder must provide the following information:

  a. name of former public servant;
  b. conditions of the lump sum payment incentive;
  c. date of termination of employment;
  d. amount of lump sum payment;
  e. rate of pay on which lump sum payment is based;
  f. period of lump sum payment including start date, end date and number of weeks;
  g. number and amount, professional fees, of other contracts subject to the restrictions of a work force adjustment program.

For all contracts awarded during the lump sum payment period, the total amount of fees that may be paid to a FPS who received a lump sum payment is $5,000, including Applicable Taxes.

4.0 Communications - Solicitation Period

All enquiries should be submitted to the Contracting Authority no later than ten (10) calendar days before the bid closing date. Enquiries received after that time may not be answered.

Bidders should reference as accurately as possible the numbered item of the bid solicitation to which the enquiry relates. Care should be taken by bidders to explain each question in sufficient detail in order to enable Canada to provide an accurate answer. Technical enquiries that are of a "proprietary" nature must be clearly marked "proprietary" at each relevant item. Items identified as proprietary will be treated as such except where Canada determines that the enquiry is not of a proprietary nature. Canada may edit the question(s) or may request that the Bidder do so, so that the proprietary nature of the question(s) is eliminated and the enquiry can be answered to all bidders. Enquiries not submitted in a form that can be distributed to all bidders may not be answered by Canada.

5.0 Applicable Laws

Any resulting contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in Ontario.

Bidders may, at their discretion, substitute the applicable laws of a Canadian province or territory of their choice without affecting the validity of their bid, by deleting the name of the Canadian province or territory specified and inserting the name of the Canadian province or territory of their choice. If no change is made, it acknowledges that the applicable laws specified are acceptable to the bidders.

6.0 Improvement of Requirement during Solicitation Period

Should bidders consider that the specifications or Statement of Requirement contained in the bid solicitation could be improved technically or technologically, bidders are invited to make suggestions, in writing, to the Contracting Authority named in the bid solicitation. Bidders must clearly outline the suggested improvement as well as the reason for the suggestion. Suggestions that do not restrict the level of competition nor favour a particular bidder will be given consideration provided they are submitted to the Contracting Authority at least fifteen (15) days before the bid closing date. Canada will have the right to accept or reject any or all suggestions, and also to extend the solicitation period.

7.0 Basis for Canada's Ownership of Intellectual Property

DRDC has determined that any intellectual property rights, related to Foreground information as defined in the General Conditions 2040 referenced in Part 7, arising from the performance of the Work under the resulting contract will belong to Canada, on the following grounds:

(a) the main purpose of the contract, or of the deliverables contracted for, is to deliver a component or subsystem that will be incorporated into a complete system at a later date, as a prerequisite to the planned transfer of the complete system to the private sector, through licensing or assignment of ownership, for purposes of commercial exploitation;

8.0   Canada's Maximum Funding for Core and Optional Work and Additional Contractor Funding

a)   Canada's maximum funding available for the core work, identified at Annex A of the resulting Contract from this bid solicitation is $2,800,000.00 CAD, Applicable taxes extra.

b)   Canada's estimated funding for the optional work, identified in Appendix 1 to Annex "A" of the resulting contract, may reach up to an additional $6,000,000.00 CAD, Applicable taxes extra.

c)   Any cost in excess of the maximum funding for the core work will be construed as a Contractor's commitment of additional funding to the Contract. Also, this disclosure does not commit Canada to pay the maximum funding available.

PART 3 - BID PREPARATION INSTRUCTIONS

1. Bid Preparation Instructions

Canada requests that bidders provide their bid in separately bound sections as follows:

Section I: Technical Bid* – Three (3) hard copies and one (1) soft copy on a CD-ROM or DVD-ROM

Technical Bid should include all information requested under the evaluation criteria attachment: Technical, management and corporate bid, along with proposed candidate résumés and past experience, as applicable.

Section II: Financial Bid - One (1) hard copy and one (1) soft copy on a CD-ROM or USB

Section III: Certifications - One (1) hard copy and one (1) soft copy on a CD-ROM or USB

If there is a discrepancy between the wording of the soft copy and the hard copy, the wording of the hard copy will have priority over the wording of the soft copy.

Prices must appear in the financial bid only. No prices must be indicated in any other section of the bid.

1.1 Bid Preparation Format

Canada requests that bidders follow the format instructions described below in the preparation of their bid:

(a)   use 8.5 x 11 inch (216 mm x 279 mm) paper; and
(b)   use a numbering system that corresponds to the bid solicitation.

In April 2006, Canada issued a policy directing federal departments and agencies to take the necessary steps to incorporate environmental considerations into the procurement process Policy on Green Procurement (http://www.tpsgc-pwgsc.gc.ca/ecologisation-greening/achats-procurement/politique-policy-eng.html).

To assist Canada in reaching its objectives, bidders should:

(1)   use paper containing fibre certified as originating from a sustainably-managed forest and containing minimum 30% recycled content; and

(2)   use an environmentally-preferable format including black and white printing instead of colour printing, print double sided/duplex, using staples or clips instead of cerlox, duotangs or binders.

Section I: Technical Bid

In their technical bid, bidders should demonstrate their understanding of the requirements contained in the bid solicitation and explain how they will meet these requirements. Bidders should demonstrate their capability and describe their approach in a thorough, concise and clear manner for carrying out the work.

The technical bid should clearly address and in sufficient depth the points that are subject to the evaluation criteria against which the bid will be evaluated. Simply repeating the statement contained in the bid solicitation is not sufficient. In order to facilitate the evaluation of the bid, Canada requests that bidders address and present topics in the order of the evaluation criteria

under the same headings. To avoid duplication, bidders may refer to different sections of their bids by identifying the specific paragraph and page number where the subject topic has already been addressed. Also, in their Management and Corporate Bid (portions of the Technical Bid), bidders must describe their capability and experience, the project management team and provide client contact(s), as applicable.

The technical requirements, specified in Annex A and its appendices, that are preceded by the term "must" are to be included as part of the Bidder's technical proposal. The technical requirements, specified in Annex A, preceded by the term "should" may be added to the Bidder's technical proposal. Bidder acknowledges and agrees that once added to its bid, these technical requirements become contractual requirements, on which the Bidder must deliver.

Section II: Financial Bid

Bidders must submit their financial bid in accordance with the following:

(a)   For the core work: A Total Cost to the Ceiling price specified at Article 8.0 (a) of Part 2. The total amount of Applicable Taxes are to be shown separately, if applicable. As previously stated, any cost in excess of the maximum funding for the core work will be construed as a Contractor's commitment of additional funding to the Contract. The information should be provided in accordance with the Financial Bid Presentation Sheet at Attachment 1 to PART 3 - BID PREPARATION INSTRUCTIONS.

   No travel and living expenses will be paid for services provided within the National Capital Region (NCR). Further, Canada will not accept any travel and living expenses for travel between the contractor's place of business and the NCR. All of these costs are to be included in the firm all inclusive labour rates**.**

(b)   For Canadian-based bidders, prices must be in Canadian funds, Applicable Taxes excluded, and Canadian customs duties and excise taxes included.

   For foreign-based bidders, prices must be in Canadian funds, Applicable Taxes and Canadian customs duties and excise taxes excluded. Canadian customs duties and excise taxes payable by Canada will be added, for evaluation purposes only, to the rates and prices submitted by foreign-based bidders.

   For the purpose of the bid solicitation, bidders with an address in Canada are considered Canadian-based bidders and bidders with an address outside of Canada are considered foreign-based bidders.

Section III: Certifications

Bidders must submit the certifications required under Part 5.

1.2   Exchange Rate Fluctuation

The requirement does not offer exchange rate fluctuation risk mitigation. Requests for exchange rate fluctuation risk mitigation will not be considered. All bids including such provision will render the bid non-responsive.

1.3   Submission of a bid containing classified information

If a bidder includes classified information to the SECRET level in its bid, all part(s) of the bid containing such classified information must be submitted in a standalone envelope marked as follow: "This envelope contains SECRET information and can only be opened by an authorized person". The Bidder must insert this standalone envelope into the main envelope used to submit its bid. Note that the main envelope used for the submission of the bid must be sealed, without security marks and appropriately addressed.

ATTACHMENT 1 OF PART 3
FINANCIAL BID PRESENTATION SHEET

Bidders must provide their financial information in accordance with the following, and break it down by phases, if preferred:

1.0 **For the Work identified at Annex "A", Statement of Requirements (Core Work), to a Ceiling price which must not exceed the maximum funding specified in Part 2:**

1.1 **Labour Rates** at a Firm All-Inclusive Hourly Rate (FAIHR):

	Resource Category	Estimated Level of effort (h)	FAIHR	Sub-Total
1	Senior Project Manager (PM)		$	$
2	Lead System Architect (LSA)		$	$
3	Android Programmer (AP)		$	$
4	Firmware Software Engineer (FSE)		$	$
5	Mobile R&D Specialist (MR&D)		$	$
6	*Specify other resource category(ies)*		$	$
7	…		$	$

Est. Labour: $ _____

1.2 **Equipment:** at laid down cost without markup **Est.: $ _____**
(Specify the type of equipment and provide a description)

1.3 **Rentals:** at actual cost without markup **Est.: $ _____**
(Specify what rentals are required)

1.4 **Materials and Supplies:** at laid down cost without markup **Est.: $ _____**
(Specify what categories of materials and supplies.)

1.5 **Travel and Living expenses:** **Est.: $ _____**

(a) Canada will not accept any travel and living expenses incurred by the Contractor in the performance of the Work, for:

  (i) services provided within the National Capital Region (NCR). The National Capital Region (NCR) is defined in the *National Capital Act*, R.S.C. 1985, c.N-4, S.2. The *National Capital Act* is available on the Justice Website: http://laws.justice.gc.ca/eng/N-4/20100210/ and

  (ii) any travel between the Contractor's place of business and the NCR.

(b) For services to be provided outside the NCR, the Contractor will be reimbursed its authorized travel and living expenses reasonably and properly incurred in the performance of the Work, at cost, without any allowance for profit and/or administrative overhead, in accordance with the meal, private vehicle and incidental expenses provided in Appendices B, C and D of the Treasury Board Travel Directive (http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php), and with the other provisions of the directive referring to "travellers", rather than those referring to "employees". The Treasury Board Secretariat's Special Travel Authorities, http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/tbm_113/statb-eng.asp, also apply.

(c)   Canada will not accept any travel and living expenses incurred by the Contractor as a consequence of any relocation of personnel required to satisfy the terms of this Contract.

(d)   All travel must have prior authorization of the Technical Authority. All payments are subject to government audit.

1.6   SUBCONTRACTS: at actual cost without markup   **Est.: $ _____**
(Identify subcontractors and cost related to each one, if applicable)

1.7   OTHER DIRECT CHARGES: at actual cost without markup   **Est.: $ _____**
(Specify what categories of direct charges)

1.8   PROFIT: at a firm rate of __% of item(s) __ above   **Est.: $ _____**

Estimated Cost to a Ceiling Price: $ _____
(Applicable Taxes extra)

With the exception of the firm rate(s) and firm price(s), the amounts shown in the various items specified above are estimates only. Changes to these estimates will be accepted for billing purposes as the Work proceeds, provided that these changes have the prior approval of the Technical Authority and provided that the estimated cost does not exceed the aforementioned Ceiling Price.

2.0   For the optional work identified at Appendix 1 to Annex "A": Bidders are not obligated to provide a resource name and any résumé at the time of submission of their bid. The resource(s) will be evaluated before issuance of a Task Authorization, based on each resource category requirements identified in Appendix 1 to Annex A, as applicable.

	Resource Category	Estimated Level of effort (h)	FAIHR Core Work Period	FAIHR Optional Period 1	FAIHR Optional Period 2	FAIHR Optional Period 3	Sub-Total
1	Senior Project Manager	N/A	Same as 1.1 above				$
2	Intermediate Project Manager	N/A	$				$
3	Intermediate Project Communications Specialist	N/A	$				$
4	Senior Project Control Officer	N/A	$				$
5	Intermediate SharePoint developer	N/A	$				$
6	Lead System Architect	N/A	Same as 1.1 above				$
7	Technical Writer	N/A					$
8	User Interface Analyst	N/A					
9	Firmware Software Engineer	N/A	Same as 1.1 above				
10	Mobile R&D specialist	N/A					
11	Information Technology Security Analyst	N/A					
12	Information Technology Certification and Accreditation Specialist	N/A					
13	Android Programmer	N/A	Same as 1.1 above				
14	Intermediate Programmer	N/A					
15	Junior Programmer	N/A					
16	Senior WEB Developer	N/A					
17	Operating System Administrator	N/A					
18	Project Test Coordinator	N/A					
19	Quality Assurance Specialist	N/A					
20	Tester	N/A					

PART 4 - EVALUATION PROCEDURES AND BASIS OF SELECTION

1. Evaluation Procedures

(a) Bids will be assessed in accordance with the entire requirement of the bid solicitation including the evaluation criteria, identified in Attachment 1 of Part 4 - MANDATORY, FINANCIAL AND POINT RATED TECHNICAL CRITERIA.

(b) An evaluation team composed of representatives of Canada will evaluate the bids.

1.1 Technical Evaluation

1.1.1 Bidder Experience

As stated for specific sections of the evaluation criteria, past experience described in the bid must be the experience of the Bidder itself, which includes the experience of any companies that formed the Bidder by way of a merger, but does not include any experience acquired through a purchase of assets or an assignment of contract). For these specific evaluation criteria, the experience of the Bidder's affiliates (e.g. parent, subsidiary or sister corporations) not directly involved in the submission of a bid, subcontractors, or suppliers will not be considered.

As stated for other specific sections of the evaluation criteria, past experience described in the bid can be experience of the Bidder's affiliates (i.e. parent, subsidiary or sister corporations) or Bidder's subcontractors, provided that the Bidder identifies and demonstrates the transfer of know-how, the use of toolsets and the use of key personnel from the affiliate for the applicable criterion, and provided that the Bidder includes a copy of the teaming agreements or identifies the roles and responsibilities of all parties under the agreement and how their work will be integrated for all subcontractors.

The experience of the Bidder's suppliers will not be considered.

1.1.2 Supporting Information

In the event that the Bidder fails to submit any supporting information pursuant to the bid solicitation, the Contracting Authority may request it thereafter in writing, including after the closing date of the bid solicitation. It is mandatory that the Bidder provide the supporting information within three (3) business days of the written request or within such period as specified or agreed to by the Contracting Authority in the written notice to the Bidder.

1.1.3 Mandatory Technical Criteria

Refer to Attachment 1 of Part 4, MANDATORY, FINANCIAL AND POINT RATED TECHNICAL CRITERIA.

1.1.4 Point Rated Technical Criteria

Refer to Attachment 1 of Part 4, MANDATORY, FINANCIAL AND POINT RATED TECHNICAL CRITERIA.

1.2 Financial Evaluation

1.2.1 Mandatory Financial Criteria and Point Rated Financial Criteria

Refer to Attachment 1 of Part 4, MANDATORY, FINANCIAL AND POINT RATED TECHNICAL CRITERIA.

1.2.2   Evaluation of Price

The price of the bid will be evaluated in Canadian dollars, Applicable Taxes excluded, Canadian customs duties and excise taxes included. For evaluation purposes only, the price of the bid will be determined as the Total cost of the bid provided for the core work only.

2.   Basis of Selection

2.1   Basis of Selection - Highest Rated Within Budget

To be declared responsive, a bid must:

   (a)   Comply with all the requirements of the bid solicitation;

   (b)   Meet all mandatory evaluation criteria;

   (c)   Obtain the required minimum points for each criterion and each group of criteria with a pass mark summarized in the table at Article 2.2 below;

Bids not meeting (a) or (b) or (c) will be declared non responsive.

The responsive bid with the highest number of points will be recommended for award of a contract, provided that the total bid evaluated price does not exceed the maximum budget for the core work.

In the event that the highest number of points is obtained by more than one responsive bid, the responsive bid with the lowest evaluated price will be recommended for award of a contract.

2.2   Pass mark Table Summary

Section	Sub-section		Max points	Min Points - Pass mark
3.1 - Management Proposal			**39**	**22**
3.1 consist of the total of 3.1.1 and 3.1.2	3.1.1 - Project Management Plan		18	10
	3.1.2 - Personnel		21	12
	3.1.2 consist of the total of 3.1.2.1 and 3.1.2.2	3.1.2.1 - Senior Project Manager	8	0
		3.1.2.2 - Key Tech Team Members	13	7
3.2 - Corporate Proposal			**26**	**14**
3.2 consist of the total of 3.2.1 and 3.2.2	3.2.1 - Corporate Experience - Bidder		17	0
	3.2.2 - Corporate Experience - Team		9	0
3.3 - Technical Proposal			**152**	**100**
3.3 consist of the total of 3.3.1 to 3.3.3	3.3.1 - Understanding of the requirement		20	0
	3.3.2 - Adequacy Technical solution		100	5
	3.3.2 consist of the total of a) to c)	sub-section a)	40	0
		sub-section b)	40	0
		sub-section c)	20	5
	3.3.3 – Requirements Table and Classified Features Table		32	0

ATTACHMENT 1 OF PART 4,
MANDATORY, FINANCIAL AND POINT RATED TECHNICAL CRITERIA

1.   Evaluation Procedures

1.1   Evaluation of Bids

The points awarded for each bid will be allocated according to Technical, Management, and Corporate categories as described below.

1.1.1   Technical

The score associated with technical merit will be determined based on a proportional formula relative to the compliant bidder with the highest score in this category, to a maximum of 65 points for the highest score, as follows:

$$\text{Points for Technical} = 65 \times \frac{\text{Bid Score of the Proposal Being Evaluated}}{\text{Highest Compliant Score}}$$

Bidder	Example Point Rated Score	Calculation	Final Score
a	896	65 x 896/1258	46.3
b	1000	65 x 1000/1258	51.7
c	1042	65 x 1042/1258	53.8
d	1182	65 x 1182/1258	61.1
e	1258 (highest compliant score)	65 x 1258/1258	65.0

Points awarded for Technical will be rounded to 1 decimal place, as shown in the example. The technical score will be computed based on the evaluation criteria in section 3.3, "Technical Evaluation". Note that the numbers in the table above are for example purposes only. The Maximum Achievable Score for the technical evaluation is detailed in section 3.3.

Note: The technical requirements, specified in Annex A, that are preceded by the term "must" are to be included as part of the Bidder's technical proposal. The technical requirements, specified in Annex A, preceded by the term "should" may be added to the Bidder's technical proposal. Bidder acknowledges and agrees that once added to its bid, these technical requirements become contractual requirements, on which the Bidder must deliver.

1.1.2   Management

The score associated with management merit will be determined based on a proportional formula relative to the compliant bidder with the highest score in this category, to a maximum of 25 points for the highest score, as follows:

$$\text{Points for Management} = 25 \times \frac{\text{Bid Score of the Proposal Being Evaluated}}{\text{Highest Compliant Score}}$$

Bidder	Example Point Rated Score	Calculation	Final Score
e	23	25 x 23/41	14.0
d	26	25 x 26/41	15.9
a	31	25 x 31/41	18.9
b	33	25 x 33/41	20.1
c	41 (highest compliant score)	25 x 41/41	25.0

Points awarded for Management will be rounded to 1 decimal place, as shown in the example. The management score will be computed based on the evaluation criteria in section 3.1, "Management Evaluation". Note that the numbers in the table above are for example purposes only. The Maximum Achievable Score for the management evaluation is detailed in section 3.1.

1.1.3 Corporate

The score associated with corporate experience will be determined based on a proportional formula relative to the compliant bidder with the highest score in this category, to a maximum of 10 points for the highest score, as follows:

Points for Corporate = 10 X <u>Bid Score of the Proposal Being Evaluated</u>
Highest Compliant Score

Bidder	Example Point Rated Score	Calculation	Final Score
c	14	10 x 14/26	5.4
e	16	10 x 16/26	6.2
b	20	10 x 20/26	7.7
a	21	10 x 21/26	8.1
d	26 (highest compliant score)	10 x 26/26	10.0

Points awarded for Corporate will be rounded to 1 decimal place, as shown in the example. The corporate score will be computed based on the evaluation criteria in section 3.2, "Corporate Evaluation". Note that the numbers in the table above are for example purposes only. The Maximum Achievable Score for the corporate evaluation is detailed in section 3.2.

1.1.4 Total Points

The Technical Points, Corporate Points, and Management Points will be added to provide the total bid score. In the example shown, bidder D obtained the highest total score.

Bidder	Technical	Corporate	Management	TOTAL:
a	46.3	8.1	18.9	73.3
b	51.7	7.7	20.1	79.5
c	53.8	5.4	25.0	84.2
d	**61.1**	**10.0**	**15.9**	**87.0**
e	65.0	6.2	14.0	85.2

1.2 Note to Bidders

The Bidder is requested to respond to the Evaluation Criteria using the table format provided in Sections 2 and 3.

Listing experience without providing any supporting data to describe where and how such experience was obtained will result in the experience not being included for evaluation purposes.

In demonstrating that a bidder's solution achieves the TEC3 functional requirements, the bidder must point to evidence in the submitted documentation of how their proposed solution will achieve the TEC3 requirements. Simply stating that the bidders will achieve the requirements is not sufficient and will be awarded a score of zero.

For proposed personnel resources, the bidder must make clear references to the candidates' curriculum vitae (CV) or résumé for each stated claim in the response, where applicable.

Complete details demonstrating how a Bidder meets each Evaluation Criteria must be provided, including reference to where, when and how experience was obtained and how it relates to each requirement.

2. Mandatory Requirements

Any proposal which fails to meet the following Mandatory criteria will be deemed non-responsive and will not be given further consideration. Each requirement must be addressed separately.

2.1 Management Mandatory Evaluation Criteria

The Bidder must submit a Management Proposal, which must include a draft Project Management Plan (PMP) and a set of proposed resources, as requested in the table below. The Management Proposal will be used to evaluate the Bidder response to the Management Mandatory Evaluation Criteria. The Management Proposal is to be structured to facilitate evaluation of the mandatory and point rated criteria in sections 2.1 and 3.1. The draft PMP is to be structured in accordance with the DID PM001, as described in Annex "A" - Statement of Requirements (SOR). The draft PMP must demonstrate a thorough work plan and must include a comprehensive schedule with consideration to respond to unforeseen delays.

Note that throughout the remainder of this document the evaluation criteria will make use of the terminology "story" or "user story". In all cases, these terms are to be treated as synonymous with any of: "Agile story", "Rapid Application mock-up with description", "Work Breakdown Structure (WBS) with dictionary", or any another task element from an iterative development approach.

	Management Evaluation Criteria	Cross Reference (Demonstrate HOW the requirement is Met)
ID	**Project Management Plan**	
M1.	Bidder's PMP submitted includes a description of the development approach and risk mitigation plan, including the Bidder's approach to cyclical development that will accommodate the potential for evolving requirements resulting from each development phase.	
M2.	Bidder's PMP submitted includes a set of high-level stories (or tasks), and an estimated level of effort for these high-level stories (or tasks).	
M3.	Bidder's PMP submitted includes a description of the Quality Metrics in use by the Bidder.	
M4.	Bidder's PMP submitted includes a Resource Plan which describes the allocation of Key Technical Team Members, other labour and non-labour resources assigned to tasks and sub-tasks of the work plan; the organizational structure and reporting relationships. The Resource Plan must describe the nature of any teaming or sub-contracting relationships between the Bidder and other members of the proposed team.	
M5.	Bidders must implement a minimum of 2 out of the 4 classified features, identified in the classified Appendix 3 to Annex A.	
ID	**Personnel - Senior project manager**	

	Management Evaluation Criteria	Cross Reference (Demonstrate HOW the requirement is Met)
M6.	The Contractor must provide a Senior project manager that holds, at the minimum, a Professional certification from a Project Management Institute (PMI) or Post-Graduate Degree in Project Management or Certificate in Project Management from a recognized Canadian educational institution; **or** has at least eight (8) years of experience as a Senior project manager of software development project(s) (larger than ten (10) Person-Years), within the last fifteen (15) years from the date of bid closing.	
M7.	The proposed Senior project manager must have at least four (4) years of experience in managing software development project(s) in a Research & Development (R&D) environment.	
M8.	The proposed Senior project manager must have experience using one of the following project management methodologies in an R&D environment for a combined period of at least four (4) years: • Agile • Scrum • Rapid Application Development (RAD)	
ID	**Personnel - Lead System Architect (LSA)**	
M9.	The Contractor must provide a Lead System Architect that must have at least eight (8) years of experience within the last twelve (12) years from the date of bid closing in software development.	
M10.	Lead System Architect must have at least five (5) years of experience within the last eight (8) years from the date of bid closing with IT project(s) translating business and functional requirements into technical specifications that can be used by the system and/or programming team.	
ID	**Personnel - Android Programmer (AP)**	
M11.	The Contractor must provide an Android Programmer that must have at least five (5) years of experience within the last ten (10) years from the date of bid closing in software development.	
M12.	The Bidder must demonstrate that the proposed Android Programmer has a minimum of (5) five years of experience within the last (10) ten years from the date of bid closing with programming and system design with Java or C++ programming language.	
ID	**Personnel – Firmware Software Engineer (FSE)**	
M13.	The Contractor must provide a Firmware Software Engineer that must have a minimum of (5) five years of experience within the last (10) ten years from the date of bid closing with system design with Java or C++ programming language.	
M14.	The Bidder must demonstrate that the proposed Firmware Software Engineer has a minimum of (1) one year of experience within the last (5) five years from the date of bid closing with device driver, firmware or middleware development on the Android Operating System.	

	Management Evaluation Criteria	Cross Reference (Demonstrate HOW the requirement is Met)
ID	**Personnel - Mobile R&D Specialist (MR&D)**	
M15.	The Bidder must demonstrate that the MR&D has demonstrated minimum of three (3) years of experience within the last ten (10) years from the date of bid closing performing the functional analysis of tactical or mobile systems (R&D or operational setting) on a minimum of two (2) IT projects, advising on concepts and system requirements.	
M16.	The Bidder must demonstrate that the MR&D has a minimum of five (5) years of experience in the last ten (10) years from the date of bid closing in cyber security research and development.	

2.2   Corporate Mandatory Evaluation Criteria

The Bidder must submit a Corporate Proposal document that includes a corporate evaluation. The Corporate Proposal must describe the corporate experience and how the bidder(s) will work as a team to deliver TEC3.

The corporate capabilities and experience is a general description of corporate capabilities and experience applicable to the scope of the TEC3 project including a description of COTS product business lines and Software Integration Services business lines. The Corporate Proposal must also include a description of the approach that will be used with any dispersed team members or sub-contractors for the delivery of TEC3 to ensure the Bidder can effectively leverage the corporate experience included in the bid response.

The Corporate Proposal is to be structured to facilitate evaluation of the mandatory and point rated criteria in sections 0 and 3.2.

	Corporate Evaluation Criteria	Cross Reference to Resume (Demonstrate HOW the requirement is Met)
ID	**Mandatory Corporate Criteria**	
M17.	The Bidder or one of the proposed key technical team members has successfully completed at least one (1) relevant project in which they were required to set up a wireless environment for testing or deployment, including the creation of test scenarios and test data sets. *Relevant projects are defined as being similar to the TEC3 project, including team size, and including technical aspects such as tactical real-time nature, Android software development, research related to tactical situational awareness, mobile ad-hoc networking or tactical cyber effects.*	

3.   Point Rated Requirements

Each Proposal that meets all the Mandatory Requirements specified above will be evaluated and scored in accordance with the following point-rated evaluation criteria.

3.1   Management Evaluation

Evaluation criteria	Scale	Max Points	Min Points
Management Proposal		**39 Points** (total of 3.1.1 and 3.1.2)	**22 Points** (total of 3.1.1 and 3.1.2)
3.1.1 Project Management Plan		**18 Points** (total of a to d)	**10 Points** (total of a to d)
a) Development Approach and Risk Mitigation The draft PMP should include a description of the development approach and risk mitigation plan including the Bidder's approach to cyclical development that will accommodate the potential for evolving requirements resulting from each development phase. The development approach should include a brief description of the intended approach to Requirements Management, Configuration Management and Demonstration Management. The proposed work plan will be evaluated for its completeness, clarity and achievability.	**5 Points:** Work plan includes an industry-based development approach that is well suited to cyclical software development in a complex environment and can adapt to evolving requirements, while effectively managing risk and has been used by the Bidder on at least one other project for at least 6 months - (examples of accepted industry-based development approaches include Unified Process, Scrum, Agile Software Development, including requirements management and configuration management tools); **4 Points:** Work plan includes an identified development approach that is well suited to cyclical software development in a complex environment and can adapt to evolving requirements, while effectively managing risk - (examples of accepted development approaches would be those involving incremental development, rapid prototyping, spiral development, or rapid application development, including requirements management and configuration management tools); **3 Points:** Work plan includes an identified development approach that can effectively manage a complex software development project while effectively managing risk - (examples would include non-cyclical development approaches like the waterfall method and incorporates requirements management and configuration management tools, including requirements management and configuration management tools); **2 Points:** Work plan includes an identified development approach that can manage common software development tasks and moderate risk levels - (examples would include non-cyclical development approaches like the waterfall method but lacking either requirements management or configuration management tools);	**Max: 5** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
	1 Point: Work plan includes an identified development approach that can manage simple software development tasks and low risk levels (examples would include non-cyclical development approaches like the waterfall method but lacking both requirements management and configuration management tools); **0 Points:** No Work plan included or work plan includes an identified development approach that does not address software development tasks and low risk levels (examples would include use of a development approach that does not include at least Requirements Analysis, Design, Build, Test, and Demonstration stages, or does not account for rework following the Test phase).		
b) High level stories, story testing and total story points The proposed work plan will be evaluated for its completeness, clarity and achievability as demonstrated through the following: the use of a complete story (or task) backlog, story (or task) testing and acceptance for each story (or task), and quality assurance metrics identified mapped to the Statement of Requirements for TEC 3 Demonstration Project, DID PM 001.	**6 Points:** The proposed work plan for the TEC3 initiative is broken down into smaller epic(s) / WBE(s) and identifies all the necessary stories (or tasks), story (or task) tests, quality assurance and related PM activities required for the successful completion of Phase 1, and for each deliverable of Phase 1 of the Initial Requirement identified in the SOR at Annex A, at a greater level of detail than described in the SOR and functional specification. Tasks and sub-tasks are defined within each sprint in sufficient detail (2-4 weeks) for Phase 1. All stories (or tasks) are reflected in a comprehensive backlog that also includes limiting activities, required inputs from Canada, identifies critical activities and presents consideration to anticipate and avoid delays. The proposed work plan also includes smaller epic(s)/WBE(s) for subsequent phases in a backlog, where the epic(s)/WBE(s) for subsequent phases do not need to be broken down to the level of stories for this initial submission. **4 Points:** The proposed work plan for the TEC3 initiative is broken down into smaller epic(s) / WBEs and identifies all the necessary stories (or tasks), story (or task) tests, quality assurance and related PM activities required for the successful completion of Phase 1, and for each deliverable of Phase 1 of the Initial Requirement identified in the SOR at Annex A, at a greater level of detail than described in the SOR and functional specification. **2 Points:** The TEC3 initiative is broken down into smaller epic(s) / WBEs showing the major bodies of work for phase 1. The epic(s) show some detail in a backlog that also includes limiting activities, required inputs from Canada, identifies critical activities and presents consideration to anticipate and avoid delays. **0 Points:** No Work plan included or the proposed work plan does not address all the necessary stories (or tasks) identified in the SOR at Annex A; or the stories (or tasks) are not identified or not described at the level of detail provided in the SOR up to phase 1. The stories (or tasks) identified are incomplete, or the	**Max: 6** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
	backlog does not identify: limiting activities, required inputs from Canada, the critical path activities or consideration for delays.		
c) Quality Metrics The Quality Metrics proposed by the bidder in the work plan will be evaluated; the bidder should include a description of any Quality Management Standards followed, or Quality Management Certifications held.	**4 Points:** The Bidder maintains a relevant quality management system certification and follows software development process standards validated by an independent review or certification body; the bidder has proposed a development methodology that includes quality metrics and reporting for each sprint and overall project progress. Quality metrics include: backlog story (or task) points, stories (or tasks) committed, stories (or tasks) completed, burn down rate, open System Problem Reports (SPR), unit test coverage, automated acceptance test coverage, lines of code per (class/method), code size and code duplication. The bidder has identified on how they will maintain or improve these quality metrics throughout the project lifecycle. **3 Points:** The Bidder maintains a relevant quality management system certification and follows software development process standards validated by an independent review or certification body; the bidder has proposed a development methodology that includes quality metrics and reporting for each sprint and overall project progress. Quality metrics include some of, but not all: backlog story (or task) points, stories (or tasks) committed, stories (or tasks) completed, burn down rate, open System Problem Reports (SPR), unit test coverage, automated acceptance test coverage, lines of code per (class/method), code size and code duplication. **2 Points:** The bidder has proposed a development methodology that includes quality metrics and reporting for each sprint and overall project progress. Quality metrics include some of, but not all: backlog story (or task) points, stories (or tasks) committed, stories (or tasks) completed, burn down rate, open System Problem Reports (SPR) but not code or test coverage. **1 Point:** The bidder has proposed a development methodology that includes quality metrics and reporting for each sprint and overall project progress. **0 Points:** The bidder does not maintain either a relevant quality management or software development	**Max: 4** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
	process standard or this information has not been provided.		
d) Resource allocation and control The following will be evaluated: • The level of effort and commitment of the proposed personnel in all activities of the project; • An assessment of the team organizational structure, description of responsibilities, and description of reporting relationships including sub-contracting and partnering agreements; • An assessment of the available personnel resource pool and the ability to ensure qualified resources are available to meet project demands including alternate sources of personnel and recruiting mechanisms; and • The demonstrated means by which the Bidder will control the project resources and the quality assurance processes as applied to subcontracting and partnering agreements.	**3 Points:** The level of effort for Key Technical Team Members and other labour resources is identified for each story (or task) in each phase of the proposed PMP and are commensurate with proposed scope of work of the task. The responsibilities of each identified resource are defined for each story (or task). The flow of information and communications is detailed in the reporting structure between Key Technical Team Members, other labour resources, and subcontractors and how Canada will integrate into this process. Detailed processes and procedures address: definition, prioritization, control, testing and quality assurance of all resources throughout the duration of the contract. **2 Points:** The level of effort is identified for Key Technical Team Members and other labour resources for most stories (or tasks) in each phase are identified in the proposed PMP and are commensurate with proposed scope of work of the task. The responsibilities of each identified resource are defined for each story (or task) and how Canada will integrate into this process. High level concept of the processes and procedures address: definition, prioritization, control, testing and quality assurance of resources for all tasks throughout the duration of the contract are presented at a high level. **1 Point:** The level of effort is identified for Key Technical Team Members and other labour resources for the majority of each story (or task) in each phase are mostly identified in the proposed PMP and are commensurate with proposed scope of work of the task. The responsibilities of each identified resource are defined for the majority of tasks. The bidder presents a plan without processes or procedures for addressing: definition, prioritization control, testing and quality assurance of resources for all tasks throughout the duration of the contract. **0 Points:** The level of effort is not identified for all Key Technical Team Members and other labour resources for each story (or task) in each phase identified in the proposed work plan; or the level of effort identified is not commensurate with the proposed scope of work for each task. The responsibilities of each identified resource are not defined for the majority of tasks. Processes and Procedures for addressing: definition, prioritization control, testing and quality assurance are not addressed.	**Max: 3** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
3.1.2 Personnel		**21 Points** (total of 3.1.2.1 and 3.1.2.2)	**12 Points** (total of 3.1.2.1 and 3.1.2.2)
3.1.2.1 Senior project manager This section will evaluate the demonstrated practical relevant experience of the Bidder's proposed Senior project manager within the past fifteen (15) years. The Senior project manager's experience in Research and Development projects, and relevant technical expertise will also be evaluated.		**8 Points** (total of a to c)	**Min: N/A**
a) Experience, past projects and accomplishments of the Senior project manager. Relevant projects are defined as being similar to the TEC3 project, including elements such as team size, nature, and complexity for software R&D projects.	**3 Points:** The Senior project manager has more than twelve (12) years of project management experience relevant to this project; **2 Points:** The Senior project manager has more than ten (10) years of project management experience relevant to this project; **1 Point:** The Senior project manager has more than eight (8) years of project management experience relevant to this project; **0 Points:** The Senior project manager has eight (8) or fewer years of project management experience relevant to this project.	**Max: 3** **Points are not cumulative**	**Min: N/A**
b) Education and credentials of the Senior project manager **Relevant fields include scientific, engineering, mathematics or business.** Credentials include certifications from the Project Management Institute (PMI) or officially recognized equivalent. University degree or college diploma from a Canadian institution or equivalent form a foreign institution, as determined by the World Education Services. http:/www.wes.org/ca	**2 Points:** University Degree in relevant field, and Project Management credentials; **1 Point:** University Degree in relevant field or equivalent Project Management credentials; **0.5 Points:** College Diploma in a relevant field; **0 Points:** No applicable degree/diploma.	**Max: 2** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
c) Technical expertise of the Senior project manager relevant to this project. Technical fields of IT Security, relevant to this project are limited to: developing wireless protocols, android software development, Software Defined Radios (SDRs), tactical situational awareness with handheld display devices, mobile ad-hoc networking and tactical cyber effects.	**3 Points:** The Senior project manager has a total of at least three (3) years of experience in one of the technical fields relevant to the project and at least two (2) years of experience in another technical field relevant to the project. **2 Points:** The Senior project manager has at least four (4) years of experience in at least one of the technical fields relevant to this project. **1 Point:** The Senior project manager has at least two (2) years of experience in at least one of the technical fields relevant to this project. **0 Points:** The Senior project manager has less than two (2) years of experience in a technical field relevant to this project.	**Max: 3** **Points are not cumulative**	**Min: N/A**
3.1.2.2 Key Technical Team Members The experience and education of the project team members will be evaluated. This criterion will assess how suitable is the breadth, or range, of expertise proposed as part of the team, as well as the depth, or level, of this expertise. The experience for each team member within the past ten (10) years on projects of similar nature, size and complexity will be evaluated according to the criteria defined from (a) to (e) below. The following resources will be evaluated to fill the roles of Key Technical Team Members: 1) Senior project manager (PM); 2) Lead System Architect (LSA) 3) Android Programmer (AP) 4) Firmware Software Engineer (FSE) 5) Mobile R&D Specialist (MR&D)		**13 Points** (total of a to e)	**7 points** (total of a to e)
a) Relevant TEC3 technical experience of key technical team members (excluding the Senior project manager): Relevant areas of TEC3 technical fields include: - Developing wireless protocols; - Android software development; - Encryption techniques; - Software defined radios; and - Mobile ad hoc networking. The bidder should clearly identify the key team members to be evaluated for this criterion.	**3 Points:** At least three (3) of the key technical team members have at least five (5) years each of experience relevant to TEC3 technical fields and the team has at least one (1) year of collective experience in each one of the five (5) TEC3 technical fields. **2 Points:** At least two (2) of the key technical team members have at least five (5) years each of experience relevant to TEC3 technical fields and the team has at least one (1) year of collective experience in each one of the five (5) TEC3 technical fields. **1 Point:** At least one (1) of the key technical team members have at least five (5) years of experience relevant to TEC3 technical fields and the team has at least one (1) year of collective experience in each one of the five (5) TEC3 technical fields. **0 Points:** None of the key technical team members has at least five (5) years each of experience relevant to TEC3 technical fields or the team does not have at least one (1) year of collective experience in each one of the five (5) TEC3 technical fields. *Years of experience include graduate work in this field.*	**Max: 3** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
b) Education and credentials of key technical team members of proposed team (excluding the Senior project manager). The bidder should clearly identify the key technical team members to be evaluated for this criterion.	Excluding the Senior project manager: **0.5 Points** for each key technical team member with a computer science, engineering, or mathematics university degree; **0.25 Points** for each key technical team member with a computer science or programming diploma; *A key technical team member cannot score both categories. If the team member holds any of: diploma(s) or degree(s), only the higher score (0.5) points will be awarded.*	**Max: 2**	**Min: N/A**
c) Software development on Android systems experience of key technical team members of proposed team (excluding the Senior project manager and excluding the Android Programmer). The bidder should clearly identify the key technical team members to be evaluated for this criterion.	**2 Points:** At least one (1) additional member of the Key Technical Team Members has at least three (3) years of experience in Developing software on Android operating system. **1 Point:** At least one (1) additional member of the Key Technical Team Members has at least two (2) years of experience in Developing software on Android operating system. **0 Points:** No additional member of the Key Technical Team Members has two (2) years or more of experience in Developing software on Android operating system.	**Max: 2** **Points are not cumulative**	**Min: N/A**
d) Experience of proposed key technical team members in developing projects that required mobile ad hoc networking (MANET). The bidder should clearly identify the key technical team members to be evaluated for this criterion.	**3 Points:** At least two (2) of the key technical team members have at least two (2) years each demonstrated experience on projects that required MANET networking; **2 Points:** At least two (2) of the key technical team members have at least one (1) year each demonstrated experience on projects that required MANET networking; **1 Point:** At least one (1) of the key technical team members has at least one (1) year demonstrated experience on projects that required MANET networking; **0 Points:** None of the key technical team members has at least one (1) year demonstrated experience on projects that required MANET networking.	**Max: 3** **Points are not cumulative**	**Min: N/A**
e) Experience of proposed key technical team members in design, development, and integration of communications software within mobile networking projects. The bidder should clearly identify the key technical team members to be evaluated for this criterion.	**3 Points:** At least four (4) of the key technical team members have at least four (4) years each of experience in design, development, and integration of communications software within mobile networking projects; **2 Points:** At least three (3) of the key technical team members have at least three (3) years each of experience in design, development, and integration of	**Max: 3** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
	communications software within mobile networking projects; **1 Point:** At least two (2) of the key technical team members have at least two (2) years each of experience in design, development, and integration of communications software within mobile networking projects; **0 Points:** Less than two (2) of the key technical team members have at least two (2) years each of experience in designing, development, and integration of communications software within mobile networking projects:		

3.2 Corporate Evaluation

Evaluation criteria	Scale	Max Points	Min Points
Corporate Proposal		**26 Points** (total of 3.2.1 and 3.2.2)	**14 Points** (total of 3.2.1 and 3.2.2)
3.2.1 Corporate Experience of Bidder (Prime) Only For the purposes of this section (3.2.1), the experience described in the bid should be the experience of the Bidder itself (which includes the experience of any companies that formed the Bidder by way of a merger **but does not include** any experience acquired through a purchase of assets by other than an affiliated company. The experience of the Bidder's subsidiary or sister corporations, subcontractors, or suppliers **will not** be considered for criteria of section 3.2.1. The experience of the Bidder's parent corporation will be considered only if the parent has transferred all relevant operating assets, assignable contracts, employees and know-how to the Bidder.		**17 Points** (total of a to c)	**Min: N/A**
a) Relevance of Prime Bidder core business lines Relevant applications are part of the core business of the Prime Bidder, including delivery of turn-key integration services. Relevant applications include those with functions and features similar to the ones described in the TEC3 functional specification. This includes tactical wireless key management, blue force situational awareness, non-blue force situational awareness, tactical network command and	**1 point per** relevant application (COTS, or MOTS) developed and sold by the Bidder or an authorized third party. Maximum of 8 points.	**Max: 8**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
control, mobile ad-hoc networking software development.			
b) Establishing and managing integrated project teams involving cross-discipline team members The number, scope, and relevance of past projects in which the Bidder was required to setup an integrated project team involving use of hardware / software and professional support services will be evaluated considering whether they were successfully completed as demonstrated by client certification of acceptance. Note that to demonstrate client certification it is sufficient for the bidder to testify that the past projects were successfully completed, and provide at least one client reference per project. DND may contact client references to verify bidder testimonials. Relevant projects are defined as being similar to the TEC3 project in size and scope, requiring software development and integration activities for tactical mobile network devices, where the cross-discipline project team consisted of at least 4 people. Adequately demonstrated mechanisms to leverage the reference project experience into the TEC3 project would include, for example, use of management personnel that were on the reference project teams, use of pre-existing processes for tracking lessons learned and making them available for reference during the project, including development lessons learned to formalize knowledge transfer from one project team to another, or Bidder equivalent processes.	**1 point per** successfully completed relevant project including an adequately demonstrated mechanism to leverage the experience into the TEC3 project. Maximum of 4 points.	**Max: 4**	**Min: N/A**
c) Demonstrated Experience in "tactical cyber situational awareness" or "wireless Situational Awareness / Command and Control" Software Development and Integration Projects. The number, scope and relevance of past software development and integration projects will be evaluated considering whether they	**5 Points:** The Bidder has successfully completed at least four (4) relevant projects and has adequately demonstrated a mechanism to leverage the experience into the TEC3 project; **4 Points:** The Bidder has successfully completed at least three (3) relevant projects and has adequately demonstrated a mechanism to leverage the experience into the TEC3 project;	**Max: 5** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
were successfully completed as demonstrated by certification of client acceptance. Note that to demonstrate client certification it is sufficient for the bidder to testify that the past projects were successfully completed, and provide at least one client reference per project. DND may contact client references to verify bidder testimonials. Relevant projects are defined as being similar to the TEC3 project in size and scope, requiring software development and integration activities for tactical mobile network devices, where the cross-discipline project team consisted of at least 4 people. Adequately demonstrated mechanisms to leverage the reference project experience into the TEC3 project would include, for example, use of management personnel that were on the reference project teams, use of pre-existing processes for tracking lessons learned and making them available for reference during the project, including development lessons learned to formalize knowledge transfer from one project team to another, or Bidder equivalent processes.	**3 Points:** The Bidder has successfully completed at least two (2) relevant projects and has adequately demonstrated a mechanism to leverage the experience into the TEC3 project; **2 Points:** The Bidder has successfully completed at least one (1) relevant projects and has adequately demonstrated a mechanism to leverage the experience into the TEC3 project; **1 Point:** The Bidder has successfully has adequately demonstrated a mechanism to leverage previous experience into the TEC3 project; **0 Points:** The Bidder has no relevant projects or has not adequately demonstrated a mechanism to leverage previous experience into the TEC3 project.		
3.2.2 Corporate Experience of Proposed Team For the purposes of this section (3.2.2) only, the experience described in the bid may include the experience of any combination of the Bidder, its affiliates (i.e. parent, subsidiary or sister corporations) or subcontractors. The experience of the Bidder's hardware, software or other equipment suppliers will only be considered where it is demonstrated that the hardware, software or other equipment supplier is included as part of the Bidder's integrated project team (e.g., hardware modification, FPGA, SDR or device driver modification experience of a device supplier will not be considered if the product supplier is not also part of the deployment team).		**Maximum of 9 Points** (total of a to c)	**Min: N/A**
a) Test Environment Setup The number, scope and relevance of past projects in which the Bidder was required to setup an operational environment for testing, including mobile tactical nodes will be evaluated, considering whether they were	**5 Points:** The Bidder has successfully completed at least four (4) relevant projects and has adequately demonstrated a mechanism to leverage the experience into the TEC3 project; **4 Points:** The Bidder has successfully completed at least three (3) relevant projects and has adequately	**Max: 5**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
successfully completed as demonstrated by certification of client acceptance. Note that to demonstrate client certification it is sufficient for the bidder to testify that the past projects were successfully completed, and provide at least one client reference per project. DND may contact client references to verify bidder testimonials. Relevant projects are defined as being similar to the TEC3 project in size and scope, requiring software development and integration activities for tactical mobile network devices, where the cross-discipline project team consisted of at least 4 people. Adequately demonstrated mechanisms to leverage the reference project experience into the TEC3 project would include, for example, use of management personnel that were on the reference project teams, use of pre-existing processes for tracking lessons learned and making them available for reference during the project.	demonstrated a mechanism to leverage the experience into the TEC3 project; **3 Points:** The Bidder has successfully completed at least two (2) relevant projects and has adequately demonstrated a mechanism to leverage the experience into the TEC3 project; **2 Points:** The Bidder has successfully completed at least one (1) relevant projects and has adequately demonstrated a mechanism to leverage the experience into the TEC3 project; **1 Point:** The Bidder has successfully has adequately demonstrated a mechanism to leverage previous experience into the TEC3 project; **0 Points:** The Bidder has no relevant projects or has not adequately demonstrated a mechanism to leverage previous experience into the TEC3 project.	**Points are not cumulative**	
b) Team integration The bidder should identify the process to develop, deliver and track work on the stories (or tasks) followed by the entire integration team (prime + sub-contractors). This process includes (but is not limited to) developing stories (or breaking the work into tasks), mapping stories (or tasks) to the functional specification, quality assurance and testing, integration testing, deployment of software on devices and field testing.	**2 Points - Excellent:** The bidder describes in considerable detail the integration of the entire proposed team (prime + subcontractors) and the entire process for design, development and delivery of TEC3. **1 Point - Good:** The bidder describes in some detail the integration of the team members (prime + sub-contractors) and most of the process for design, development and delivery of TEC3. **0 Points - Weak:** The bidder does not describe the how members of the Key Technical team will work together or the description is missing part of the process for design, development and/or delivery of TEC3.	**Max: 2** **Points are not cumulative**	**Min: N/A**
c) Document development The process for developing iterative (or ongoing) documentation and delivery of a final end-of-phase document is well defined.	**2 Points - Excellent:** The bidder describes in considerable detail the development, acceptance and delivery of documentation during the development process, including the integration of contributions by the entire project team (prime + sub-contractors). The bidder describes in considerable detail the end of phase delivery of documentation and includes: copy-editing, diagram cleanup, unification of formatting and styles, management of document content into appropriate DID deliverables, and process for final document approval. **1 Point - Good:** The bidder describes in some detail but omits one or more of the development,	**Max: 2** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
	acceptance and delivery of documentation during the development process, including the integration of contributions by the entire project team (prime + sub-contractors). The bidder describes in some detail the end of phase delivery of documentation, but omits one or more of: copy-editing, diagram cleanup, unification of formatting and styles, management of document content into appropriate DID deliverables, and process for final document approval. **0 Points - Weak:** The bidder does not describe the development, acceptance and delivery of documentation during the development process, including the integration of contributions by the entire project team (prime + sub-contractors). The bidder does not describe: copy-editing, diagram cleanup, unification of formatting and styles, management of document content into appropriate DID deliverables, and process for final document approval.		

3.3   Technical Evaluation

The Bidder should submit a Technical Proposal that includes a draft Architecture Design Document, a draft Product Backlog, a completed Requirements Table, and a completed Classified Features Table. The completed Requirements Table and Classified Requirements Table are to be structured according to the sample "Requirements Table" and "Classified Features Table" provided below in section 3.3.3. The draft Architectural Design Document is to be structured in accordance with the Data Item Description (DID) SD 002, as described in Annex "A" - Statement of Requirements (SOR). The draft Product Backlog is to be structured in accordance with the Data Item Description (DID) SD 001, as described in Annex "A" - Statement of Requirements (SOR).

Bidders should note that the technical requirements, specified in Annex A, that are preceded by the term "must" are to be included as part of the Bidder's technical proposal. The technical requirements, specified in Annex A, preceded by the term "should" may be added to the Bidder's technical proposal. Bidder acknowledges and agrees that once added to its bid, these technical requirements become contractual requirements, on which the Bidder must deliver.

The Technical Proposal should describe the TEC3 architecture and how the bidder will deliver TEC3. The draft Architectural Design Document should describe the proposed architecture and approach the Bidder intends to use to meet the TEC3 requirements, and should include a cross-referencing or mapping of the proposed architecture to the requirements in the Bidder's completed Requirements Table and Classified Features Table.

Evaluation criteria	Scale	Max Points	Min Points
Technical Proposal		**152** **Points** (total of 3.3.1, 3.3.2 and 3.3.3)	**100** **Points** (total of 3.3.1, 3.3.2 and 3.3.3)
3.3.1 Understanding of the vision, objectives and scope The level of understanding and the relevance of the approach will be evaluated. An assessment of the development challenges, technical gaps, technology trends, and potential use of TEC3 concepts by the CAF/DND/DRDC in the proposal will also be carried out.	**20 Points:** Good understanding of vision, scope and objectives of contract demonstrated. The bidder clearly articulates developmental challenges, existing technical gaps, technical trends, and how demonstrated TEC3 concepts and the TEC3 system could be of use to the CAF/DND/DRDC. **10 Points:** Good understanding of vision, scope and objectives of contract demonstrated. The bidder fails to articulate developmental challenges, fails to identify technical trends, and/or fails to articulate how TEC3 concepts and the TEC3 system could be of use to CAF/DND/DRDC. **0 Point:** Limited or no understanding of vision, scope and objectives of contract demonstrated	**Max: 20** **Points are not cumulative**	**Min: N/A**
3.3.2 Adequacy of the technical solution Given the requirements stated in the RFP, the adequacy of the technical solution proposed by the bidder will be evaluated as a whole. An assessment will be made as to whether the Bidder's proposed solution is technically feasible, addresses technical challenges, uses justified complexity, and maximizes the system's flexibility and evolutionary capability. Note that in this portion of the evaluation criteria, the feasibility of the Bidder's solution to meet the Functional Specification requirements will be evaluated in parts (a) to (c). In evaluating feasibility we consider all of the following elements: - **Completeness:** The proposed solution considers how the specific TEC3 features and functions are integrated into the TEC3 system so as not to conflict with one another; - **Technical challenges:** The proposed solution has identified viable methods of dealing with perceived technical challenges in implementing the features and functions; - **Complexity:** The proposed solution optimizes development effort and demonstrates feasibility by the inclusion of pre-existing or well-understood technology or techniques, where applicable; the solution explains how these techniques and technologies will be integrated into TEC3; - **Flexibility:** The proposed solution ensures flexibility and future usability by employing open standards, modular and extensible design principles, well-defined APIs, and upgradeable hardware/software components, where applicable.		**100 Points** (total a to c)	**Min: 5**
a) What is the feasibility and risk of the proposed solution to meet the basic TEC3 communications and display requirements consisting of the following features: - "TEC3 Devices" - "Modularity of Design" - "Configuration and Management" - "Communications and Networking" - "Encryption and Key Management" - "User Communication Services"	The feasibility and risk associated with delivering these features will be awarded points according to the following four categories. The sum of all four categories will create a composite score. **Completeness** **10 points** = proposal clearly describes how all features and functions will be integrated so as not to conflict **5 points** = proposal describes how some features and functions will be integrated to avoid conflict **0 points** = proposal does not make clear how features and functions will avoid conflict	**Max: 40** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
- "Blue Force Tracking with GPS" - "Data Dissemination" - "Data Prioritization" - "Display and User Interface"? (reference TEC3 FS Sections 2.1, 2.2, 2.3, 3, 4, 5.1, 5.2, 7, 8)	**Technical challenges** **10 points** = proposal highlights at least 1 relevant technical challenge for every TEC3 feature and provides feasible mitigation strategies; in cases where bidders do not foresee a technical challenge for a particular feature, bidders must justify (with reference to an existing mature solution) how this feature is well-understood and easily integrated. **5 points** = proposal highlights at least 1 relevant technical challenge for some (at least half) but not all TEC3 features and provides some feasible mitigation strategies, or, in cases where bidders do not foresee a technical challenge for a particular feature, bidders must justify (with reference to an existing mature solution) how this feature is well-understood and easily integrated. **0 points** = proposal does not highlight relevant technical challenges for TEC3 features or does not provide feasible mitigation strategies, or, bidders have not justified (with reference to an existing mature solution) that the features do not present a challenge. **Integration of pre-existing technology/techniques and solution maturity/readiness** **10 points** = proposal clearly explains the use of pre-existing technology and techniques (proprietary, open source, or commercial), makes use of more mature or higher TRL solutions where applicable, and clearly explains how these will be integrated into the TEC3 system; in cases where pre-existing technology is not employed or lower TRL solutions are used, the proposal justifies this decision. **5 points** = proposal makes use of some pre-existing technology but fails to clearly explain how it will be integrated into the TEC3 system, or, in the cases where pre-existing technology is not use the proposal fails to justify this decision. **0 points** = proposal fails to explain how pre-existing technology will be integrated into the TEC3 system and fails to justify why pre-existing technology is not being employed in cases where lower TRL solutions are proposed. **Flexibility** **10 points** = proposal clearly describes how the TEC3 system employs all of: open standards; modular and extensible design principles; well-defined APIs; and upgradeable hardware/software components **5 points** = proposal describes how the TEC3 system employs some of: open standards; modular and extensible design principles; well-defined APIs; and upgradeable hardware/software components **0 points** = proposal fails to describe how the TEC3 system employs open standards; modular and extensible design principles; well-defined APIs; or upgradeable hardware/software components		

Evaluation criteria	Scale	Max Points	Min Points
b) What is the feasibility and risk of the proposed solution to meet the TEC3 Network Situational Awareness and Command and Control functional requirements consisting of the following features: "Blue Force Tracking without GPS" "Blue Force Status Updates" "Direction of Travel" "Link and Route Quality" "Node-level Trust" "Geo-location of non-allied Emitters" "Identification of Network Threats" "Policy-based Routing and Device Management" "Go Dark (Emission Control)" "Revoke User Key" "Establish Encrypted Community of Interest" "Create Covert Channel" "Send Misinformation" (reference TEC3 FS Section 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 6)	The feasibility and risk associated with delivering these features will be awarded points according to the following four categories. The sum of all four categories will create a composite score. **Completeness** **10 points** = proposal clearly describes how all features and functions will be integrated so as not to conflict **5 points** = proposal describes how some features and functions will be integrated to avoid conflict **0 points** = proposal does not make clear how features and functions will avoid conflict **Technical challenges** **10 points** = proposal highlights at least 1 relevant technical challenge for every TEC3 feature and provides feasible mitigation strategies; in cases where bidders do not foresee a technical challenge for a particular feature, bidders must justify (with reference to an existing mature solution) how this feature is well-understood and easily integrated. **5 points** = proposal highlights at least 1 relevant technical challenge for some (at least half) but not all TEC3 features and provides some feasible mitigation strategies, or, in cases where bidders do not foresee a technical challenge for a particular feature, bidders must justify (with reference to an existing mature solution) how this feature is well-understood and easily integrated. **0 points** = proposal does not highlight relevant technical challenges for TEC3 features or does not provide feasible mitigation strategies, or, bidders have not justified (with reference to an existing mature solution) that the features do not present a challenge. **Integration of pre-existing technology/techniques** **10 points** = proposal clearly explains the use of pre-existing technology and techniques (proprietary, open source, or commercial), makes use of more mature or higher TRL solutions where applicable, and clearly explains how these will be integrated into the TEC3 system; in cases where pre-existing technology is not employed or lower TRL solutions are used, the proposal justifies this decision. **5 points** = proposal makes use of some pre-existing technology but fails to clearly explain how it will be integrated into the TEC3 system, or, in the cases where pre-existing technology is not used the proposal fails to justify this decision. **0 points** = proposal fails to explain how pre-existing technology will be integrated into the TEC3 system and fails to justify why pre-existing technology is not being employed in cases where lower TRL solutions are proposed.	**Max: 40** **Points are not cumulative**	**Min: N/A**

Evaluation criteria	Scale	Max Points	Min Points
	Flexibility **10 points** = proposal clearly describes how the TEC3 system employs all of: open standards; modular and extensible design principles; well-defined APIs; and upgradeable hardware/software components **5 points** = proposal describes how the TEC3 system employs some of: open standards; modular and extensible design principles; well-defined APIs; and upgradeable hardware/software components **0 points** = proposal fails to describe how the TEC3 system employs open standards; modular and extensible design principles; well-defined APIs; or upgradeable hardware/software components		
c) How does the proposed solution meet the TEC3 Functional Specification requirements of: "Cyber Operations" (reference "Specifications for advanced capabilities of the Tactical Edge Cyber Command and Control (TEC3) project (U)", DRDC-RDDC-2016-D002).	The feasibility and risk associated with delivering these features will be awarded points according to the following four categories. The sum of all four categories will create a composite score. **Completeness** **5 points** = proposal clearly describes how all features and functions will be integrated so as not to conflict **2.5 points** = proposal describes how some features and functions will be integrated to avoid conflict **0 points** = proposal does not make clear how features and functions will avoid conflict **Technical challenges** **5 points** = proposal highlights at least 1 relevant technical challenge for every TEC3 feature and provides feasible mitigation strategies; in cases where bidders do not foresee a technical challenge for a particular feature, bidders must justify (with reference to an existing mature solution) how this feature is well-understood and easily integrated. **2.5 points** = proposal highlights at least 1 relevant technical challenge for some (at least half) but not all TEC3 features and provides some feasible mitigation strategies, or, in cases where bidders do not foresee a technical challenge for a particular feature, bidders must justify (with reference to an existing mature solution) how this feature is well-understood and easily integrated. **0 points** = proposal does not highlight relevant technical challenges for TEC3 features or does not provide feasible mitigation strategies, or, bidders have not justified (with reference to an existing mature solution) that the features do not present a challenge. **Integration of pre-existing technology/techniques** **5 points** = proposal clearly explains the use of pre-existing technology and techniques (proprietary, open source, or commercial), makes use of more mature or higher TRL solutions where applicable, and clearly explains how these will be integrated into the TEC3 system; in cases where pre-existing technology is not employed or lower TRL solutions are used, the proposal justifies this decision.	**Max: 20** **Points are not cumulative**	**Min: 5**

Evaluation criteria	Scale	Max Points	Min Points
	2.5 points = proposal makes use of some pre-existing technology but fails to clearly explain how it will be integrated into the TEC3 system, or, in the cases where pre-existing technology is not used the proposal fails to justify this decision. **0 points** = proposal fails to explain how pre-existing technology will be integrated into the TEC3 system and fails to justify why pre-existing technology is not being employed in cases where lower TRL solutions are proposed. **Flexibility** **5 points** = proposal clearly describes how the TEC3 system employs all of: open standards; modular and extensible design principles; well-defined APIs; and upgradeable hardware/software components **2.5 points** = proposal describes how the TEC3 system employs some of: open standards; modular and extensible design principles; well-defined APIs; and upgradeable hardware/software components **0 points** = proposal fails to describe how the TEC3 system employs open standards; modular and extensible design principles; well-defined APIs; or upgradeable hardware/software components		

3.3.3   Sample Requirements Table and Classified Features Table

The Bidder should complete the sample Requirements Table and the Classified Features Table. For every optional item included in the bid, the Bidder earns additional points in the Technical Evaluation portion of the bid. The value of the points earned is computed by adding the number of points earned in the "Additional points available" column and scaling the result by a factor of 0.1.

For example, if the Bidder proposes to include optional items "NETWORK.12" and "NETWORK.14" in the bid, then the Bidder earns a total of (10 + 10) x 0.1 = 2 additional points on the Technical Evaluation portion of the bid.

The maximum total additional points available in this section is 32. There is no required minimum for this section.

A NOTE ON CLASSIFIED FEATURES TABLE

The Classified Features Table includes four classified features: CYBER_OPS.1, CYBER_OPS.2, CYBER_OPS.3, and CYBER_OPS.4. These features correspond to the classified features described in reference "Specifications for advanced capabilities of the Tactical Edge Cyber Command and Control (TEC3) project (U)", DRDC-RDDC-2016-D002, where CYBER_OPS.1 corresponds to the feature with requirements described in section 1, CYBER_OPS.2 corresponds to the feature with

requirements described in section 2, CYBER_OPS.3 corresponds to the feature with requirements described in section 3, and CYBER_OPS.4 corresponds to the feature with requirements described in section 4.

For each additional classified feature the bidder includes in the bid (over and above the minimum of 2 features), the bidder will earn additional points.

REQUIREMENTS TABLE

Req #	Requirement Name	Mandatory (MUST)	Optional (SHOULD)	Included in Contractor Bid	Additional points available
1	DEVICE.1	X		YES	0
2	DEVICE.2	X		YES	0
3	DEVICE.3	X		YES	0
4	DEVICE.4	X		YES	0
5	DEVICE.5	X		YES	0
6	DEVICE.6		X	YES or NO ? _____	1
7	DEVICE.7	X		YES	0
8	DEVICE.8		X	YES or NO ? _____	1
9	DEVICE.9		X	YES or NO ? _____	1
10	DEVICE.10		X	YES or NO ? _____	1
11	DEVICE.11	X		YES	0
12	DEVICE.12		X	YES or NO ? _____	1
13	DEVICE.13	X		YES	0
14	DEVICE.14		X	YES or NO ? _____	1
15	DEVICE.15		X	YES or NO ? _____	1
16	DEVICE.16	X		YES	0
17	DEVICE.17		X	YES or NO ? _____	1
18	DEVICE.18	X		YES	0
19	DEVICE.19	X		YES	0
20	MOD.1	X		YES	0
21	MOD.2		X	YES or NO ? _____	5
22	MOD.3		X	YES or NO ? _____	5
23	MOD.4	X		YES	0
24	CONFIG.1	X		YES	0
25	CONFIG.2	X		YES	0
26	CONFIG.3	X		YES	0
27	CONFIG.4	X		YES	0
28	CONFIG.5	X		YES	0
29	NETWORK.1	X		YES	0
30	NETWORK.2	X		YES	0
31	NETWORK.3	X		YES	0
32	NETWORK.4	X		YES	0
33	NETWORK.5	X		YES	0
34	NETWORK.6	X		YES	0
35	NETWORK.7	X		YES	0
36	NETWORK.8	X		YES	0
37	NETWORK.9		X	YES or NO ? _____	1
38	NETWORK.10	X		YES	0
39	NETWORK.11	X		YES	0
40	NETWORK.12		X	YES or NO ? _____	10
41	NETWORK.13	X		YES	0
42	NETWORK.14		X	YES or NO ? _____	10
43	NETWORK.15		X	YES or NO ? _____	1
44	NETWORK.16		X	YES or NO ? _____	1
45	NETWORK.17	X		YES	0
46	NETWORK.18		X	YES or NO ? _____	1
47	NETWORK.19		X	YES or NO ? _____	1
48	NETWORK.20		X	YES or NO ? _____	1
49	NETWORK.21		X	YES or NO ? _____	1
50	NETWORK.22		X	YES or NO ? _____	1
51	DATASERV.1	N/A	N/A	N/A	0

Req #	Requirement Name	Mandatory (MUST)	Optional (SHOULD)	Included in Contractor Bid	Additional points available
52	DATASERV.2	X		YES	0
53	DATASERV.3		X	YES or NO ? _____	10
54	DATASERV.4	X		YES	0
55	DATASERV.5	X		YES	0
56	DATASERV.6		X	YES or NO ? _____	1
57	DATASERV.7	N/A	N/A	N/A	0
58	DATASERV.8		X	YES or NO ? _____	1
59	DATASERV.9		X	YES or NO ? _____	1
60	DATASERV.10		X	YES or NO ? _____	1
61	COMM.1	X		YES	0
62	COMM.2a	X		YES	0
63	COMM.2b	X		YES	0
64	COMM.2c	X		YES	0
65	COMM.2d	X		YES	0
66	COMM.2e	X		YES	0
67	COMM.3	X		YES	0
68	COMM.4	X		YES	0
69	COMM.5	X		YES	0
70	COMM.6a	N/A	N/A	N/A	0
71	COMM.6b		X	YES or NO ? _____	1
72	COMM.6c		X	YES or NO ? _____	1
73	COMM.7a		X	YES or NO ? _____	1
74	COMM.7b		X	YES or NO ? _____	1
75	COMM.7c		X	YES or NO ? _____	1
76	ENCRYPT.1	X		YES	0
77	ENCRYPT.2	X		YES	0
78	ENCRYPT.3	X		YES	0
79	ENCRYPT.4		X	YES or NO ? _____	1
80	ENCRYPT.5	X		YES	0
81	ENCRYPT.6	X		YES	0
82	ENCRYPT.7	X		YES	0
83	ENCRYPT.8	X		YES	0
84	ENCRYPT.9	X		YES	0
85	ENCRYPT.10		X	YES or NO ? _____	1
86	ENCRYPT.11		X	YES or NO ? _____	1
87	ENCRYPT.12a	X		YES	0
88	ENCRYPT.12b		X	YES or NO ? _____	20
89	ENCRYPT.13	X		YES	0
90	ENCRYPT.14	X		YES	0
91	ENCRYPT.15	X		YES	0
92	ENCRYPT.16		X	YES or NO ? _____	1
93	ENCRYPT.17		X	YES or NO ? _____	1
94	ENCRYPT.18	X		YES	0
~~95~~	~~ENCRYPT.19~~	~~X~~		~~YES~~	~~0~~
96	ENCRYPT.20	X		YES	0
97	ENCRYPT.21	X		YES	0
98	ENCRYPT.22	X		YES	0
99	ENCRYPT.23	X		YES	0
100	ENCRYPT.24	X		YES	0
101	ENCRYPT.25	X		YES	0
102	ENCRYPT.26	X		YES	0
103	ENCRYPT.27	X		YES	0
104	ENCRYPT.28	X		YES	0
105	ENCRYPT.29		X	YES or NO ? _____	1
106	ENCRYPT.30	X		YES	0
107	ENCRYPT.31		X	YES or NO ? _____	1
108	ENCRYPT.32		X	YES or NO ? _____	1
109	ENCRYPT.33		X	YES or NO ? _____	1
110	ENCRYPT.34		X	YES or NO ? _____	1
111	ENCRYPT.35	X		YES	0
112	UCS.1	X		YES	0
113	UCS.2	X		YES	0
114	UCS.3	X		YES	0

Req #	Requirement Name	Mandatory (MUST)	Optional (SHOULD)	Included in Contractor Bid	Additional points available
115	UCS.4	X		YES	0
116	UCS.5	X		YES	0
117	UCS.6	X		YES	0
118	UCS.7	X		YES	0
119	UCS.8	X		YES	0
120	UCS.9	X		YES	0
121	UCS.10	X		YES	0
122	UCS.11	X		YES	0
123	UCS.12a	X		YES	0
124	UCS.12b	X		YES	0
125	UCS.12c		X	YES or NO ? _____	5
126	UCS.12d		X	YES or NO ? _____	1
127	UCS.13	X		YES	0
128	UCS.14	X		YES	0
129	UCS.15	X		YES	0
130	UCS.16	X		YES	0
131	UCS.17	X		YES	0
132	UCS.18	X		YES	0
133	UCS.19	X		YES	0
134	BFT_GPS.1	X		YES	0
135	BFT_GPS.2	X		YES	0
136	BFT_GPS.3	X		YES	0
137	BFT_GPS.4	X		YES	0
138	BFT_GPS.5	X		YES	0
139	BFT_GPS.6	X		YES	0
140	BFT_GPS.7	X		YES	0
141	BFT_GPS.8	X		YES	0
142	BFT_GPS.9	X		YES	0
143	BFT_NOGPS.1	X		YES	0
144	BFT_NOGPS.2		X	YES or NO ? _____	10
145	BFT_NOGPS.3	X		YES	0
146	BFT_NOGPS.4	X		YES	0
147	BFT_NOGPS.5	X		YES	0
148	BFT_NOGPS.6		X	YES or NO ? _____	1
149	BFT_NOGPS.7	X		YES	0
150	STATUS.1	X		YES	0
151	STATUS.2	X		YES	0
152	STATUS.3	X		YES	0
153	STATUS.4	X		YES	0
154	STATUS.5	X		YES	0
155	DIRECTION.1	X		YES	0
156	DIRECTION.2	X		YES	0
157	DIRECTION.3	X		YES	0
158	DIRECTION.4	X		YES	0
159	LR_QUAL.1	X		YES	0
160	LR_QUAL.2	X		YES	0
161	LR_QUAL.3	X		YES	0
162	LR_QUAL.4	X		YES	0
163	LR_QUAL.5	X		YES	0
164	LR_QUAL.6		X	YES or NO ? _____	1
165	LR_QUAL.7	X		YES	0
166	LR_QUAL.8	X		YES	0
167	LR_QUAL.9	X		YES	0
168	LR_QUAL.10	X		YES	0
169	LR_QUAL.11	X		YES	0
170	LR_QUAL.12		X	YES or NO ? _____	1
171	TRUST.1	X		YES	0
172	TRUST.2a	X		YES	0
173	TRUST.2b	X		YES	0
174	TRUST.2c		X	YES or NO ? _____	1
175	TRUST.2d		X	YES or NO ? _____	1
176	TRUST.2e		X	YES or NO ? _____	1
177	TRUST.2f	X		YES	0

Req #	Requirement Name	Mandatory (MUST)	Optional (SHOULD)	Included in Contractor Bid	Additional points available
178	TRUST.3	X		YES	0
179	TRUST.4	X		YES	0
180	TRUST.5	X		YES	0
181	TRUST.6	X		YES	0
182	TRUST.7	X		YES	0
183	TRUST.8	X		YES	0
184	TRUST.9		X	YES or NO ? _____	10
185	TRUST.10	X		YES	0
186	TRUST.11	X		YES	0
187	TRUST.12	X		YES	0
188	TRUST.13	X		YES	0
189	TRUST.14	X		YES	0
190	TRUST.15	X		YES	0
191	TRUST.16	X		YES	0
192	GEO_THREAT.1	X		YES	0
193	GEO_THREAT.2	X		YES	0
194	GEO_THREAT.3	X		YES	0
195	GEO_THREAT.4	X		YES	0
196	GEO_THREAT.5	X		YES	0
197	GEO_THREAT.6		X	YES or NO ? _____	15
198	GEO_THREAT.7		X	YES or NO ? _____	1
199	GEO_THREAT.8		X	YES or NO ? _____	1
200	GEO_THREAT.9	N/A	N/A	N/A	0
201	GEO_THREAT.10	X		YES	0
202	GEO_THREAT.11		X	YES or NO ? _____	1
203	NET_THREAT.1	X		YES	0
204	NET_THREAT.2	X		YES	0
205	NET_THREAT.3	X		YES	0
206	NET_THREAT.4	X		YES	0
207	NET_THREAT.5		X	YES or NO ? _____	1
208	NET_THREAT.6		X	YES or NO ? _____	1
209	NET_THREAT.7	X		YES	0
210	NET_THREAT.8		X	YES or NO ? _____	1
211	NET_THREAT.9	X		YES	0
212	NET_THREAT.10	X		YES	0
213	NET_THREAT.11	X		YES	0
214	NET_THREAT.12	X		YES	0
215	NET_THREAT.13	X		YES	0
216	NET_THREAT.14	X		YES	0
217	NET_THREAT.15	X		YES	0
218	NET_THREAT.16	X		YES	0
219	NET_THREAT.17	X		YES	0
220	POLICY_RDM.1	X		YES	0
221	POLICY_RDM.2	X		YES	0
222	POLICY_RDM.3	X		YES	0
223	POLICY_RDM.4	X		YES	0
224	POLICY_RDM.5a	X		YES	0
225	POLICY_RDM.5b	X		YES	0
226	POLICY_RDM.5c	N/A	N/A	N/A	0
227	POLICY_RDM.5d	X		YES	0
228	POLICY_RDM.6a	X		YES	0
229	POLICY_RDM.6b		X	YES or NO ? _____	1
230	POLICY_RDM.6c		X	YES or NO ? _____	1
231	POLICY_RDM.7	X		YES	0
232	DARK.1		X	YES or NO ? _____	2
233	DARK.2		X	YES or NO ? _____	1
234	DARK.3		X	YES or NO ? _____	5
235	DARK.4		X	YES or NO ? _____	1
236	DARK.5		X	YES or NO ? _____	5
237	DARK.6		X	YES or NO ? _____	1
238	DARK.7		X	YES or NO ? _____	1
239	DARK.8		X	YES or NO ? _____	1
240	DARK.9		X	YES or NO ? _____	1

Req #	Requirement Name	Mandatory (MUST)	Optional (SHOULD)	Included in Contractor Bid	Additional points available
241	DARK.10		X	YES or NO ? _____	1
242	DARK.11		X	YES or NO ? _____	1
243	DARK.12		X	YES or NO ? _____	1
244	REVOKE.1	X		YES	0
245	REVOKE.2	X		YES	0
246	REVOKE.3	X		YES	0
247	REVOKE.4	X		YES	0
248	REVOKE.5	X		YES	0
249	REVOKE.6	X		YES	0
250	REVOKE.7	X		YES	0
251	REVOKE.8	X		YES	0
252	REVOKE.9	X		YES	0
253	COI.1		X	YES or NO ? _____	10
254	COI.2		X	YES or NO ? _____	1
255	COI.3		X	YES or NO ? _____	1
256	COI.4		X	YES or NO ? _____	1
257	COI.5		X	YES or NO ? _____	1
258	COI.6		X	YES or NO ? _____	10
259	COI.7		X	YES or NO ? _____	1
260	COI.8		X	YES or NO ? _____	1
261	COI.9		X	YES or NO ? _____	1
262	COI.10		X	YES or NO ? _____	1
263	COI.11		X	YES or NO ? _____	1
264	COI.12		X	YES or NO ? _____	1
265	COVERT.1		X	YES or NO ? _____	10
266	COVERT.2		X	YES or NO ? _____	10
267	COVERT.3		X	YES or NO ? _____	1
268	COVERT.4		X	YES or NO ? _____	1
269	COVERT.5		X	YES or NO ? _____	1
270	COVERT.6		X	YES or NO ? _____	1
271	COVERT.7		X	YES or NO ? _____	1
272	COVERT.8		X	YES or NO ? _____	1
273	COVERT.9		X	YES or NO ? _____	1
274	MISINF.1	X		YES	0
275	MISINF.2	X		YES	0
276	MISINF.3	X		YES	0
277	MISINF.4	X		YES	0
278	MISINF.5		X	YES or NO ? _____	1
279	MISINF.6	X		YES	0
280	MISINF.7	X		YES	0
281	MISINF.8	X		YES	0
282	MISINF.9	X		YES	0
283	MISINF.10	X		YES	0
284	DISSEM.1	X		YES	0
285	DISSEM.2	X		YES	0
286	DISSEM.3	X		YES	0
287	DISSEM.4		X	YES or NO ? _____	10
288	DISPLAY.1	X		YES	0
289	DISPLAY.2	X		YES	0
290	DISPLAY.3	X		YES	0
291	DISPLAY.4	X		YES	0
292	DISPLAY.5	X		YES	0
293	DISPLAY.6	X		YES	0
294	DISPLAY.7	N/A	N/A	N/A	0
295	DISPLAY.8	X		YES	0
296	DISPLAY.9	X		YES	0
297	DISPLAY.10	X		YES	0
298	DISPLAY.11	N/A	N/A	N/A	0
299	DISPLAY.12	X		YES	0
300	DISPLAY.13		X	YES or NO ? _____	1
MAX AVAILABLE POINTS FOR OPTIONAL REQUIREMENTS (RAW SCORE)					**240**

Req #	Requirement Name	Mandatory (MUST)	Optional (SHOULD)	Included in Contractor Bid	Additional points available
MAX SCALED AVAILABLE POINTS FOR OPTIONAL REQUIREMENTS = (RAW SCORE)x0.1					24

CLASSIFIED FEATURES TABLE

Classified Feature Name	Included in bid (bidder MUST select a minimum of 2)	Additional Points Available
CYBER_OPS.1	YES or NO? _____	For 2 features, bidders earn 0 points.
CYBER_OPS.2	YES or NO? _____	For 3 features, bidders earn 40 additional points.
CYBER_OPS.3	YES or NO? _____	For 4 features, bidders earn 80 additional points.
CYBER_OPS.4	YES or NO? _____	
MAX AVAILABLE POINTS FOR CLASSIFIED REQUIREMENTS (RAW SCORE)		80
MAX SCALED AVAILABLE POINTS FOR CLASSIFIED REQUIREMENTS = (RAW SCORE)x0.1		8

Total scaled additional points available for the optional requirements and classified features:
24+8 = 32 additional points available for the Technical Evaluation portion of the bid.

PART 5 - CERTIFICATIONS

Bidders must provide the required certifications and documentation to be awarded a contract.

The certifications provided by bidders to Canada are subject to verification by Canada at all times. Canada will declare a bid non-responsive, or will declare a contractor in default, if any certification made by the Bidder is found to be untrue, whether made knowingly or unknowingly, during the bid evaluation period or during the contract period.

The Contracting Authority will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply and to cooperate with any request or requirement imposed by the Contracting Authority may render the bid non-responsive or constitute a default under the Contract.

1. Certifications Required Precedent to Contract Award

1.1 Integrity Provisions – Associated Information

By submitting a bid, the Bidder certifies that the Bidder and its Affiliates are in compliance with the provisions as stated in Section 01 Integrity Provisions - Bid of Standard Instructions 2003. The associated information required within the Integrity Provisions will assist Canada in confirming that the certifications are true.

1.2 Federal Contractors Program for Employment Equity - Bid Certification

By submitting a bid, the Bidder certifies that the Bidder, and any of the Bidder's members if the Bidder is a Joint Venture, is not named on the Federal Contractors Program (FCP) for employment equity "FCP Limited Eligibility to Bid" list (http://www.labour.gc.ca/eng/standards_equity/eq/emp/fcp/list/inelig.shtml) available from Employment and Social Development Canada (ESDC) - Labour's website

Canada will have the right to declare a bid non-responsive if the Bidder, or any member of the Bidder if the Bidder is a Joint Venture, appears on the "FCP Limited Eligibility to Bid" list at the time of contract award.

Canada will also have the right to terminate the Contract for default if a Contractor, or any member of the Contractor if the Contractor is a Joint Venture, appears on the "FCP Limited Eligibility to Bid" list during the period of the Contract.

The Bidder must provide the Contracting Authority with a completed Federal Contractors Program for Employment Equity - Certification found at Attachment 1 to Part 5, before contract award. If the Bidder is a Joint Venture, the Bidder must provide the Contracting Authority with a completed Federal Contractors Program for Employment Equity - Certification, for each member of the Joint Venture.

1.3 Canadian Content Certification

This procurement is limited to Canadian goods and Canadian services.

The Bidder certifies that:

( )   a minimum of 80 percent of the total bid price consist of Canadian goods and Canadian services as defined in paragraph 5 of clause A3050T.

For more information on how to determine the Canadian content for a mix of goods, a mix of services or a mix of goods and services, consult Annex 3.6.(9), Example 2, of the Supply Manual.
(https://buyandsell.gc.ca/policy-and-guidelines/supply-manual/annex/3/6)

1.3.1 SACC Manual clause A3050T (2010-01-11), Canadian Content Definition

1.4 Status and Availability of Resources

The Bidder certifies that, should it be awarded a contract as a result of the bid solicitation, every individual proposed in its bid will be available to perform the Work as required by Canada's representatives and at the time specified in the bid solicitation or agreed to with Canada's representatives. If for reasons beyond its control, the Bidder is unable to provide the services of an individual named in its bid, the Bidder may propose a substitute with similar qualifications and experience. The Bidder must advise the Contracting Authority of the reason for the substitution and provide the name, qualifications and experience of the proposed replacement. For the purposes of this clause, only the following reasons will be considered as beyond the control of the Bidder: death, sickness, maternity and parental leave, retirement, resignation, dismissal for cause or termination of an agreement for default.

If the Bidder has proposed any individual who is not an employee of the Bidder, the Bidder certifies that it has the permission from that individual to propose his/her services in relation to the Work to be performed and to submit his/her résumé to Canada. The Bidder must, upon request from the Contracting Authority, provide a written confirmation, signed by the individual, of the permission given to the Bidder and of his/her availability. Failure to comply with the request may result in the bid being declared non-responsive.

1.5 Education and Experience

The Bidder certifies that all the information provided in the résumés and supporting material submitted with its bid, particularly the information pertaining to education, achievements, experience and work history, has been verified by the Bidder to be true and accurate. Furthermore, the Bidder warrants that every individual proposed by the Bidder for the requirement is capable of performing the Work described in the resulting contract.

1.6 Language Capability

The Bidder certifies that it has the language capability required to perform the Work, as stipulated in the Statement of Requirements.

By submitting a bid, the Bidder certifies that the information submitted by the Bidder in response to the above requirements is accurate and complete.

ATTACHMENT 1 TO PART 5
FEDERAL CONTRACTORS PROGRAM FOR EMPLOYMENT EQUITY –
CERTIFICATION

I, the Bidder, by submitting the present information to the Contracting Authority, certify that the information provided is true as of the date indicated below. The certifications provided to Canada are subject to verification at all times. I understand that Canada will declare a bid non-responsive, or will declare a contractor in default, if a certification is found to be untrue, whether during the bid evaluation period or during the contract period. Canada will have the right to ask for additional information to verify the Bidder's certifications. Failure to comply with any request or requirement imposed by Canada may render the bid non-responsive or constitute a default under the Contract.

For further information on the Federal Contractors Program for Employment Equity visit Employment and Social Development Canada (ESDC)-Labour's website.

Date: _____ (YYYY/MM/DD) (If left blank, the date will be deemed to be the bid solicitation closing date.)

Complete both A and B.

A. Check only one of the following:

( ) A1. The Bidder certifies having no work force in Canada.

( ) A2. The Bidder certifies being a public sector employer.

( ) A3. The Bidder certifies being a federally regulated employer being subject to the *Employment Equity Act*.

( ) A4. The Bidder certifies having a combined work force in Canada of less than 100 employees (combined work force includes: permanent full-time, permanent part-time and temporary employees [temporary employees only includes those who have worked 12 weeks or more during a calendar year and who are not full-time students]).

A5. The Bidder has a combined workforce in Canada of 100 or more employees; and

    ( ) A5.1 The Bidder certifies already having a valid and current Agreement to Implement Employment Equity (AIEE) in place with ESDC-Labour.

OR

    ( ) A5.2 The Bidder certifies having submitted the Agreement to Implement Employment Equity (LAB1168) to ESDC-Labour. As this is a condition to contract award, proceed to completing the form Agreement to Implement Employment Equity (LAB1168), duly signing it, and transmit it to ESDC-Labour.

B. Check only one of the following:

( ) B1. The Bidder is not a Joint Venture.

OR

( ) B2. The Bidder is a Joint venture and each member of the Joint Venture must provide the Contracting Authority with a completed annex Federal Contractors Program for Employment Equity - Certification. (Refer to the Joint Venture section of the Standard Instructions)

PART 6 - SECURITY, FINANCIAL AND OTHER REQUIREMENTS

1. Security Requirement

1.1 Before award of a contract, the following conditions must be met:

(a) The Bidder must meet all security requirements as indicated in Part 7 - Resulting Contract Clauses, Article 3.0, Security Requirements;

(b) The Bidder's proposed individuals requiring access to classified or protected information, assets or sensitive work site(s) must meet the security requirements as indicated in Part 7 - Resulting Contract Clauses;

(c) The Bidder must provide the name of all individuals who will require access to classified or protected information, assets or sensitive work sites.

(d) The Bidder's proposed location of work performance or document safeguarding must meet the security requirement as indicated in Part 7 - Resulting Contract Clauses;

(e) The Bidder must provide the address (es) of proposed location(s) of work performance or document safeguarding.

1.2 Bidders are reminded to obtain the required security clearance promptly. Any delay in the award of a contract to allow the successful bidder to obtain the required clearance will be at the entire discretion of the Contracting Authority.

1.3 For additional information on security requirements, bidders should consult the "Security Requirements for PWGSC Bid Solicitations - Instructions for Bidders" (http://www.tpsgc-pwgsc.gc.ca/app-acq/lc-pl/lc-pl-eng.html#a31) document on the Departmental Standard Procurement Documents website.

1.4 Distribution of classified document

In order to obtain a copy of the Appendix 3 to Annex A which is classified, Bidders must meet the security requirements indicated at Article 3.0, Security Requirement of Part 7, Resulting Contract Clauses. Bidders must contact the Contracting Authority (CA) by e-mail and provide the following information in order to initiate the security verification process:

1- Contractor's legal name;
2- Address of the Contractor's site or premises where classified information will be stored;
3- Name, birthday and citizenship of all individuals, who will require access to classified or protected information;

Following reception of these information, the CA will confirm Bidder's security status with the Contract Security Program of PWGSC before to mail out the classified document. All classified document(s) must be returned by mail to the CA at the end of the solicitation period. For more information on this process, please contact the CA.

2. Financial Capability

SACC Manual clause A9033T (2012-07-16), Financial Capability

3. Controlled Goods Requirement

SACC Manual clause A9130T (2014-11-27), Controlled Goods Program

PART 7 - RESULTING CONTRACT CLAUSES

The following clauses and conditions apply to and form part of any contract resulting from the bid solicitation.

1.1 Statement of Requirement

The Contractor must perform the Work in accordance with the Statement of Requirement at Annex "A" and the Contractor's technical bid dated _____.

1.2 Task Authorization - For the optional work identified in Appendix 1 to Annex "A" only

A portion of the Work to be performed under the Contract will be on an "as and when requested basis" using a Task Authorization (TA). The Work described in the TA must be in accordance with the scope of the Contract.

1.2.1 Task Authorization Process

a) The Technical Authority will provide the Contractor with a description of the task using the Task Authorization Form - DND 626.

b) The Task Authorization (TA) will contain the details of the activities to be performed, a description of the deliverables, and a schedule indicating completion dates for the major activities or submission dates for the deliverables. The TA will also include the applicable basis and methods of payment, as specified in the Contract.

c) The Contractor must provide the Technical Authority, within 10 calendar days of its receipt, the proposed total estimated cost for performing the task and a breakdown of that cost, established in accordance with the Basis of Payment specified in the Contract.

d) The Contractor must not commence work until a TA authorized by the Technical Authority or the Contracting Authority, which one first apply has been received by the Contractor. The Contractor acknowledges that any work performed before a TA has been received will be done at the Contractor's own risk.

1.2.2 Task Authorization Limit

The Technical Authority may authorize individual task authorizations up to a limit of $100,000.00, Applicable Taxes included, inclusive of any revisions.

Any task authorization to be issued in excess of that limit must be authorized by the Contracting Authority before issuance.

1.2.3 Periodic Usage Reports - Contracts with Task Authorizations

The Contractor must compile and maintain records on its provision of services to the federal government under authorized Task Authorizations issued under the Contract.

The Contractor must provide this data in accordance with the reporting requirements detailed below. If some data is not available, the reason must be indicated. If services are not provided during a given period, the Contractor must still provide a "nil" report.

The data must be submitted on June 1st of each year of the Contract period to the Contracting Authority.

1.2.4 Reporting Requirement Details

A detailed and current record of all authorized tasks must be kept for each contract with a task authorization process. This record must contain:

For each authorized task:

- the authorized task number or task revision number(s);
- a title or a brief description of each authorized task;
- the total estimated cost specified in the authorized Task Authorization (TA) of each task, exclusive of Applicable Taxes;
- the total amount, exclusive of Applicable Taxes, expended to date against each authorized task;
- the start and completion date for each authorized task; and
- the active status of each authorized task, as applicable.

For all authorized tasks:

- the amount (exclusive of Applicable Taxes) specified in the contract (as last amended, as applicable) as Canada's total liability to the contractor for all authorized TAs; and
- the total amount, exclusive of Applicable Taxes, expended to date against all authorized TAs.

2.0   Standard Clauses and Conditions

All clauses and conditions identified in the Contract by number, date and title are set out in the *Standard Acquisition Clauses and Conditions* Manual (https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual) issued by Public Works and Government Services Canada.

2.1   General Conditions

2040 (2016-04-04), General Conditions - Research & Development, apply to and form part of the Contract.

2.2   Supplemental General Conditions

The following supplemental general conditions apply to and form part of the Contract, as applicable:

4001 (2015-04-01), Hardware Purchase, Lease and Maintenance
4002 (2010-08-16), Software Development or Modification Services
4003 (2010-08-16), Licensed Software

2.3   SACC Manual Clauses

K3410C (2015-02-25), Canada to Own Intellectual Property Rights in Foreground Information

3.0   Security Requirement

3.1   The following security requirement (SRCL and related clauses) applies and form part of the Contract.

3.1.1   The Contractor must, at all times during the performance of the Contract, hold a valid **Facility Security Clearance at the level of SECRET, with approved Document Safeguarding at the level of SECRET,** issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC)

3.1.2   The Contractor personnel requiring access to PROTEGES/CLASSIFIED information, assets or sensitive work site(s) **must be citizens of Canada, USA, UK, Australia, New Zealand and must EACH hold a valid personnel security screening at the level of SECRET**, granted or approved by the CISD, PWGSC.

3.1.3   This contract includes access to **Controlled Goods.** Prior to access, the contractor must be registered in the Controlled Goods Program of Public Works and Government Services Canada (PWGSC).

3.1.4   The Contractor MUST NOT utilize its **Information Technology** systems to electronically process, produce or store any sensitive PROTEGES/CLASSIFIED information until CISD/ PWGSC has issued written approval. After approval has been granted, these tasks may be performed at the level of **SECRET**.

3.1.5   Subcontracts which contain security requirements are NOT to be awarded without the prior written permission of CISD/PWGSC.

3.1.6   The Contractor must comply with the provisions of the:

(a)   Security Requirements Check List, attached at Annex C;
(b)   *Industrial Security Manual* (Latest Edition).

3.2   Contractor's Site or Premises Requiring Safeguard Measures

The Contractor must diligently maintain up-to-date, the information related to the Contractor's site or premises, where safeguard measures are required in the performance of the Work, for the following addresses:

Address:
Street Number / Street Name, Unit / Suite / Apartment Number
City, Province, Territory / State
Postal Code / Zip Code
Country

4.0   Term of Contract

4.1   Period of Contract

The period of the Contract is from date of Contract for a period of 36 months inclusive.

4.2   Option to Extend the Contract

The Contractor grants to Canada the irrevocable option to extend the term of the Contract by up to three (3) additional period of up to 24 months/period under the same conditions. The Contractor agrees that, during the extended period of the Contract, it will be paid in accordance with the applicable provisions as set out in the Basis of Payment.

Canada may exercise this option at any time by sending a written notice to the Contractor at least 15 calendar days prior to the Contract expiry date. The option may only be exercised by the Contracting Authority, and will be evidenced for administrative purposes only, through a contract amendment.

5.0   Authorities

5.1   Contracting Authority

The Contracting Authority for the Contract is:

Ian Potvin
Supply Team Leader
Public Works and Government Services Canada
Acquisitions Branch
Place du Portage, Phase III, 11C1
11 Laurier Street
Gatineau, Quebec
K1A 0S5

Telephone: 873-469-4831
E-mail address: ian.potvin@tpsgc-pwgsc.gc.ca

The Contracting Authority is responsible for the management of the Contract and any changes to the Contract must be authorized in writing by the Contracting Authority. The Contractor must not perform work in excess of or outside the scope of the Contract based on verbal or written requests or instructions from anybody other than the Contracting Authority.

5.2   Technical Authority

The Technical Authority for the Contract is:

(To be inserted at contract award)

The Technical Authority is the representative of the department or agency for whom the Work is being carried out under the Contract and is responsible for all matters concerning the technical content of the Work under the Contract. Technical matters may be discussed with the Technical Authority; however, the Technical Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of the Work can only be made through a contract amendment issued by the Contracting Authority.

5.3   Contractor's Representative

(To be inserted at contract award)

5.4   DND Procurement Authority

The Procurement Authority for DND is:

(To be inserted at contract award)

The Procurement Authority is the representative of the department for whom the Work is being carried out under the Contract. The Procurement Authority is responsible for the implementation of tools and processes required for the administration of the Contract. The Contractor may discuss administrative matters identified in the Contract with the Procurement Authority however the Procurement Authority has no authority to authorize changes to the scope of the Work. Changes to the scope of Work can only be made through a contract amendment issued by the Contracting Authority.

6.0 Proactive Disclosure of Contracts with Former Public Servants, as applicable

By providing information on its status, with respect to being a former public servant in receipt of a Public Service Superannuation Act (PSSA) pension, the Contractor has agreed that this information will be reported on departmental websites as part of the published proactive disclosure reports, in accordance with Contracting Policy Notice: 2012-2 of the Treasury Board Secretariat of Canada.

7.0 Payment

7.1 Basis of Payment

7.1.1 For the Core Work described in Annex "A", Statement of Requirements:

The Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work, as determined in accordance with the Basis of Payment in Annex "B", to a ceiling price of $_____ (**insert the amount at contract award)**. Customs duties are included and Applicable Taxes are extra.

The ceiling price is subject to downward adjustment so as not to exceed the actual costs reasonably incurred in the performance of the Work and computed in accordance with the Basis of Payment.

7.1.2 For the optional work described at Appendix 1 to Annex "A", one of the following types of basis of payment will form part of the approved Task Authorization (TA):

(a) <u>Firm Unit Price(s) or Firm Lot Price TA</u>

In consideration of the Contractor satisfactorily completing all of its obligations under the authorized Task Authorization (TA), the Contractor will be paid the firm lot price or the firm unit price(s), in accordance with the basis of payment, in Annex "B", as specified in the authorized TA. Customs duties are included and Applicable Taxes are extra.

Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work, unless they have been authorized, in writing, by the Contracting Authority before their incorporation into the Work.

(b) <u>Ceiling Price TA</u>

The Contractor will be reimbursed its costs reasonably and properly incurred in the performance of the Work, as determined in accordance with the Basis of Payment in Annex "B", to the ceiling price specified in the approved TA. Customs duties are included and Applicable Taxes are extra.

The ceiling price is subject to downward adjustment so as not to exceed the actual costs reasonably incurred in the performance of the Work and computed in accordance with the Basis of Payment.

Canada will not pay the Contractor for any design changes, modifications or interpretations of the Work unless they have been approved, in writing, by the Contracting Authority before their incorporation into the Work.

(c) <u>TA subject to a Limitation of Expenditure</u>

The Contractor will be reimbursed for the costs reasonably and properly incurred in the performance of the Work specified in the authorized Task Authorization (TA), as

determined in accordance with the Basis of Payment in Annex "B", to the limitation of expenditure specified in the authorized TA.

Canada's liability to the Contractor under the authorized TA must not exceed the limitation of expenditure specified in the authorized TA. Customs duties are included and Applicable Taxes are extra.

No increase in the liability of Canada or in the price of the Work specified in the authorized TA resulting from any design changes, modifications or interpretations of the Work will be authorized or paid to the Contractor unless these design changes, modifications or interpretations have been authorized, in writing, by the Contracting Authority before their incorporation into the Work.

7.2   Limitation of Expenditure – All Task Authorizations (Task Authorization portion only)

Canada's total liability to the Contractor under the Contract for all authorized Task Authorizations (TAs), inclusive of any revisions, must not exceed the sum of $0.00 (**insert the amount at contract award or at a later date)**. Customs duties are included and Applicable Taxes are extra.

No increase in the total liability of Canada will be authorized or paid to the Contractor unless an increase has been approved, in writing, by the Contracting Authority.

The Contractor must notify the Contracting Authority in writing as to the adequacy of this sum:

  i.   when it is 75 percent committed, or
  ii.   four (4) months before the contract expiry date, or
  iii.   as soon as the Contractor considers that the sum is inadequate for the completion of the Work required in all authorized TAs, inclusive of any revisions,

whichever comes first.

If the notification is for inadequate contract funds, the Contractor must provide to the Contracting Authority, a written estimate for the additional funds required. Provision of such information by the Contractor does not increase Canada's liability.

7.3   Method of Payment

7.3.1   The following Method of Payment will be used for the core work identified in Annex "A" and the Optional Work identified in Appendix 1 to Annex A, when applicable:

7.3.1.1 Progress Payments

A.   Canada will make progress payments in accordance with the payment provisions of the Contract, no more than once a month, for cost incurred in the performance of the Work up to 90 percent of the amount claimed and approved by Canada if:

  (i)   an accurate and complete claim for payment using form PWGSC-TPSGC 1111(http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf), Claim for Progress Payment, and any other document required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;

  (ii)   the amount claimed is in accordance with the Basis of payment;

(iii) the total amount for all progress payments paid by Canada does not exceed 90 percent of the total amount to be paid under the Contract;

(iv) all certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives.

B. The balance of the amount payable will be paid in accordance with the payment provisions of the Contract upon completion and delivery of all work required under the Contract, if the Work has been accepted by Canada and a final claim for the payment is submitted.

C. Progress payments are interim payments only. Canada may conduct a government audit and interim time and cost verifications and reserves the right to make adjustments to the Contract from time to time during the performance of the Work. Any overpayment resulting from progress payments or otherwise must be refunded promptly to Canada.

7.3.2 The following Method of Payment will be used for the optional work identified in Appendix 1 to Annex "A" only:

7.3.2.1 Milestone Payments – Task Authorisation

Canada will make milestone payments in accordance with the Schedule of Milestones detailed in the TA and the payment provisions of the Contract if:

(a) an accurate and complete claim for payment using form PWGSC-TPSGC 1111 (http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf)), Claim for Progress Payment, and any other document required by the Contract have been submitted in accordance with the invoicing instructions provided in the Contract;

(b) all the certificates appearing on form PWGSC-TPSGC 1111 have been signed by the respective authorized representatives;

(c) all work associated with the milestone and as applicable any deliverable required has been completed and accepted by Canada.

7.4   SACC Manual Clauses

A9117C (2007-11-30), T1204 - Direct Request by Customer Department

C0305C (2014-06-26), Cost Submission

7.5   Time Verification

SACC Manual Clause C0711C (2008-05-12), Time Verification

8.0   Invoicing Instructions - Progress Claim (Core Work and Optional Work)

8.1   The Contractor must submit a claim for progress payment using form PWGSC-TPSGC 1111 (http://www.tpsgc-pwgsc.gc.ca/app-acq/forms/documents/1111.pdf), Claim for Progress Payment.

Each claim must show, as applicable:

(a) all information required on form PWGSC-TPSGC 1111;

    (b)   all applicable information detailed under the section entitled "Invoice Submission" of the general conditions;

    (c)   a list of all expenses;

    (d)   expenditures plus pro-rated profit or fee;

    (e)   the description and value of the TA milestone claimed as detailed in the Contract.

Each claim must be supported by:

    (a)   a copy of time sheets to support the time claimed;
    (b)   a copy of the invoices, receipts, vouchers for all direct expenses, and all travel and living expenses;
    (c)   a copy of the monthly progress report.

8.2   Applicable Taxes must be calculated on the total amount of the claim before the holdback is applied. At the time the holdback is claimed, there will be no Applicable Taxes payable as it was claimed and payable under the previous claims for progress payments. Holdback is not applicable to Milestone Payment.

8.3   The Contractor must prepare and certify an original claim on Form PWGSC-TPSGC 1111, and forward it to the Contracting Authority for certification in an electronic format to the electronic mail address identified under section entitled "Authorities" of the Contract. Portable Document Format (.pdf) is acceptable. The Contracting Authority will then forward the certified claim, in an electronic format, to the Technical Authority for appropriate certification after inspection and acceptance of the Work takes place, and onward submission to the Payment Office for the remaining certification and payment.

8.4   The Contractor must not submit claims until all work identified in this claim is completed.

9.0   **Certifications**

9.1   **Compliance**

Compliance with the certifications and related documentation provided by the Contractor in its bid is a condition of the Contract and subject to verification by Canada during the entire contract period. If the Contractor does not comply with any certification, provide the related documentation or if it is determined that any certification made by the Contractor in its bid is untrue, whether made knowingly or unknowingly, Canada has the right, pursuant to the default provision of the Contract, to terminate the Contract for default.

9.2   **Federal Contractors Program for Employment Equity - Default by the Contractor**

The Contractor understands and agrees that, when an Agreement to Implement Employment Equity (AIEE) exists between the Contractor and Employment and Social Development Canada (ESDC)-Labour, the AIEE must remain valid during the entire period of the Contract. If the AIEE becomes invalid, the name of the Contractor will be added to the "FCP Limited Eligibility to Bid" list. The imposition of such a sanction by ESDC will constitute the Contractor in default as per the terms of the Contract.

9.3   SACC Manual Clauses

A3060C (2008-05-12), Canadian Content Certification

10.0   Applicable Laws

The Contract must be interpreted and governed, and the relations between the parties determined, by the laws in force in _____ (to be inserted at contract award).

11.0   Priority of Documents

If there is a discrepancy between the wordings of any documents that appear on the list, the wording of the document that first appears on the list has priority over the wording of any document that subsequently appears on the list.

(a)   the Articles of Agreement;
(b)   the supplemental general conditions:

      4001 (2015-04-01), Hardware Purchase, Lease and Maintenance
      4002 (2010-08-16), Software Development or Modification Services
      4003 (2010-08-16), Licensed Software;

(c)   the general conditions 2040 (2016-04-04), General Conditions - Research & Development
(d)   Annex A, Statement of Requirements;
(e)   Annex B, Basis of Payment;
(f)   Annex C, Security Requirements Check List;
(g)   Annex D, Non-disclosure Agreement
(h)   the signed Task Authorizations (including all of its annexes, if any);
(i)   the Contractor's bid dated _____.

12.0   Defence Contract

SACC Manual clause A9006C (2012-07-16), Defence Contract

13.0   Foreign Nationals (Canadian Contractor)

SACC Manual clause A2000C (2006-06-16), Foreign Nationals (Canadian Contractor)

14.0   Insurance

SACC Manual clause G1005C (2016-01-28), Insurance

15.0   Controlled Goods Program

SACC Manual clause A9131C (2014-11-27), Controlled Goods Program
SACC Manual clause B4060C (2011-05-16), Controlled Goods

16.0   Progress Reports

16.1   The Contractor must submit monthly reports, in electronic format, on the progress of the Work, to both the Technical Authority.

16.2   The progress report must contain three parts:

PART 1: The Contractor must answer the following three questions:

   (i)   Is the project on schedule?
   (ii)   Is the project within budget?
   (iii)   Is the project free of any areas of concern in which the assistance or guidance of Canada may be required?

 Each negative response must be supported with an explanation.

PART 2: A narrative report, brief, yet sufficiently detailed to enable the Technical Authority to evaluate the progress of the Work, containing as a minimum:

   (i)   A description of the progress of each task and of the Work as a whole during the period of the report. Sufficient sketches, diagrams, photographs, etc., must be included, if necessary, to describe the progress accomplished.
   (ii)   An explanation of any variation from the work plan.
   (iii)   A description of trips or conferences connected with the Contract during the period of the report.
   (iv)   A description of any major equipment purchased or constructed during the period of the report.

PART 3: The "Contract Plan and Report Form", PWGSC-TPSGC 9143 (http://publiservice-app.tpsgc-pwgsc.gc.ca/forms/pdf/9143.pdf), (or an equivalent form acceptable to the Contracting Authority) showing the following:

   (i)   Actual and forecast expenditure on a monthly basis for the period being covered. (Expenditures are to be outlined by month and by task.)

   (ii)   Progress of the Work against the Contractor's original Contract Plan (instructions for showing the above on the Contract Plan are detailed in Annex "_____" attached). The form will provide the basis for planning and estimating the cost of work, and reporting actual progress and cost against the plan during contract performance.

17.0   Canadian Forces Site Regulations

The Contractor must comply with all standing orders or other regulations, instructions and directives in force on the site where the Work is performed.

ANNEX A
STATEMENT OF REQUIREMENTS

Tactical Edge Cyber Command and Control (TEC3) Technology Demonstration Project

Version 2.0

May 2017

1.   Introduction

1.1   Background

1.1.1   Future Canadian Armed Forces (CAF) tactical networks are expected to be increasingly sophisticated and to provide voice, data, and blue-force tracking capabilities to dismounted soldiers. Advanced radio networks supporting more sophisticated protocols may, however, be more vulnerable to attack—not simply jamming, but cyber-attack as well: vulnerabilities include denial of service through protocol manipulation, routing disruptions, traffic analysis, and simple radio loss or capture.

1.1.2   The Tactical Edge Cyber Command and Control (TEC3) project aims to address some of these vulnerabilities by demonstrating network security, network situational awareness, and network management tools that will enable the protection of sophisticated high-bandwidth tactical edge networks. In a fully net-enabled tactical battlespace, commanders at the network edge will need to be able to answer questions such as:

- How do I know I can trust the nodes in my network?
- Is the network under attack—and where are the attackers?
- What level of assurance do I have in my communications?

1.1.3   To this end, TEC3 is a fully integrated tactical edge network situational awareness and security tool suite that will enable improved decision-making and will facilitate the effective management and protection of a tactical network by relying on both automated algorithms and protocols and informed human-in-the-loop action. TEC3 will demonstrate technology that will enhance the resilience of future CAF tactical networks by providing insight to users and commanders into potential network vulnerabilities and attacks and a network command and control (C2) capability to respond to these issues.

1.1.4   The TEC3 project will leverage current and emerging tactical network security research to provide a visual network and security situational awareness and C2 capability integrated with a radio at the tactical edge. The visual interface will provide users at the network edge with insight into network topology (logical and geographical), an estimated level of trust in network nodes, an understanding of risks to communications activities, geo-location of adversary nodes, and potential attacks and vulnerabilities within the tactical network. The situational awareness will be coupled with a C2 capability that allows commanders or analysts the flexibility to rapidly configure communication applications, routes, protocols, and security features in the context of ensuring mission success.

1.2   Purpose of this document

1.2.1   This document describes the work to be performed for the TEC3 technology demonstrator: a tactical edge networking tool suite for mobile devices intended to demonstrate security-enhanced network situational awareness (SA), network command and control (C2) and cyber operations (CO).

1.3   Development vision for the TEC3 technology demonstrator

1.3.1   The envisioned TEC3 technology demonstrator will consist of an integration of commercial- or military-grade portable commercial off the shelf (COTS) / military off the shelf (MOTS) display devices with customized wireless networking / communications devices; applications (apps) and algorithms will be developed to demonstrate a capability and to supply an extensible platform for future research activities.

1.3.2   TEC3 must have a modular design that consists of a communications radio (for communications and establishing the tactical network), a sensing radio, a radio-agnostic Graphical User Interface (GUI) display (for visual situational awareness and management of the network), and an interface connecting the GUI to the two radios. The display component is expected to host and run applications (apps) to deliver network SA and network C2 features/functions.   The interdependence among features/functions must be minimized to allow for a modular design where—in general—features/functions can be added or removed without affecting other features/functions.

1.3.3   The TEC3 system must include all wiring, harnesses, chest/arm mounting, networking, communication, battery and charging gear to support outdoor field trials as defined in 1.3.5.   The system must be sufficiently rugged that a continuous 4-hour outdoor summer field trial can be conducted.

1.3.4   The TEC3 project must follow a phased, cyclical software development and demonstration approach. Each phase must develop and demonstrate a solution using scenarios inspired by the TEC3 concept document (reference [1]).

1.3.5   Four development phases are planned:

- The first phase must demonstrate—in the Defence Research and Development (DRDC) Cyber Operations and Signals Warfare (COSW) laboratory located at the DRDC-Ottawa campus—the basic TEC3 communications and networking capability, including a demonstration of the modularity of the TEC3 design, TEC3 communications and data services, TEC3 encryption and key management, and blue-force tracking.
- The second phase must demonstrate, outdoors at the DRDC-Ottawa campus, all the functionality from the first phase, with the addition of basic network SA and C2 features.
- The third phase must demonstrate, outdoors at the DRDC-Ottawa campus, all the functionality from the first and second phases, with the addition of advanced network SA and C2 features.
- The fourth and final development phase will demonstrate, outdoors at the DRDC-Ottawa campus (or at a Department of National Defence (DND) or CAF facility in Eastern Ontario that is no further than 200km from the DRDC-Ottawa campus), all the functionality from the first, second, and third phases, with the addition of Cyber Operations (CO) features.

1.3.6   The Contractor's project management must be conducted in accordance with the contract proposal as outlined in DID PM 001. The Contractor's draft plan delivered, as part of their bid at time of solicitation, must be reviewed by both parties at contract award, updated based on feedback, and accepted according to the DID.

1.3.7   The Bidder's technical development must be conducted in accordance with the original contract proposal as outlined in DID SD 002. The Contractor's draft architecture delivered, as part of their bid at time of solicitation, must be reviewed by both parties, updated based on feedback and accepted according to the DID.

1.4   Assumptions

1.4.1   There are three types of nodes in TEC3—or, equivalently—three types of TEC3-enabled devices: basic nodes, commander nodes, and analyst nodes.

1.4.2   It is assumed that basic nodes would be carried by dismounted (non-command) operators. These nodes would consist of a low-power communications radio, a sensing radio, and a GUI display device. In a dismounted deployment, basic node TEC3 devices would have a limited set of features to display SA to basic node operators but would be equipped to collect and deliver SA to commander and analyst nodes.

1.4.3   Operators of commander nodes are equipped with larger GUI display devices than basic nodes, but with the same low-power radio and sensing radio. These devices have a larger screen to allow for better understanding of the network for mission execution and planning. These devices would also offer a richer set of SA features along with a selection of network C2 features.

1.4.4   In certain mounted vehicle deployments and at non-mobile forward operating bases, TEC3 provides nodes with a larger screen interface and offers a complete suite of SA, C2 and CO capabilities. Known as analyst nodes, these nodes would receive SA from the tactical edge (i.e., collected by the dismounted units) and allow for the control of the network and remote execution of tactical C2. Analyst nodes would consist of laptops or larger computers connected to radios for sensing and for communication with commander and basic nodes. These devices would be used in protected (mounted or headquarters (HQ)) environments by, for instance, signals officers, analysts, Platoon/Company leadership, or an as-of-yet undefined role.

1.4.5   The dynamic and mobile environment of the tactical edge requires mobile ad hoc network (MANET) routing protocols to connect the TEC3 radios, where each node serves as a potential relay to forward information to other nodes with limited point-to-point radio range. A fundamental assumption of TEC3 is that all TEC3 nodes must support and utilize MANET multi-hop routing technology.

2. Applicable documents

2.1 Priority of documents

2.1.1 The TEC3 technical requirements are defined by TEC3 functional specification (reference [2]) and the classified annex to the functional specification (reference [3]).

The technical requirements, specified in Annex A, that are preceded by the term "must" are to be included as part of the Bidder's technical proposal. The technical requirements, specified in Annex A, preceded by the term "should" may be added to the Bidder's technical proposal. Bidder acknowledges and agrees that once added to its bid, these technical requirements become contractual requirements, on which the Bidder must deliver.

2.2 List of documents

[1] D. Brown, M. Salmanian, D. Simmelink, H. Tang, R. Song, "Tactical edge cyber command and control (TEC3) concept: A vision for network situational awareness and network command and control at the tactical edge", DRDC-RDDC-2014-R155, December 2014.

[2] D. Brown, M. Salmanian, S. Watson, R. Song, H. Tang, D. Simmelink, "Tactical edge cyber command and control (TEC3) Functional Specification", version 6.0, May 2017.

[3] D. Brown, M. Salmanian, S. Watson, R. Song, H. Tang, D. Simmelink, "Specifications for advanced capabilities of the Tactical Edge Cyber Command and Control (TEC3) project (U)", DRDC-RDDC-2016-D002, February 2016, SECRET ASCANZUKUS EYES ONLY.

3. Project objectives and Contractor responsibilities

3.1 Work objectives

3.1.1 The Tactical Edge Cyber Command and Control (TEC3) Technology Demonstrator (TD) will implement and demonstrate a capability that provides network situational awareness (SA), network management, network command and control (C2) and cyber operations (CO) for tactical networks.

3.1.2 The purpose of this work is to design, build and test a system to demonstrate TEC3, which includes the following objectives:

- Design and build a tactical network with geographical positional and cyber SA information, along with cyber C2 and CO capabilities;
- Perform testing, verification and validation (V&V) of the system; and
- Demonstrate system capabilities in laboratory and field environments.

3.2 Contractor responsibilities

3.2.1 **The Contractor must:**

- Refine the TEC3 Functional Specification into an initial vision and roadmap;

- Breakdown the initial TEC3 functions and features into smaller scope blocks called "user stories". For the purposes of this document, a user story (or story) is defined as: an Agile story, Rapid Application mock-up with description, Work Breakdown Structure (WBS) element with dictionary, or similar iterative development task breakdown element;
- Define the development time for each reporting period (or "sprint length"), and build the TEC3 product backlog (the combination of all user stories for the phase(s)).
- Define the quality metric for each user story (i.e., provide clear definitions of what constitutes the completion and delivery of a "user story");
- Define the metrics for tracking overall project progress (cost, team size, sprint length);
- Design the system (as per the Agile story / Rapid Application mock-ups / Work Breakdown Structure (WBS));
- Develop, integrate and test the system (as per the quality metric);
- Demonstrate the system at each sprint;
- Deliver updated code and documentation, per reporting period;
- Assemble preliminary System Authorization and Accreditation (SA&A) documentation;
- Perform demonstrations of the developed system, and prepare any required plans, reports and demonstration material necessary for demonstrations;
- Produce system documentation, updated as the system is developed, such as project management plans, system designs, development and testing plans/reports, system usage and support guides; and
- Produce a complete set of system documentation at the end of each phase that is copy-edited, formatted, and reviewed for content.

3.2.2 The Contractor must supply hardware and software as follows:

- 13 basic nodes, 2 commander nodes and 1 analyst node;
- Communications and sensing radios (may be part of basic/commander/analyst nodes above);
- Arm and / or chest mounting equipment for basic and commander nodes;
- Tactical vest and wiring harness for basic and commander nodes;
- Wiring and networking gear as required;
- Batteries, chargers and support equipment as required for basic and commander nodes; and
- Mapping software with tile sets for TEC3 displays on all nodes.

4. Design and development approach

4.1.1 TEC3 design must consider network situational awareness, network security, network command and control, network management, and cyber operations;

4.1.2 The development work must be advanced by means of a cyclic development approach to design, build, test, and evaluate. This approach is required to allow DRDC to confirm and evaluate progress, adapt to requirements derived from the functional specification, and manage risk. Industry-based development approaches include (but are not limited to): Unified process, Scrum, and Agile.

4.1.3   The TEC3 system must use a communications protocol stack that includes Internet Protocol (IP) - based networking technology for communications between the nodes in the network.

4.1.4   The nodes in the TEC3 system must operate as a mobile ad hoc network (MANET).

4.1.5   The display device used by the "basic nodes" in the TEC3 system must use an Android-based operating system of variant no earlier than version 5 (where the Contractor may modify or harden the operating system and make changes to the kernel and/or drivers, but the operating system is based on Android).

4.1.6   The short-range radio communications in the TEC3 system must operate in one or more of the following frequency bands: 2.4 GHz to 2.5 GHz, or 902 MHz to 928 MHz.

5.   Contract phases

5.1   Contract phase summary

5.1.1   The project work must be partitioned into the following phases:

- Phase 1: Basic Capability – Duration: 9 months;
- Phase 2: Network SA and C2 application development – Duration: 9 months;
- Phase 3: Advanced SA and C2 application development – Duration: 7 months;
- Phase 4: Cyber Operations – Duration: 8 months; and
- Phase 5: Project close out and final documentation – Duration: 3 months.

5.1.2   In the remainder of this document, Data Item Description (DID) references are used to refer to specific contract deliverables; a complete list of DIDs and their descriptions is provided in Section 9.

5.2   Phase 1 – Basic capability

5.2.1   The intent of Phase 1 is to develop core TEC3 communication and networking capabilities, and a framework for further TEC3 application development. The phase must be completed with a demonstration that will show functionality in a laboratory environment with 8 TEC3 nodes, consisting of 6 basic nodes, 1 commander node, and 1 analyst node.

5.2.2   A Kick-Off Meeting (see Task 1 in section 6) must be held within 20 days of Contract Award that will review the overall project including work content, schedule, technical and procedural issues, and contract deliverables. Minutes of the meeting must be completed in accordance with DID PM 002.

5.2.3   The Contractor must update the Project Management Plan (starting from the initial draft submitted with the Contractor's bid) in accordance with DID PM 001 and must create the Product Backlog in accordance with DID SD 001.

5.2.4   The Contractor must conduct a thorough review of the TEC3 functional specification. As a result of this review, the Contractor must submit a Requirements Management Plan in accordance with DID PM 005.

5.2.5   The Contractor must refine and submit an updated Architectural Design document starting from the initially proposed solution, in accordance with DID SD 002. The Contractor must also produce an initial Detailed Design document in accordance with DID SD 003. The Contractor must also define the configuration management approaches and processes that will be used throughout the project and must produce a Configuration Management Plan in accordance with DID PM 004.

5.2.6   The Contractor must produce a detailed plan for development Phase 1 (a Development Phase Plan in accordance with DID PM 006) to deliver on the requirements specified in sections 2, 3, 4 and 5.2 of reference [2] (the TEC3 Functional Specification). The Contractor's plan must address relevant requirements in sections 7 and 8 of reference [2] as required to deliver on sections 2, 3, 4 and 5.2 of reference [2].

5.2.7   The Contractor must develop and build the Phase 1 TEC3 capability in accordance with the Development Phase Plan specified in 5.2.6. The Contractor must deliver the Phase 1 System software, hardware and documentation in accordance with DID SD 004. The Contractor must deliver a Software Development Kit (SDK) in accordance with DID SD 006.

5.2.8   The Phase 1 demonstration(s) and trial(s) must be conducted at the COSW-DRDC laboratory.

5.2.9   Phase 1 should be completed within 9 months after Contract Award. In the event that the Contractor cannot meet the deadline, it's the Contractor's responsibility to inform Canada and to propose a new deadline schedule that must be mutually agreed on by both parties. End of phase documents and deliverables must be final versions of any interim documents generated during the Phase. See individual DIDs for more details. The Contractor must deliver the following items:

a) The Project Management Plan, in accordance with DID PM 001;
b) The Configuration Management Plan, in accordance with DID PM 004;
c) The Requirements Management Plan, in accordance with DID PM 005;
d) The Development Phase plan, in accordance with DID PM 006;
e) The Product Backlog, in accordance with DID SD 001;
f) The Architectural Design document, in accordance with DID SD 002;
g) The Detailed Design document, in accordance with DID SD 003;
h) System software, hardware and documentation, in accordance with DID SD 004;
i) Software Development Kit (SDK), in accordance with DID SD 006;
j) Demonstration material, in accordance with DID DM 001; and
k) Data collection material, in accordance with DID DM 002.

5.3   Phase 2 – Network SA and C2 application development

5.3.1   The intent of Phase 2 is to further develop TEC3 through refinement of Situational Awareness (SA) and Command and Control (C2) application development. The phase must be completed with a demonstration that will show functionality in a field demonstration with 16 TEC3 nodes, consisting of 1 analyst node, 2 commander nodes, and 13 basic nodes.

5.3.2   A Progress Review Meeting (see Task 1 in section 6) must be held at the beginning of this phase that will review the overall project phase activities, including work

content, backlog / schedule, technical and procedural issues, and contract deliverables, with meeting minutes to be documented in accordance with DID PM 002.

5.3.3　　In response to lessons learned from Phase 1 activities and current plans, the Contractor must update the Project Management Plan in accordance with DID PM 001 and the Product Backlog in accordance with DID SD 001.

5.3.4　　The Contractor must verify that the Requirements Management Plan is current and must update the document if necessary in accordance with DID PM 005.

5.3.5　　The Contractor must refine the Architectural Design document in accordance with DID SD 002 and the Detailed Design document in accordance with DID SD 003, starting from the Phase 1 documentation and lessons learned. The Contractor must also update the System Configuration Management Plan in accordance with DID PM 004 to ensure that it is current.

5.3.6　　The Contractor must produce a detailed plan for development Phase 2 (a Development Phase Plan in accordance with DID PM 006) to deliver on the requirements specified in sections 5.1, 5.3, 5.4, 5.5., 5.6, 5.7, 6.1, 6.3 and 6.4 of reference [2] (the TEC3 Functional Specification). The Contractor's plan must also address all remaining requirements in sections 7 and 8 of reference [2] that were not addressed as part of Phase 1.

5.3.7　　The Contractor must develop and build the Phase 2 TEC3 capability in accordance with the Development Phase Plan specified in 5.3.6. The Contractor must deliver the Phase 2 System software, hardware and documentation in accordance with DID SD 004. The Contractor must update the Software Development Kit (SDK) in accordance with DID SD 006.

5.3.8　　The Phase 2 demonstration(s) and trial(s) must be conducted outdoors at DRDC-Ottawa.

5.3.9　　Phase 2 should be completed within 9 months after initiation of Phase 2. In the event that the Contractor cannot meet the deadline, it's the Contractor's responsibility to inform Canada and to propose a new deadline schedule that must be mutually agreed on by both parties. End of phase documents and deliverables must be final versions of any interim documents generated during the Phase. See individual DIDs for more details. The Contractor must deliver the following:

a) The Project Management Plan, in accordance with DID PM 001;
b) The Configuration Management Plan, in accordance with DID PM 004;
c) The Requirements Management Plan, in accordance with DID PM 005;
d) The Development Phase plan, in accordance with DID PM 006;
e) The Product Backlog, in accordance with DID SD 001;
f) The Architectural Design document, in accordance with DID SD 002;
g) The Detailed Design document, in accordance with DID SD 003;
h) System software, hardware and documentation, in accordance with DID SD 004;
i) Software Development Kit (SDK), in accordance with DID SD 006;
j) Demonstration material, in accordance with DID DM 001; and
k) Data collection material, in accordance with DID DM 002.

5.4　　Phase 3 – Advanced SA and C2 application development

5.4.1   The intent of Phase 3 is to further develop TEC3 through advanced Situational Awareness (SA) and Command and Control (C2) application development. The phase must be completed with a demonstration that will show functionality in a field demonstration with 8 TEC3 nodes, including 1 analyst node, 1 commander node, and 6 basic nodes.

5.4.2   A Progress Review Meeting (see Task 1 in section 6) must be held at the beginning of this phase that will review the overall project phase activities, including work content, backlog / schedule, technical and procedural issues, and contract deliverables, with meeting minutes to be documented in accordance with DID PM 002.

5.4.3   In response to lessons learned from Phase 1 and Phase 2 activities, and to current plans, the Contractor must update the Project Management Plan in accordance with DID PM 001 and the Product Backlog in accordance with DID SD 001.

5.4.4   The Contractor must verify that the Requirements Management Plan is current and must update the document if necessary in accordance with DID PM 005. The Contractor must also conduct an SA&A requirements review for the TEC3 system and document the results in an SA&A Report in accordance with DID SD 005.

5.4.5   The Contractor must refine the Architectural Design document in accordance with DID SD 002 and the Detailed Design document in accordance with DID SD 003, starting from the Phase 2 documentation and lessons learned. The Contractor must also update the System Configuration Management Plan in accordance with DID PM 004 to ensure that it is current.

5.4.6   The Contractor must produce a detailed plan for development Phase 3 (a Development Phase Plan in accordance with DID PM 006) to deliver on the requirements specified in sections 5.8, 5.9, 6.2, 6.5 and 6.6 of reference [2] (the TEC3 Functional Specification).

5.4.7   The Contractor must develop and build the Phase 3 TEC3 capability in accordance with the Development Phase Plan specified in 5.4.6. The Contractor must deliver the Phase 3 System software, hardware and documentation in accordance with DID SD 004. The Contractor must update the Software Development Kit (SDK) in accordance with DID SD 006.

5.4.8   The Phase 3 demonstration(s) and trial(s) must be conducted outdoors at DRDC-Ottawa.

5.4.9   Phase 3 should be completed within 7 months after initiation of Phase 3. In the event that the Contractor cannot meet the deadline, it's the Contractor's responsibility to inform Canada and to propose a new deadline schedule that must be mutually agreed on by both parties. End of phase documents and deliverables must be final versions of any interim documents generated during the Phase. See individual DIDs for more details. The Contractor must deliver the following:

a)   The Project Management Plan, in accordance with DID PM 001;
b)   The Configuration Management Plan, in accordance with DID PM 004;
c)   The Requirements Management Plan, in accordance with DID PM 005;
d)   The Development Phase plan, in accordance with DID PM 006;
e)   The Product Backlog, in accordance with DID SD 001;
f)   The Architectural Design document, in accordance with DID SD 002;

g) The Detailed Design document, in accordance with DID SD 003;
h) System software, hardware and documentation, in accordance with DID SD 004;
i) The SA&A Report, in accordance with DID SD 005;
j) Software Development Kit (SDK), in accordance with DID SD 006;
k) Demonstration material, in accordance with DID DM 001; and
l) Data collection material, in accordance with DID DM 002.

5.5   Phase 4 – Cyber operations

5.5.1   The intent of Phase 4 is to further develop TEC3 through Cyber Operations application development. The phase must be completed with a demonstration that will show functionality in a field demonstration with 8 TEC3 nodes, including 1 analyst node, 1 commander node, and 6 basic nodes. This phase will require that the Contractor have facilities that can process and develop classified information as per the security requirements check list (SRCL).

5.5.2   A Progress Review Meeting (see Task 1 in section 6) must be held at the beginning of this phase that will review the overall project phase activities, including work content, backlog / schedule, technical and procedural issues, and contract deliverables, with meeting minutes to be documented in accordance with PM 002.

5.5.3   In this phase the Contractor must develop, build, and demonstrate a final capability. In response to lessons learned from Phase 1, Phase 2, and Phase 3 activities, and to current plans, the Contractor must update the Project Management Plan in accordance with DID PM 001 and the Product Backlog in accordance with DID SD 001.

5.5.4   The Contractor must verify that the Requirements Management Plan is current and must update the document if necessary in accordance with DID PM 005.

5.5.5   The Contractor must refine the Architectural Design document in accordance with DID SD 002 and the Detailed Design document in accordance with DID SD 003, starting from the Phase 3 documentation and lessons learned. The Contractor must also update the System Configuration Management Plan in accordance with DID PM 004 to ensure that it is current. Updates to SD 002 and SD003 must be defined in the Configuration Management Plan.

5.5.6   The Contractor must produce a detailed plan for development Phase 4 (a Development Phase Plan in accordance with DID PM 006) to deliver on the requirements specified in reference [3] (advanced functionality comprising a classified annex to the TEC3 Functional Specification) and all remaining requirements in reference [2] (the TEC3 Functional Specification).

5.5.7   The Contractor must develop and build the Phase 4 TEC3 capability in accordance with the Development Phase Plan specified in 5.5.6. The Contractor must deliver the Phase 4 System software, hardware and documentation in accordance with DID SD 004. The Contractor must update the Software Development Kit (SDK) in accordance with DID SD 006.

5.5.8   The Phase 4 demonstration(s) and trial(s) must be conducted outdoors at DRDC-Ottawa or at a DND or CAF facility in Eastern Ontario that is no further than 200km from the DRDC-Ottawa campus, as determined by the Technical Authority (TA).

5.5.9   Phase 4 should be completed within 8 months after initiation of Phase 4. In the event that the Contractor cannot meet the deadline, it's the Contractor's responsibility to inform Canada and to propose a new deadline schedule that must be mutually agreed on by both parties. End of phase documents and deliverables must be final versions of any interim documents generated during the Phase. See individual DIDs for more details. The Contractor must deliver the following:

a) The Project Management Plan, in accordance with DID PM 001;
b) The Configuration Management Plan, in accordance with DID PM 004;
c) The Requirements Management Plan, in accordance with DID PM 005;
d) The Development Phase plan, in accordance with DID PM 006;
e) The Product Backlog, in accordance with DID SD 001;
f) The Architectural Design document, in accordance with DID SD 002;
g) The Detailed Design document, in accordance with DID SD 003;
h) System software, hardware and documentation, in accordance with DID SD 004;
i) Software Development Kit (SDK), in accordance with DID SD 006; and
j) Demonstration material, in accordance with DID DM 001.
k) Data collection material, in accordance with DID DM 002.

5.6   Phase 5 – Final deliverables, and project close-out

5.6.1   The objective of Phase 5 is to provide DRDC with the final deliverables, document project results and position the project for a successful transition to the TA. The Contractor must produce a final report that summarizes the lessons learned from Phases 1-4 and recommendations for operational deployment of the system.

5.6.2   Phase 5 should be completed within 3 months of the completion of Phase 4, and the Contractor must deliver the following:

a) Final Report, in accordance with DID PM 007.

5.7   Demonstrations and verification and validation (V&V)

5.7.1   The Contractor must provide TEC3 System software, hardware and documentation (in accordance with DID SD 004) to DRDC at the end of each development phase. At the end of each phase (and after successful testing by the Contractor), an updated instantiation of TEC3 software must be provided by the Contractor to DRDC for the purposes of performing Verification and Validation (V&V). DRDC will be responsible to install, integrate and configure the software and then conduct V&V. The Contractor must assist in the installation, integration and configuration of the TEC3 software and ancillary software required for the operation of TEC3.

5.7.2   Demonstrations are used to communicate the current capabilities of TEC3 to departmental and external stakeholders. The demonstrations will typically occur after the V&V at the end of each development phase and will require the active involvement of the TA and the Contractor. They will be based on scenarios which reflect the intended operational environment of the system. The Contractor must be responsible for the installation, integration, and configuration of all TEC3 software and hardware (and ancillary software) required to support all demonstrations.

6.   Project tasks

The Contractor must perform the following tasks outlined below.

6.1 Task 1: Project management

6.1.1 Project management activities relate to the process of leading, planning, organizing, staffing, monitoring and controlling activities, people and other resources in order to achieve particular objectives. Many of these tasks will be captured in the Project Management Plan (PMP), in accordance with DID PM 001. The Contractor must be responsible for performing project management, within its organization, to ensure successful development of TEC3. This task will be ongoing during the entire TEC3 project lifetime (i.e., throughout Phases 1, 2, 3, 4 and 5).

6.1.2 The Contractor must hold, as part of the project management task, various meetings with the TA during the lifetime of the TEC3 project. Minutes for these meetings will be documented in accordance with DID PM 002. These meetings will include:

- Project Kick-Off Meeting :
     1) Frequency: once, within 20 days of contract award
     2) Location: DRDC Ottawa

- Progress Review Meetings
     1) Frequency: monthly, unless mutually agreed otherwise.
     2) Location: At the Contractor's facility (if mutually agreed upon by both the Contractor and the TA), otherwise via teleconferencing facilities.

- Technical Review Meetings
     1) Frequency: Once every two weeks, and as required to discuss any technical issues during the project.
     2) Location: At the DRDC Ottawa facility (if mutually agreed upon by both the Contractor and the TA), otherwise via teleconferencing facilities.

- Milestone Review Meetings (note that these may be combined with Progress Review Meetings if mutually agreed upon by the Contractor and the TA)
     1) Frequency: At the end of Phases 1, 2, 3, and 4.
     2) Location: DRDC Ottawa

- Final Review Meeting
     1) Frequency: Once, at the end of Phase 5
     2) Location: DRDC Ottawa.

6.2 Task 2: Concept review and requirements refinement

6.2.1 The Contractor must develop the Product Backlog during Phase 1 and refine it in subsequent development phases in accordance with DID SD 001. Requirements refinement is necessary to ensure that the project continues to deliver on the TEC3 vision and the prescribed functionality enunciated in references [2] and [3] (the TEC3 Functional Specification and classified annex) and incorporates any lessons learned from previous phases.

6.3 Task 3: TEC3 architectural design refinement

6.3.1 The Contractor must refine the proposed system architecture in light of the requirements refinement described in Task 2. The architecture must be documented in the Architectural Design document in accordance with DID SD 002.

6.3.2 As part of this task, the Contractor must hold technical review meetings with the TA to review changes or refinements to the proposed system architecture.

6.3.3 The TA will request that the selection of COTS, MOTS, and Open Source software and hardware proposed as part of the solution be justified against TEC3 Functional Specifications (references [2] and [3]) and evaluation criteria.

6.4 Task 4: TEC3 detailed design

6.4.1 The Contractor must develop the detailed design of TEC3 to a sufficient level of detail such that the system can be built and tested by the Contractor, and evaluated by the TA. The design must be documented in the Detailed Design document in accordance with DID SD 003. The initial detailed design must be completed during Phase 1. However, additional detailed design work will be carried out during the development cycles of Phases 2, 3, and 4 to incorporate refinements to the requirements and architecture as discussed in Tasks 2 and 3.

6.5 Task 5: TEC3 build and test

6.5.1 This task will take place during Phases 1, 2, 3 and 4. The Contractor must conduct activities such as coding, integrating, and testing the components and systems that are part of TEC3. The Contractor must also assemble hardware, compile and install software, and perform any other activities associated with the delivery of a functioning TEC3 system to the TA. The Contractor must deliver TEC3 System software, hardware and documentation in accordance with DID SD 004.

6.5.2 This task also includes internal testing and phase containment processes, which must both be part of the Contractor's quality assurance processes. Visibility into these processes must be granted upon request by the TA. The Contractor must:

- Define the testing strategy and objectives as well as system performance metrics. These will be captured as part of defined testing scenarios;
- Develop and validate the testing scenarios;
- Develop and validate the system test environment;
- Develop test cases which are compatible with defined system performance metrics; and
- Test the developed system and ensure it meets intended performance metrics in the testing scenarios.

6.6 Task 6: TEC3 verification and validation

6.6.1 Verification and validation (V&V) will be conducted by DRDC at the end of each project phase, following the Contractor's end-of-phase testing. Successful V&V will ensure the correct and expected operation of the TEC3 system and will ensure that the COSW-DRDC laboratory maintains an updated and functional TEC3 system necessary to support demonstrations and to serve as a testbed for ongoing and future research activities.

6.6.2   The Contractor must deliver TEC3 software (and requisite hardware) at the end of each phase and must assist DRDC in the installation, integration and configuration of all TEC3 software and ancillary software required for the operation of TEC3.

6.6.3   DRDC will be responsible to conduct V&V activities with the assistance of the Contractor. The Contractor must provide for 5 person-days per development phase at the DRDC-Ottawa, Shirley's Bay campus, in order to support these V&V activities.

6.7   Task 7: TEC3 demonstrations

6.7.1   Demonstrations are vital for maintaining operational client support and for generating national and international interest in the TEC3 project. The purpose of TEC3 demonstrations is to demonstrate TEC3 system capabilities.

6.7.2   The Contractor must provide formal demonstrations at the end of each development phase, demonstrating the capability developed in that phase (and previous phases). It is expected that a period of two weeks will be reserved for demonstration support at the end of each development phase.

6.7.3   The first three system demonstrations (for Phases 1, 2 and 3) must be conducted at DRDC-Ottawa. The fourth system demonstration will take place at DRDC-Ottawa or at a DND or CAF facility in Eastern Ontario that is no further than 200km from the DRDC-Ottawa campus, as determined by the Technical Authority (TA).

6.7.4   The fourth demonstration may take place as part of an operational exercise as a stand-alone capability within the exercise (i.e., not fully integrated).

6.7.5   The Contractor must provide technical support for ad hoc demonstrations during the project. The Contractor must provide for a minimum of 5 person-days per development phase at the DRDC-Ottawa, Shirley's Bay campus, in order to support these ad hoc demonstrations. In addition, any informal function and feature demonstrations that the Contractor wishes to show to DRDC can be conducted at the Contractor's facility, or remotely via video teleconference (using Skype).

6.7.6   As part of this task, the Contractor must produce demonstration materials in accordance with DID DM 001 and DID DM 002.

6.8   Task 8: System administration

6.8.1   The Contractor must provide, upon request, support services for the instantiation of the TEC3 system installed at DRDC-Ottawa (i.e., the system delivered as discussed in Task 6). These services include configuration, software product installation and maintenance, user support and troubleshooting. This task will extend for the duration of the whole project, including Phase 5. The Contractor must provide for a minimum of 5 person-days per development phase at the DRDC-Ottawa, Shirley's bay campus, for these support services.

6.9   Task 9: Project close-out

6.9.1   The Contractor must conduct project close-out activities with the intent of providing the TA with a thorough summary of the project history, achievements, and lessons learned. These activities will be documented in the Final Report in accordance with DID PM 007. The Contractor must give a presentation of the Final Report. The presentation may be held as part of the Final Review Meeting.

7.   Requirements

7.1   Technical requirements

7.1.1   A list of applicable documents is provided in Section 2. If required, the Contractor must make arrangements with Contracting Authority to receive or view the documentation.

7.1.2   Some TEC3 functionality may be addressed by existing MOTS/COTS technologies. However, other functionality will require research and development to reach an acceptable solution. The Contractor project team must have the expertise to carry out this research and development.

7.2   Management requirements

7.2.1   The Contractor must appoint one person to act as the Contractor Senior project manager (PM). The PM must be vested with the appropriate authority within the Contractor's organization to plan, co-ordinate, control and supervise personnel resources and have the authority to allocate financial resources.

7.2.2   All development work must be carried out at the Contractor's own facilities. Experiments may occur at either the Contractor's or DRDC-Ottawa facilities. Demonstrations and trials must be held at DRDC-Ottawa facilities (or, in the case of Phase 4, demonstrations and trials must be held at either DRDC-Ottawa facilities or a DND/CAF facility in Eastern Ontario no more than 200km from DRDC-Ottawa).

7.2.3   All deliverables must be submitted in English.

7.3   Optional Work Requirements

7.3.1   The optional work requirements are to provide professional services for any work not clearly defined in this SOR. Optional works cannot be used to meet core functional specification delivery as specified in the bidder's proposal. Over the course of the work identified in this SOR or before its completion, Canada may request additional work for:

- Providing technical support for ad hoc demonstrations;
- Developing new functions and features beyond what is defined in the functional specification / SOR;
- Providing support services for the setup, configuration, testing of the new functions and features beyond what is defined in the functional specification / SOR;
- Conducting Verification and Validation exercises and data gathering for specific features;
- Enhancements to existing core features beyond what is initially proposed; and

- Providing ad-hoc experimentation support at DRDC-Ottawa.

7.3.2   Appendix 1 to Annex A includes examples of additional work.

7.3.3   The optional work is planned to be used during the core contract or during the optional contract periods. The estimated start of the optional service requirement is expected between 8 months to 16 months from contract award. The amount of support required is estimated to be 1 PY in total across the resource categories, for the first year. This is estimated to increase every year by 1-2 PY.

8.   Government Supplied Services

8.1.1   Access to military users: The TA will facilitate and coordinate access to representatives of the CAF, as well as to other departmental and international stakeholders, who may provide feedback and pertinent knowledge, which the Contractor could use in the development of TEC3.

8.1.2   Laboratory: The COSW-DRDC laboratory will be made available to the Contractor for trials, experiments and demonstration purposes. Floor space, basic furniture, and electricity will be made available to the Contractor.

8.1.3   Parallel research considerations: It is expected that separate but related DRDC research initiatives will be conducted in parallel to TEC3 development. The results of these parallel activities, such as algorithms or processes, could be made available to the Contractor. Current related research initiatives include software defined radio development, dynamic spectrum access, broadcast/multicast dissemination schemes, and attack detection. Integration of parallel research activities will be done using the contract option periods (if required). Parallel research is not part of the core TEC3 delivery.

9.   Deliverables

9.1   Electronic format

9.1.1   All documents and reports produced as deliverables under this SOR and its Appendices must be delivered in electronic format on appropriate, virus-free, properly labelled, supported media such as USB. Final documents and reports must also be provided in hard copy. The following format, and subsequent upgrades, must be used by the Contractor, unless otherwise agreed to by the TA: Microsoft (MS) Word, MS Excel, MS Power Point, MS Visio, MS Project, MS Access, Adobe portable document format (PDF).

9.2   Design and documentation standards

9.2.1   Software requirements, architecture, design, testing and implementation documents produced as part of this contract must follow industry established documentation and process standards.

9.3 Contract Data Requirement List (CDRL)

9.3.1 The following table provides the Contract Data Requirement List (CDRL) for TEC3. Subsequent sections define each of the Data Item Description (DID) elements in detail.

CDRL	DID	Deliverables
1	PM 001	Project Management Plan
2	PM 002	Meetings agendas and minutes
3	PM 003	Progress Review Report
4	PM 004	Configuration Management Plan
5	PM 005	Requirements Management Plan
6	PM 006	Development Phase Plan
7	PM 007	Final Report
8	SD 001	Product Backlog
9	SD 002	Architectural Design document
10	SD 003	Detailed Design document
11	SD 004	System software, hardware and documentation
12	SD 005	SA&A documentation
13	SD 006	Software Development Kit
14	DM 001	Demonstration material
15	DM 002	Data collection material

9.4 PM 001: Project Management Plan

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Project Management Plan	PM 001
2. Description/Purpose The Project Management Plan is a living document describing how the Contractor will employ resources to meet project requirements.	4. Delivery Date Baseline version: With bid proposal First version: 20 working days after contract award. Iteration: An updated version will be provided at the beginning of each phase and each development cycle.
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation 10 working days after receipt of first version and any subsequent iterations.
	9. References

10. Preparation Instructions

The Contractor must prepare a Project Management Plan following IT project management best practices. The Project Management Plan will include, as a minimum, how the contractor will:

- Define the roles and responsibilities of the product owner, team leader, team
- Define the TEC3 vision from the Functional Specification
    1) Create function and feature stories
    2) Prioritize stories
    3) Code, validate and test stories
    4) Mapping of stories to the Functional Specification
- Define TEC3 stories / schedule in terms of
    1) Time (Sprint length or iteration duration)
    2) Scope (Sprint Backlog or WBS/schedule)
    3) Quality (Definition of task completion / definition of prototypes / acceptance criteria)
    4) Cost tracking (team size and sprint length or completeness tracking)
- Status reporting including:
    1) percentage completion
    2) Pass rate for story tests or acceptance criteria
    3) Key project milestone status
- Backlog or WBS Schedule with sequencing information;
- Key roles and responsibilities
- Development methodology including:
    1) Total sprints or schedule
    2) Sprint duration or WBS/sequencing
    3) Quality metrics
- Change control process
- List of deliverables and milestones, including the target dates;
- Resource plan, including the names and responsibilities of each team member and subcontractors as well as the reporting structure;
- Risk analysis and mitigation plan.

The Project Management Plan baseline version consists of a high-level plan for the entire project and a detailed schedule (including prioritized story backlog) for Phase 1. This DID will be an update of the draft PMP provided as part of the bid submission. Subsequent iterations of the Project Management Plan will provide details for the immediately following phase or development cycle, as well as a revised high-level plan for the remainder of the project.

9.5 PM 002: Meeting agendas and minutes

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Meeting agendas and minutes	PM 002

2. Description/Purpose	4. Delivery Date
For each meeting defined as a DID, the Contractor must prepare and submit a meeting agenda. The Contractor must also record, in softcopy and hardcopy, the discussions, action items, and decisions in the minutes and submit them to the TA.	Meeting agenda: 5 working days before each meeting Meeting minutes: 5 working days after each meeting
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation N/A
	9. References

10. Preparation Instructions
This deliverable refers to the meetings listed in Task 1. The content of meeting agendas will be discussed between the TA and the Contractor PM after contract award and as required during the project. The minutes for each meeting must include, at a minimum, the following: - List of attendees;   - Meeting agenda, date, location;   - Action items list, details, status, OPI and schedule;   - Discussion summary for each agenda item; and   - Time and location for the next meeting.   The Contractor may use its own agenda and minutes format for these deliverables. The Contractor is responsible for amendments to the agendas and minutes as may be required.

9.6 PM 003: Progress Review Report

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Progress Review Report	PM 003
2. Description/Purpose The Progress Review Report must provide details of the progress of the contract in preparation for a Progress Review Meeting (see Task 1 in section 6).	4. Delivery Date Report: 5 working days before each Progress Review Meeting
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation N/A
	9. References

10. Preparation Instructions

The Progress Review Report may be prepared in the Contractor's format and must contain, as a minimum, the following information:

- The status of action items resulting from the previous Progress Review Meetings;
- A brief summary of the major activities over the past period (since the last Progress Review Report);
- An updated project schedule (including project backlog) indicating the current project status in relation to the Project Management Plan schedule / backlog (from DID PM 001);
- A brief description of any problems encountered and the proposed remedial action. Information must include the impact of the problem on overall project schedule, cost, and phase containment;
- Expected project achievements over the next reporting period;
- Current post-mortems and lessons learned;
- Financial status of the contract; and
- Proposed amendments to any previous documents.

The information contained in the Progress Review Report must be in sufficient detail for the TA to review and discuss its content at the Progress Review Meeting. The intent of this DID is to permit the TA to familiarize herself/himself with the progress and project problems prior to the Progress Review Meeting so that the Progress Review Meeting time is spent in meaningful discussions leading to resolution of problem areas.

9.7   PM 004: Configuration management plan

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Configuration Management Plan	PM 004
2. Description/Purpose The Contractor must prepare a configuration management plan which describes how developed source code, software versions, configuration, and the life-cycle of these elements will be handled during the project.	4. Delivery Date Project baseline version: 20 working days after contract award Iterations: as required (but no more than once per development phase)
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation N/A
	9. References: IEEE 828, IEEE 1042

10. Preparation Instructions

The Contractor must prepare a Configuration Management Plan tailored to TEC3, which, at a minimum, should address the following issues:

- Software release management process;
- Software change management process;
- Code acceptability criteria;
- Software modules and versions testing methodology;
- Code and version maintenance process; and
- Code and version retirement process.

The Contractor must identify the tools used for this purpose, if applicable. The Contractor may use its internal configuration management documentation format for this deliverable.

9.8   PM 005: Requirements Management Plan

DATA ITEM DESCRIPTION	2. Identification No.
1. Title Requirements Management Plan	PM 005
2. Description/Purpose Prepare a plan describing how the Contractor will manage the TEC3 functional specification requirements and ensure that every user story is associated with the TEC3 functional specification (references [2] and [3]). Smaller stories that form part of a larger story may not tie directly to the functional specification (but will trace to a story that does contain one or more requirements from the functional specification).	4. Delivery Date Baseline Draft: 20 working days after contract award Baseline Final: 40 working days after contract award Iterations: as required for each phase (no more than once per development phase).
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation Baseline Draft: N/A Baseline Final: 10 working days after receipt Iterations: 10 working days after receipt
	9. References: ISO/IEC 12207, SEI-CMM.

10. Preparation Instructions

The Contractor must prepare and maintain a Requirement Management Plan which consists of the following:

- Functional Specification (Requirements) list and/or book;
- Requirements traceability matrix;
- Requirements modification process; and
- Design items / software functionality list linked to the requirements matrix.

The Contractor may use its internal requirement management documentation format for this deliverable.

9.9 PM 006: Development Phase Plan

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Development Phase Plan	PM 006
2. Description/Purpose This plan will cover the main objectives and milestones of the upcoming development phase. The purpose is to allow for formal approval of the upcoming development work included in the next phase.	4. Delivery Date Draft for each development phase: A minimum of 10 working days before the expected start of each development phase. Final for each development phase: At the start of the each new development phase.
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation Draft for each development phase: N/A Final for each development phase: 10 working days after receipt
	9. References

10. Preparation Instructions

The Development Phase Plan is composed of updated project management documents and technical documents. The Development Phase Plan must include, as a minimum, the following:

- Detailed, prioritized story breakdown and schedule for the subject development phase in accordance with DID PM 001;
- Development phase objectives;
- System increments from previous development phase, or from off-the-shelf capabilities (for the first development phase) including a summary of issues from previous development phases, trials and demonstration reports;
- Updated Product Backlog in accordance with DID SD 001;
- Updated Architectural Design document in accordance with DID SD 002; and
- Updated Detailed Design document in accordance with DID SD 003, including subject development phase components to be added/refined, as identified in the objective.

9.10   PM 007: Final Report

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Final Report	PM 007
2. Description/Purpose The Contractor must prepare a final report at the end of the project. This report is intended to summarize the activities and achievements for the whole project.	4. Delivery Date Draft: No later than 20 working days after the start of Phase 5 Final: At the end of Phase 5
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation Draft: N/A Final: 20 working days after receipt
	9. References

10. Preparation Instructions

The Final Report must include (as annexes) the final version of every project document. It must also discuss the following subjects:

- Summary of all the development phases' objectives, activities, and results (including any feedback from the operational community);
- Lessons learned; and
- Areas identified for further research.

The Final Report must also include a transition plan for how TEC3 could be transitioned into an operational setting. The transition plan will address, as a minimum, the following subjects:

- Concept of operations;
- Deployed system requirement specifications, including security and performance requirements;
- System testing considerations;
- Life-cycle support plan and requirements, including cost estimates;
- Deployment plan, including cost and duration estimates;
- Challenges; and
- Proposed solutions and work-around.

The Final Report will be formatted using the DRDC Standard template for Scientific Reports as provided by the TA.

9.11 SD 001: Product Backlog

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Product Backlog	SD 001
2. Description/Purpose The Product Backlog (TEC3 Scope, RAD description or WBS dictionary) consists of a description of the TEC3 user stories based on the TEC3 functional specification and its annex (available in references [2] and [3]). The Product Backlog for each phase will contain the Epic with description of the specific stories (features and functions) for the specific development phase. The Product Backlog will be prepared, reviewed and updated throughout the project, and for each development phase.	4. Delivery Date Baseline version: With bid proposal First version: No later than 20 working days after contract award. Iterations: As part of each phase plan (in accordance with DID PM 006).
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation First version: 20 working days after receipt Iterations: 10 working days after receipt
	9. References

10. Preparation Instructions

The Contractor must produce a detailed TEC3 scope breakdown (WBS or Product Backlog) and update its content as required during the project. The technical documentation provided as part of the Request for Proposal (RFP) package (including the TEC3 functional specification (reference [2]) and its classified annex (reference [3])) is intended to ensure the Contractor understands the TEC3 concept and functional requirements. For the SD 001 deliverable, the Contractor must make use of the technical documentation referenced in the contract to provide the necessary guidance in developing a complete set of user stories (or WBS/schedule).

The Product Backlog should include the following elements:

- items: the list of features to be developed. As the project develops, these may also include defects to be rectified and/or areas for further improvement;
- estimate of business value: an estimate by the Product Owner of the value to the Customer's business of each item (presented in relative terms by comparison to other items);
- estimate of effort: an estimate of the effort required by the Development Team to develop each item (presented in relative terms by comparison to other items); and
- priority: the priority for each of the items, taking account of the estimates of business value and effort.

9.12　　SD 002: Architectural Design document

DATA ITEM DESCRIPTION	3. Identification No.
1.　Title Architectural Design document	SD 002
2.　Description/Purpose The Architectural Design document explains TEC3 components and sub-systems and how these components and sub-systems and their integration will produce a system that delivers on the TEC3 functional specification (references [2] and [3]).	4. Delivery Date Baseline version:　With bid proposal First version:　No later than 40 working days after start of Phase 1. Iterations: As part of each phase plan (in accordance with DID PM 006). Final version:　With Final Report (in accordance with DID PM 007).
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8.　DND Approval Limitation First version: 10 working days after receipt Iterations: 10 working days after receipt Final version: 10 working days after receipt
	9.　References:　ISO 12207, ISO 35
10.　Preparation Instructions The Architectural Design document must include: - The system high-level architecture; - Any sub-systems and documented relationships with one another and with the main system; - The information models in use (in the form of Unified Modeling Language (UML) models or AGILE Modeling (AM)); - COTS, Open Source, and custom software name, version and general configuration information, as applicable; - General description of the interfaces to any and all sub-systems, software applications, and software plug-ins; and - Security architecture. The relationship of each of the architectural design sub-systems, software applications, and software plug-ins of the initial document must be linked to the appropriate sections of the TEC3	

functional specification; in future iterations of this architectural design document, the sub-systems, software applications, and software plug-ins must be linked to the appropriate sections of the Product Backlog (as described in DID SD 001) once the Product Backlog has been produced.

Each version of this document must include comments pertaining to the changes introduced from previous versions and the rationale supporting such changes. Updates made to this document during the technical development within a phase do not need formal review and process control. Final end-of-phase delivery of this document must include:

1) Complete copy-editing to unify editorial style;
2) Document diagram and figure cleanup to unify style and formatting;
3) Review of document content for correct information content location (Architectural Design Document vs. Detailed Design Document vs. Hardware and Software specification documents); and
4) Any other changes for clarity (with consultation with Technical Authority)

The Contractor must discuss the choice of custom, COTS and Open Source software developed / selected to be part of TEC3. The Contractor will make use of quality attributes to assess the selected COTS / Open Source software. This software assessment will be part of the Architectural Design document. The quality attributes used to assess the software should include the following:

1) API (application programming interface) characteristics;
2) Compliance with recognized standards;
3) Support availability;
4) Functionality;
5) Licensing cost;
6) Ease of integration;
7) Scalability;
8) Security features;
9) Trusted source;
10) Ubiquity;
11) Extensibility;
12) Source (organization/company) characteristics (size, stability);
13) Intellectual property (IP) related issues and restriction for the use of the product; and
14) Quality of documentation.

9.13 SD 003: Detailed Design document

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Detailed Design document	SD 003
2. Description/Purpose The Detailed Design document must explain how each sub-system, system, component, data structure, interface and algorithm are related and address identified requirements in the Product Backlog (as described in DID SD 001).	4. Delivery Date Baseline version: No later than 60 working days after start of Phase 1. Iterations: As part of each phase plan (in accordance with DID PM 006). Final version: With Final Report (in accordance with DID PM 007)
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation Baseline version: 15 working days after receipt Iterations: 15 working days after receipt Final version: 15 working days after receipt
	9. References: ISO 12207, ISO 35

10. Preparation Instructions

The Detailed Design document must include:

- Detailed descriptions of all software and hardware interfaces, including:
    1) APIs describing how to interface with exposed software functionality;
    2) Descriptions of how internal software components interact, communicate, and share information;
    3) Descriptions of the hardware interfaces between TEC3 components and accessible hardware interfaces for the addition of peripherals not included in current TEC3 development;
- Detailed description of the GUI interface;
- Detailed description of the communication design, including protocols, standards, and custom-built elements;
- Data model detailed design (in the form of UML models);
- Network model detailed design (describing expected data usage and bandwidth consumption);
- Detailed design of any and all algorithms implemented to deliver TEC3 functionality;
- Detailed design of all systems, sub-systems, components, software applications, and software plug-ins; and
- Detailed configuration of all software and hardware.

The Detailed Design document is expected to provide a sufficient level of detail that an intermediate-level programmer could use the Detailed Design document to understand how TEC3 is implemented and to add new functionality to TEC3 in the form of a software application or plug-in.

Each version of this document must include comments pertaining to the changes introduced from previous versions and the rationale supporting such changes. Updates made to this document during the technical development within a phase do not need formal review and process control. Final end-of-phase delivery of this document must include:

1) Complete copy-editing to unify editorial style;
2) Document diagram and figure cleanup to unify style and formatting;
3) Review of document content for correct information content location (Architectural Design Document vs. Detailed Design Document vs. Hardware and Software specification documents); and
4) Any other changes for clarity (with consultation with Technical Authority)

9.14   SD 004: System software, hardware and documentation

DATA ITEM DESCRIPTION	3. Identification No.
1. Title System software, hardware and documentation	SD 004
2. Description/Purpose At the conclusion of each development phase, the Contractor must deliver an instance of the TEC3 system with supporting hardware, software and documents to the TA.	4. Delivery Date Initial version: At the end of Phase 1. Iterations: At the end of Phases 2 and 3. Final version: At the end of Phase 4.
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation N/A
	9. References

10. Preparation Instructions

At the end of each development phase (i.e., at the conclusion of Phase 1, Phase 2, Phase 3, and Phase 4), the Contractor must provide DRDC with the current version of the TEC3 software and software documentation. The TEC3 software provided to DRDC will be installed and configured on hardware that the Contractor will provide to DRDC at the end of Phase 1. At a minimum, this hardware will consist of one analyst node, one commander node and six basic nodes The Contractor must provide DRDC with new hardware if any changes are made to the hardware requirements for subsequent development phases .   The intent is to allow DRDC personnel to become familiar with the TEC3 system, perform V&V testing, and to conduct parallel research activities and independent development.   Basic user documentation must also be delivered.

For demonstration activities the contractor will be responsible for supplying all the necessary hardware and software for demonstrations in Phases 1, 2, 3 and 4, and for conducting said demonstrations. Basic user documentation must also be delivered.

Hardware: Depending upon the phase, demonstration hardware includes up to one client PC, laptop, or tablet (including radio transceivers) serving as an analyst node, 13 handheld systems (including GUI displays and radio transceivers) serving as basic nodes, 2 tablet systems (including GUI displays and radio transceivers) serving as commander nodes, any required application servers and database servers, basic networking equipment such as routers, wiring, hubs, network cards and hardware appliances.

Software: Depending upon the solution, this may include client application software, server application software, database application software, supporting operating systems (OS), agent software, COTS / open source software, etc. The software must be packaged in a ready-to-install format, on appropriate media. The Contractor must also ensure that all equipment provided for this deliverable has appropriate licenses for all software products

installed. Documentation for software modules must include: Vendor; Product Name; Intellectual Property Source (opensource/freeware/etc…); Version; Download Source web link (if applicable); License Type (GPL/Apache/etc…); and License web link;

Documentation: Documentation must include installation and configuration instructions for all software packages and hardware items. A basic user manual covering system user interfaces and features must also be provided. All original documentation for COTS and open source software must be provided. Data modeling documentation must be provided in the form of UML models. Documented APIs and SDKs must be provided to allow for the development of extensions to, or modifications of, TEC3 features if desired. Updates made during the technical development (AGILE) to this document do not need formal review and process control. Final end-of-phase delivery of this document must include:

1) Complete copy-editing to unify editorial style;
2) Document diagram and figure cleanup to unify style and formatting;
3) Review of document content for correct information content location (Architectural Design Document vs. Detailed Design Document vs. Hardware and Software specification documents); and
4) Any other changes for clarity (with consultation with Technical Authority).

All software delivered under this DID must be documented to permit its usage and integration by government employees and other contractors in the context of the TEC3 project and follow-on research activities.

9.15   SD 005: SA&A Documentation

DATA ITEM DESCRIPTION	3. Identification No.
3. Title SA&A Report	SD 005
4. Description/Purpose The Contractor must deliver an SA&A report and supporting documentation. The scope and purpose is to allow the project to prepare for future SA&A requirements.	4. Delivery Date Baseline version: No later than 40 working days after start of Phase 3. Final version: With the Final Report (in accordance with DID PM 007).
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation Baseline version: 10 working days after receipt Final version: 10 working days after receipt
	9. References Department of National Defence (DND) & The Canadian Armed Forces (CAF) Security Assessment and Authorization Guideline (SAAG), 1 March 2014 (or newer)

10. Preparation Instructions

The SA&A Report is composed of SA&A documentation as discussed in the references to this DID (box 9). The SA&A Report must include, as a minimum, the following:

- Domain control profile chosen for the project, listing the requirements needed for this profile;
- Details of the recommended controls to be implemented for the project, based on the domain control profile, with reasoning behind why controls were chosen or excluded from implementation; This includes:
    1) Control identifier (i.e. AC-2A);
    2) Control definition;
    3) Criticality;
    4) Maturity;
    5) Applicability of control to TEC3;
    6) Reference to TEC3 documentation to support control;
    7) Evaluation of how the high level design and detailed design meet the recommended controls, with enough information presented within the document for the reader to understand the evaluation;
- Evaluation of the gaps (controls) that are not met. This would include a description of options to satisfy the control and an estimate of before and after residual risk.

9.16   SD 006: Software Development Kit

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Software Development Kit	SD 006
2. Description/Purpose The Software Development Kit (SDK) document provides the information and examples needed by an external developer to build new device drivers, modules and apps to integrate with, build on, or extend the TEC3 system.	4. Delivery Date Initial version: At the end of Phase 1. Iterations: At the end of each development phase (Phases 2, 3 and 4). Final version: As part of the Final Report (in accordance with DID PM 007)
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation N/A
	9. References:

10. Preparation Instructions

Updates made to this document during the technical development within a phase do not need formal review and process control. Final end-of-phase delivery of this document must include:

1) Complete copy-editing to unify editorial style;
2) Document diagram and figure cleanup to unify style and formatting;
3) Review of document content for correct information content location (Architectural Design Document vs. Detailed Design Document vs. Hardware and Software specification documents); and
4) Any other changes for clarity (with consultation with Technical Authority).

The SDK document, at a minimum, must include:

1. How TEC3 works:

    a. Consists of what is TEC3 from operator, developer, and end user perspectives.
2. Overview of TEC3 architecture and components, including security model and standards:
    a. High-level view to orient the developer
    b. Frameworks and tools used within TEC3 with a brief description of each (and references)
        i. Framework 1..x
        ii. Software tool 1..x
    c. References, including relevant books, websites

3. Standards, conventions including:
    a. Build tools (e.g., git/svn, maven)
    b. Testing (unit, service, integration)
    c. Logging
4. Setting up a development environment:
    a. prerequisite software and supported versions
    b. instructions on any special configuration
    c. integrated development environment (IDE), tools required
5. TEC3 Design:

    a. Description

    b. Subsystem Decomposition (reference to SD004 Detailed Design)
        i. Brief Functional Description of each module and component within the TEC3 system.
        ii. Interface points to each module and component identified.
        iii. Service calls or remote procedure call for each module and component.
        iv. Dependencies for each subsystem.
6. API Documentation:

    a. Overview: Explain purpose/advantages of using the API, provide an architectural description if necessary.

    b. Getting started: Help the developer get started, in the form of step-by-step tutorials or simpler walkthroughs.

    c. Sample code: Provide well-commented code samples that developers can build on.

    d. Reference material: Provide detailed information about each class, member, function.
7. Prerequisites:

    a. Development environment, referred to as IDE (e.g., Eclipse), which serves as the central programming interface. It provides insights into the following: organizing the project, compiling & debugging, building GUI widgets, testing, etc.
8. Installing the SDK
   This provides information on the following (but it is not limited to these items):

    a. How to download, unzip, and install – steps to follow

    b. Project folders' layout/hierarchy (configuration folder, build folder, binary folder, …)

    c. Global variables

    d. Configuration

    e. Import example (example configuration and description about each part)

    f. Export example (example configuration and description about each part)
9. Standards and conventions for programming:

    a. Examples include naming conventions , coding standards and similar relevant information

    b. Meeting the security standard within TEC3

       i.   Inter-module communication

      ii.   Authentication of module if required

10. Creating a module using the APIs

    a.   APIs and how to interface to the rest of system

    b.   Examples of how to use API to achieve goal

    c.   How to use/update data in the system

    d.   How to achieve security in the system (or as part of the system)

    e.   How to extend the system

    f.   Testing

    g.   Module/unit test

       i.   Component/function test integration considerations

11. Creating a new App (or equivalent) within the Android environment:

    a.   App user interface and how to interface to the rest of system

    b.   How to use/update data in the system

    c.   How to achieve security in the system (or as part of the system)

    d.   How to extend the system

    e.   Testing

    f.   Module/unit test

       i.   Component/function test integration considerations

9.17   DM 001: Demonstration material

DATA ITEM DESCRIPTION	3. Identification No.
1. Title Demonstration material	DM 001
2. Description/Purpose The Contractor must provide Demonstration Material in support of demonstration activities. These demonstration activities consist of formal system demonstrations, typically occurring at DRDC-Ottawa at the end of each development phase (or at a DND/CAF facility in Eastern Ontario within 200km of DRDC-Ottawa at the end of Phase 4), and ad-hoc demonstrations given to stakeholders at different locations.	4. Delivery Date Formal demonstration material: 5 working days before scheduled demonstration date.
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)
7. Application/interrelationship	8. DND Approval Limitation N/A
	9. References
10. Preparation Instructions Formal Demonstration material consists of the TEC3 instance delivered as part of the system hardware, software and documentation deliverable (in accordance with DID SD 004), and additional required hardware and software required to conduct a demonstration. Depending on the demonstration scenario, the additional hardware and software might include traffic generating equipment, data sets, and test scripts to support full system functionality demonstration.	

9.18 DM 002: Data collection material

DATA ITEM DESCRIPTION	3. Identification No.
3. Title Data collection material	DM 002

4. Description/Purpose	4. Delivery Date
The Contractor must provide a data collection app that will allow for data gathering of logs and performance statistics of the TEC3 devices and the TEC3 system. The data collection app must run on the TEC3 device and must be a separate app from the TEC3 suite of apps.	Data collection material: 5 working days before scheduled demonstration date.
	5. Office of Primary Interest (OPI) Contractor
	6. Office of Collateral Interest (OCI)

7. Application/interrelationship	8. DND Approval Limitation N/A
	9. References

10. Preparation Instructions

The Data collection app, as a minimum, must include:

1. The ability to control testing and logging of network and device statistics through a GUI;
2. The ability to designate a primary node in the network as a control / data collection point for running tests and gathering logs;
3. The ability for nodes to discover and synchronize with other devices running the Data collection app test applications;
4. The ability to create firewall rules such that certain nodes will block direct communications with one another (to simulate a multi-hop scenario);
5. The ability to utilize the device GPS to synchronize the system clock;
6. The ability to record GPS location with timestamps in a log file;
7. A traffic generator that creates communication requests for the multicast and unicast protocols; and
8. A log viewer that can be used to monitor the system during a test.

10.   List of acronyms

API	application programming interface
C2	command and control
CAF	Canadian Armed Forces
CDRL	contract data requirement list
CMM	capability maturity model
CO	cyber operations
COSW	Cyber Operations and Signals Warfare section
COTS	commercial off the shelf
DID	data item description
DND	Department of National Defence
DRDC	Defence Research and Development Canada
GUI	graphical user interface
HQ	headquarters
HW	hardware
IDE	integrated development environment
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	intellectual property (or Internet Protocol, depending upon context)
ISO	International Organization for Standardization
IT	information technology
MANET	mobile ad hoc network
MOTS	military off the shelf
MS	Microsoft
OCI	office of collateral interest
OPI	office of primary interest
OS	operating system
PC	personal computer
PM	Project manager (or project management, or senior project manager, depending upon context)
RFP	request for proposals
SA	situational awareness
SA&A	system authorization and accreditation
SDK	software development kit
SEI	Software Engineering Institute
SOR	statement of requirement
SRCL	security requirements check list
SW	software
TA	technical authority
TD	technology demonstrator
TEC3	Tactical Edge Cyber Command and Control
UML	Unified Modeling Language
V&V	verification and validation
WBS	work breakdown structure

APPENDIX 1 TO ANNEX A
OPTIONAL SERVICES REQUIREMENTS

Tactical Edge Cyber Command and Control (TEC3)

1. Introduction

Important disclosure: All elements or work identified in this Appendix 1 to Annex "A" are optional work and they may not be raised by Canada.

1.1 Background

1.1.1 Depending on the maturity of technology delivered within each phase of the TEC3 SOR, The Optional Services Requirement may be exercised concurrently on an "as and when requested" basis, at any point during the contract, via a 626 Task Authorization. The Optional Services Requirement which may be performed is the provision of software and supporting professional services to DND to further test, demonstrate, develop, deploy, support, and maintain TEC3 software, hardware, documentation, and associated professional services. The following non-exhaustive list contains examples of the types of tasks that may be issued:

- Perform project management activities for TEC3 integration, testing and prototyping;
- Perform project management services to schedule, guide, manage, budget and provide oversight and support to assigned tasks;
- Perform project planning, deployment and testing activities for trials and demonstrations;
- Conduct Personnel, Operations and Maintenance (PO&M) impact studies and planning in order to assess the overall PO&M needs of an operational deployment of a TEC3 type of capability and develop a transition plan to meet these needs;
- Conduct analysis of completed TEC3 demonstrations in order to identify operational gaps and, if necessary, improve the TEC3 functions and features through a design, develop, test and demonstrate life-cycle;
- Support the transition of TEC3 capability or components onto DND test and demonstration (trial) networks;
- Analyze and develop strategies and recommendations for continued operation and maintenance of the project repository after completion of the exercised options;
- Conduct technology analysis activities in support of DRDC initiatives stemming from the TEC3 Functional Specification;
- Perform technology integration for additional peripherals (radios, authentication devices, personal area network devices) into the TEC3 device(s);
- Review and develop operational requirements, integration specifications, system requirements, and design and test documents;
- Improve the TEC3 software components through a software design, develop, test and demonstrate life-cycle;
- Conduct technical and operator training as required to establish a cadre of technical and operator staff qualified to operate the TEC3 capability on an ongoing basis;
- Perform demonstrations and presentations to the TEC3 research community (including CAF, allies, research institutions, academia and commercial entities); and
- Develop new TEC3 software prototypes based on new functional specifications.

1.2   Purpose of this document

1.2.1   This document describes the professional services required to fulfill the tasks listed above for the TEC3 technology demonstrator: a tactical edge networking tool suite for mobile devices intended to demonstrate security-enhanced network situational awareness (SA), network command and control (C2) and cyber operations (CO).

1.2.2   Task Authorization will follow the process as described in the TEC3 RFP bid package and resulting contract using the DND 626 Form. The DND 626 Task Authorization form will include an appended Task Description detailing the specific Optional Services Requirement tasks to be conducted.

1.3   Duration

1.3.1   The Optional Services Requirement may be exercised at any time during the contract period.   The duration of tasks/work requested under a given DND 626 Task Authorization will be specified in the DND 626 Form.

1.4   Assumptions

1.4.1   The Optional Services Requirement may start during the core contract. The work during the core contract includes (but is not limited to):

- TEC3 experiments: Measuring the capability, performance and quality attributes of certain TEC3 features. These experiments have both a performance testing and research and exploratory element to them. The Contractor must set up, conduct and report on TEC3 experiments. Experiments may require travel. Experiments being considered are:
  - Efficacy of attack detection schemes;
  - Reliability of node trust values;
  - Communications capability in various network topologies and terrains;
  - Efficacy of encryption key distribution and revocation strategy;
  - Effect of policy-based network management selection on connectivity, power consumption;
  - Validation of use cases/scenarios.
- TEC3 trials: Formal system evaluation by the TA and the stakeholders. The intent of the trials is to evaluate the system and the quality of the resultant capabilities and direct (or re-direct) the project accordingly.
- Stakeholder interaction: Interact with various DND stakeholders to become familiar with the operational and tactical environments. These interactions could include periodic meetings with the operational clients, related DND projects staff, DND engineering and security organizations.
- Technology watch: Perform a technology watch on related software product families during the project. In cases where this survey identifies software that would add significant value to the project.
- Technology integration: Perform integration of allied software provided to TEC3. This may include integration of Apps on the mobile devices to interfacing through wireless protocols.

2. Resources

2.1 Resource responsibilities and category requirements

2.1.1 To fulfill the objectives of the Optional Services Requirement, the Contractor may be required to provide a number of resources to execute the work on an "as-and-when-requested" basis. The following table describes the roles and responsibilities that each resource type may be required to perform, along with category requirements.

Table 1: Resource Responsibilities and Requirements for Optional Services Requirement

RESOURCE	
Project Management	
Senior Project Manager	RESOURCE RESPONSIBILITIES
	Perform overall project planning, execution and supervision;
	Provide a project plan and propose breakdown structure for delivery and provide work plan and budget;
	Perform all project management and leadership activities (e.g., planning, assigning resources, assigning due dates, enforcing project schedule and milestones, maintaining the team on track);
	Keep track of all the project activities, progress, budget and deliverables;
	Identify, assess and continually manage risk, issues and change;
	Report regularly to the TA on the evolution of the work, the issues that arise and solutions to be applied in order to meet the requirements within the budget and schedule constraints.
	RESOURCE REQUIREMENTS
	This resource must have the same qualifications (or better) as the resource proposed for the "Personnel – Senior project manager" category in the "Management Proposal" response to the Evaluation Criteria.

RESOURCE	
Intermediate Project Manager	RESOURCE RESPONSIBILITIES
	Perform project planning, task execution and activity supervision;
	Provide a project activity plan and propose breakdown structure for delivery and provide work plan and budget;
	Perform specific activity project management and leadership activities (e.g., planning, assigning resources, assigning due dates, enforcing project schedule and milestones, maintaining the team on track);
	Keep track of specific project activities, progress, budget and deliverables;
	Identify assess and continually manage specific activity risk(s), issues and change;
	Report regularly to the TA on the evolution of the work, the issues that arise and solutions to be applied in order to meet the requirements within the budget and schedule constraints.
	RESOURCE REQUIREMENTS
	1. Professional certification from PMI or Post-Graduate Degree in Project Management or Certificate in Project Management from a recognized Canadian educational institution; or at least eight (4) years of experience as a Project Manager of software development project(s) (larger than five (5) Person-Years), within the last eight (8) years;
	2. Experience managing at least one (1) multi-disciplinary software development teams, and/or experience managing software development project(s) in a R&D environment for a combined period of at least four (4) years;
	3. At least three (3) years of experience using a project management methodology including five (5) of the following:
	• Agile Planning and scheduling management;
	• Agile performance and delivery;
	• Cost management;
	• Risk management;
	• Quality management;
	• Change management;
	• Communication management.
	4. Experience in two (2) medium sized IT projects (at least 5 Person-Years) successfully conducted with the methodology in point 3, with a reference of the client for each;
	5. At least two (2) years of experience with project management tool in a cyclical software development process (Agile, Scrum, Unified Process or Similar) outlined in point 3.

RESOURCE	
Intermediate Project Communications Specialist	**RESOURCE RESPONSIBILITIES**
	Prepare and execute project communication plans targeted internally to the project team and externally to the military sponsor, military client and to the Tactical Network Operations (TNO) research community;
	Advise the TA on communication issues, approaches and strategies to implement communication means appropriate to each community of interest (client, sponsor, project team and scientists);
	Edit and publish periodic electronic and hard copy TEC3 information sheets;
	Develop brochures, posters and other advertisement media;
	Deliver training to operators and trainers.
	RESOURCE REQUIREMENTS
	1. Experience of at least four (4) years within the last six (6) years in communication planning and execution for IT project(s), with the design, management and implementation of project communication plans;
	2. Experience of at least two (2) years in development and delivery of training material;
	3. Experience of at least two (2) years in product or solution marketing including preparation of promotional or marketing materials (brochures, presentations, etc.) and delivery of marketing presentation to customer and at trade shows or conferences;
	4. Experience using MS Office Suite and graphic design software;
	5. Experience using WEB technologies as means to implement project communication plans;
	6. Experience with geographically distributed teams' communication.
Senior Project Control Officer	**RESOURCE RESPONSIBILITIES**
	Assist the (Senior) / Project manager in carrying out PM responsibilities to control the project implementation activities;
	Establish and manage a project control reporting framework;
	Implement performance monitoring processes and procedures;
	Collect, analyze and publish performance monitoring indicators;
	Enforce execution of approved project plans.
	RESOURCE REQUIREMENTS

RESOURCE	
	1. PCO experience of at least three (3) years within the last six (6) years with IT project(s) including responsibilities for tracking, reporting and calculating project status in a cyclical software development process, including: schedule tracking; cost tracking; milestone deliverables; and project performance; 2. Production or maintenance of project documentation in a project using a cyclical software development process (Agile, Scrum, Unified Process, or similar) of at least three (3) years within the last six (6) years. 3. Track and monitor project breakdown (stories), performance (points) and schedule of at least two (2) major IT projects (at least 10 Person-Years) successfully conducted with the cyclical software development process.
Intermediate SharePoint developer	RESOURCE RESPONSIBILITIES
	Perform all project related SharePoint development activities (e.g., create new SharePoint site, update existing site pages, populate data to existing SharePoint site utilizing templates, standard graphics, develop new forms); Manage the content of and access to all related documents according to the approved TEC3 SharePoint access privileges; Support operators and site problems.
	RESOURCE REQUIREMENTS
	1. Experience of at least four (4) years within the last six (6) years with SharePoint 2010 or newer; 2. Experience of at least four (4) years creating SharePoint lists and libraries for managing projects; 3. Experience of at least four (4) years managing the content of SharePoint site(s), updating website templates, creating new meta-data forms and fields, uploading and updating content.

RESOURCE	
System Architecture and Design	
Lead System Architect	RESOURCE RESPONSIBILITIES
	Provide leadership and oversight for TEC3 architecture, development, models and technical choices;
	Provide technical leadership for the overall architecture of the solution and its integration within operational environment;
	Provide technical leadership in analysis and resolution of technology challenges identified as part of the TEC3 concept, functional specification, design or implementation activities, or that may arise during the development of the system;
	Provide leadership for any story development, architectural choices or options analysis by team members.
	Communicate all architectural and technical choices to the TA.
	RESOURCE REQUIREMENTS
	This resource must have the same qualifications (or better) as the resource proposed to be the "Lead System Architect" in the "Management Proposal" response to the Evaluation Criteria.
Technical Writer	RESOURCE RESPONSIBILITIES
	Work with the Contractor development team to create robust technical documentation using a rigorous documentation process such as IEEE-12207;
	Manage and enforce documentation standards;
	Produce technical documents and assign writing and reviewing responsibilities as required;
	Maintain software system documentation including the description of the project and business purpose (concept document or functional specification), high level and detailed levels architecture/design, hardware/software guide and detailed installation instructions of all key software components;
	Develop operator guides, quick reference guides, context-sensitive online help or site navigation maps;
	Validate information contained in any produced document;
	Develop and validate operator and train-the-trainer training materials.
	RESOURCE REQUIREMENTS

RESOURCE	
	1. Experience of at least three (3) years within the last five (5) years with IT projects performing all of the following: • researching and analyzing source materials such as specifications, drawings, models, design briefs and IT documents and synthesizing the information into technical write-ups for software developers (specifications), operators (manuals) and trainers (training materials); and • conducting in-depth interviews with software architect, designer, developer, or operator to understand the system to be developed. 2. Experience writing technical documents using software development process standards such as the IEEE-12207; 3. Experience verifying the adequacy of documentation by testing the system.
User Interface Analyst	RESOURCE RESPONSIBILITIES
	Maintain and enforce the User Interface Design methodology; Continue to review and assess the operator interface requirements and preferences based on the TEC3 Concept documentation and TEC3 functional specification and user feedback from operational rollout; Create and validate mock-ups of additional operator interfaces prior to implementation; Develop and assess User Acceptance Metrics.
	RESOURCE REQUIREMENTS

RESOURCE	
	1. Experience of at least four (4) years within the last six (6) years with IT project(s), including experience in at least three (3) of the following categories: • With the help of operators, translating user functional requirements into graphical user interface (GUI) technical specifications that can be used by the system and/or programming team; • capturing insight on workflows, functional and non-functional requirements; • modeling the business process; • profile primary and secondary operator community; • tracking daily usage patterns and functionality; and • system development constraints; 2. Experience with the following: • Android devices; • Mobile device browsers; and • Mobile device usability best practices. 3. Experience of at least three (3) years within the last six (6) years translating user functional requirements into graphical user interface (GUI) specifications that can be used by the system and/or programming team for TEC3 related applications and systems; 4. Experience of at least two (2) years within the last six (6) years performing GUI software development activities for mobile related applications and systems or military C2 user interfaces.
RESOURCE	
Firmware Software Engineer	RESOURCE RESPONSIBILITIES
	Design, develop and implement TEC3 firmware and hardware architecture; Modify low-level software and firmware for a Software Defined Radio; Modify low-level software and firmware for an Android networking device and PC networking device; Develop new device drivers and firmware to support the TEC3 project functional specification;
	RESOURCE REQUIREMENTS

RESOURCE	
	1. This resource must have the same qualifications (or better) as those used in the solicitation document to evaluate this resource.
Mobile R&D specialist	RESOURCE RESPONSIBILITIES
	Support the Technical Authority and the Scientific Authority with the research and development of tactical cyber security/defence concepts, functional specification, and prototypes that incorporate the concept of trust in a tactical environment;
	Gather and formalize tactical cyber security concepts, functional specification, requirements, story, planning and testing.
	Conduct technology surveys and assessments
	Design and develop benchtop prototypes and mock-ups
	Test and validate prototype solutions.
	RESOURCE REQUIREMENTS
	1. This resource must have the same qualifications (or better) as those used in the solicitation document to evaluate this resource.

RESOURCE	
RESOURCE	
Information Technology Security Analyst	RESOURCE RESPONSIBILITIES
	Assume responsibility to review, develop and enforce Information Technology (IT) security policies, standards, guidelines and procedures; Conduct reviews of backups and recovery plans; Provide advice on the security aspects of application systems under development.
	RESOURCE REQUIREMENTS
	1. Experience of at least five (5) years within the last eight (8) years with IT project(s) that collectively addresses all of the following: • IT Security architecture(s); • IT Security Risk Management Methodology; • Threats to, and vulnerabilities of, networks; • Implementation of IT Security safeguards for personnel and IT Security Assets; • IT Security system monitoring, incident response, recovery, and restoration; and • IT Security audit and assessment
Information Technology Certification and Accreditation Specialist	RESOURCE RESPONSIBILITIES
	Review, develop and enforce Information Technology (IT) certification and accreditation work plans, in accordance with DND SA&A Guidelines; Conduct security studies and SA&A activities of the planned TEC3 project activities related to experimentation in an exercise or trials.
	RESOURCE REQUIREMENTS
	1. Experience of at least five (5) years within the last eight (8) years with IT project(s), conducting security threat and risk assessments of at least three (3) application systems; 2. Experience of at least three (3) years within the last five (5) years in providing Certification and Accreditation support for at least three (3) Government of Canada projects; 3. Experience of at least one (1) year in at least 3 of the 4 following technologies: Security of Open Source Software, Tactical (wireless) security, Android security, pen testing of wireless systems.

Request for Proposal (RFP) - Tactical Edge Cyber Command and Control – TEC3
PWGSC Solicitation No. W7714-145970/B

RESOURCE	
System Programming	
Android Programmer	**RESOURCE RESPONSIBILITIES**
	Ensure the feasibility of implementing incremental changes to the overall architecture and design of the system to be developed;
	Provide directives to the team of programmers to implement and program changes and enhancements to the targeted system solution;
	Implement and program the system solution and the associated components;
	Provide advice on various software system technologies including distributed systems at various levels such as clients, servers and peer-to-peer systems, service oriented architectures, messaging, wireless protocols, and remote method invocation, TCP/IP networking at various levels including sockets and ports, IP multicasts and DNS, and integration of legacy systems with the core system;
	ANALYZE TECHNOLOGY CHALLENGES IDENTIFIED AS PART OF THE CONCEPT, DESIGN OR IMPLEMENTATION ACTIVITIES, OR THAT MAY ARISE DURING THE DEVELOPMENT OF THE SYSTEM AND MAKE RECOMMENDATIONS FOR THEIR RESOLUTION BASED ON THE RESULTS OF THE ANALYSIS;
	Plan, control and evaluate systems testing, and provide directives to the team of programmers.
	RESOURCE REQUIREMENTS
	1. This resource must have the same qualifications (or better) as those used in the solicitation document to evaluate this resource.

RESOURCE	
Intermediate Programmer	**RESOURCE RESPONSIBILITIES**
	Support the deployment and the experimentation of a test-bed to fulfil the needs of the experimentations such as providing logging/tracking mechanisms, storing experimentation data and producing results to be analyzed by the researchers;
	Work with the system operators to determine data collection requirements;
	Provide strategies to replicate sources of information that cannot be directly accessed by the system;
	ANALYZE TECHNOLOGY CHALLENGES IDENTIFIED AS PART OF THE CONCEPT, DESIGN OR IMPLEMENTATION ACTIVITIES, OR THAT MAY ARISE DURING THE DEVELOPMENT OF THE SYSTEM AND MAKE RECOMMENDATIONS FOR THEIR RESOLUTION BASED ON THE RESULTS OF THE ANALYSIS;
	Implement and program the system solution and the associated components;
	Provide development leadership to support junior programmers;
	Advise on best courses of action related to lower level implementation details;
	Perform security review and modification of contributed source code.
	RESOURCE REQUIREMENTS
	1. At least three (3) years of experience within the last five (5) years for at least one (1) IT projects, leading the software development of a solution to meet the overall architecture and design of the system;
	2. The proposed resource should have demonstrated experience in design, development and implementation of MANET protocols within a project in three (3) of the following five (5) areas: - Physical/MAC layer connectivity - Mobility and dynamic topology - Routing - Security and trust - Traffic generation and analysis
	3. The proposed resource should have demonstrated four (4) years of experience within the last seven (7) years in designing and developing software, in C or C++ programming language.
	4. The proposed resource should have demonstrated two (2) years of experience within the last five (5) years designing, development, and integration of communications software within mobile networking projects.

RESOURCE	
Junior Programmer	RESOURCE RESPONSIBILITIES
	Implement and program the system solution and the associated components;
	Perform system, unit and integration tests, and report on results obtained;
	Verify accuracy and completeness of programs by preparing sample data, and testing them by means of system test runs performed by various project participants.
	RESOURCE REQUIREMENTS
	1. Experience of at least two (2) years within the last three (3) years as a software developer for IT project(s).
	2. The proposed resource should have demonstrated experience in design, development and implementation of protocols within a project in two (2) of the following four (4) areas: • Physical/MAC layer connectivity • Routing • Security and trust • Traffic generation and analysis
	3. The proposed resource should have demonstrated four (4) years of experience within the last seven (7) years in designing and developing software, in C or C++ programming language.
	4. The proposed resource should have demonstrated two (1) years of experience within the last five (5) years designing, development, and integration of communications software within mobile networking projects.

RESOURCE	
Senior WEB Developer	**RESOURCE RESPONSIBILITIES**
	Design, build, implement and maintain new websites or upgrade existing websites in line with client specifications;
	Prototype and produce website simulations from client requirements to determine the best proposal for website appearance and operation;
	Develop and prepare diagrammatic plans for web based service delivery using web-services (or similar web-based service oriented architecture technologies);
	Select and use available web development tools for linking web-based clients, applications and systems to "back-end" information systems and databases;
	Design, code, verify and correct web pages and systems based on web-services (or similar web-based service oriented architecture technologies) to meet system requirements; and
	Analyze problems outlined by systems analysts/designers in terms of such factors as style and extend of information to be transferred across web-services infrastructures or similar web-based service oriented architecture technologies.
	RESOURCE REQUIREMENTS
	1. Experience of at least four (4) years within the last six (6) years with IT project(s) performing all of the following: - design, build, implement and maintain new websites or upgrade existing websites in line with client specifications; - prototype and produce website simulations from client requirements to determine the best proposal for website appearance and operation; - develop and prepare diagrammatic plans for web based service delivery using web-services (or similar web-based service oriented architecture technologies); - select and use available web development tools for linking web-based clients, applications and systems to "back-end" information systems and databases; and - design, code, verify and correct web pages and systems based on web-services (or similar web-based service oriented architecture technologies) to meet system requirements.

RESOURCE	
System Engineering and Operations	
Operating System Administrator	**RESOURCE RESPONSIBILITIES**
	Monitor, manage and support system architecture, hardware, servers, operating systems and application software;
	Perform and provide installation, configuration, maintenance and troubleshooting services in support of server communication architecture, server to workstation and hardware, software, peripherals and related equipment;
	Maintain user access and IT security practices and policies enforced by the department;
	Develop and/or maintain system backup strategies;
	Develop and/or maintain operating guidelines, procedures and standards in support of existing systems or newly introduced hardware, software or application releases;
	Provide advice and cost estimates to the PM on the purchase of new IT hardware and software to optimize the use of computer systems.
	RESOURCE REQUIREMENTS
	1. Experience of at least three (3) years within the last five (5) years with IT project(s) performing all of the following: • monitoring, managing and supporting system architecture, hardware, servers, operating systems and application software; • performing/providing installation, configuration, maintenance and troubleshooting services in support of server communication architecture, server to workstation and hardware/software, peripherals and related equipment; and • developing and maintaining system backup strategies; 2. Experience with all of the following technologies: • Network architecture; • Configuration and operation of servers, PCs, portable computers, peripheral devices (android); • Interaction of network components and PCs to maintain, identify, isolate, diagnose and resolve hardware connectivity and software compatibility-related problems; • Communication architecture, devices, techniques and practices for their installation, configuration, integration and troubleshooting.

RESOURCE	
Project Test Coordinator	RESOURCE RESPONSIBILITIES
	Develop, implement and supervise an overall testing strategy, plans and activities;
	Act as the subject matter expert with regard to testing tools and techniques;
	Develop standards and processes to follow with regard to system integration testing, and system readiness assessment;
	Ensure that the standards established by the Quality Assurance Specialist (QAS) are applied by reviewing work plans and interim deliverables;
	Develop test scenarios and test scripts.
	RESOURCE REQUIREMENTS
	1. Experience of at least four (4) years within the last six (6) years with IT project(s) performing all of the following: • developing test strategies and plans for at least three (3) main systems that have been successfully delivered; • preparing and supervising integrated test plans and schedules for at least three (3) main systems; 2. Experience interacting with cross-functional teams to facilitate an integrated approach to testing engagements; 3. Experience mentoring a group of testers; 4. Experience in methodology guidance, test criteria/standards, quality practices.
Quality Assurance Specialist	RESOURCE RESPONSIBILITIES
	Provide support in quality assurance activities;
	Develop and enforce quality assurance policies, procedures, metrics, forms and tools;
	Audit quality reviews and activities providing confirmation that the quality assurance process is being adhered to;
	Audit the project making recommendations for improvement;
	Identify risk areas and propose risk mitigation strategies;
	Perform security review and approval of source code.
	RESOURCE REQUIREMENTS

RESOURCE	
	1. Experience of at least four (4) years within the last eight (8) years with IT project(s), in software system quality efforts including requirement reviews, test strategy development and planning, defect reporting and fix tracking, performance benchmarking and risk management for at least two (2) main systems that have been successfully delivered; 2. Experience with standards for software to be developed, processes and good practices in order to recommend and enforce the right policies according to the needs of the system to be developed, which follow the ISO 35 (such as ISO/IEC 12207), IEEE (such as IEEE 829, 830), CMMi, SEI-CMM or equivalent and applicable documentation and process standards. 3. Experience with processes and methodologies for product security testing and evaluation or certification.
Tester	RESOURCE RESPONSIBILITIES
	Establish and operate software testing procedures for unit test, integration test and regression testing with emphasis on automating the testing procedures; Establish and operate interoperable testing procedures to ensure that the interaction and coexistence of various software elements conform to appropriate departmental standards and have no unforeseen detrimental effects on the shared infrastructure; Establish system benchmarks and the tools to assess system performance; Establish a validation and verification capability which assumes functional and performance compliance of delivered or proposed solutions with defined operator requirements.
	RESOURCE REQUIREMENTS

RESOURCE	
	1. Experience of at least three (3) years within the last five (5) years with IT project(s) performing all of the following: • using process and tools to test coded software before it is released; • identifying test data requirements; and • configuring and maintaining test data to support testing; 2. Experience performing use case, test cases, checklists and requirements verification; 3. Experience with at least three (3) of the various types of testing: • Unit testing; • Stress and load testing; • Integration testing; • System and performance tests using manual methods and tools; • Performance benchmarking; • Security testing; • Tracking usability issues and inconsistencies. 4. Experience with client/server and multi-tiers development with a database (Oracle or SQL Server); Experience with Service Oriented Architecture or Web-Services technology testing.

3. CONDUCT OF WORK

3.1 Location of Work

3.1.1 The work associated to the Optional Services Requirement will take place within the National Capital Region (NCR). Some aspects of the Optional Services Requirement could include tasks located at CAF Bases within Canada. Canada is open to suggested deployment strategies for this cycle that would minimize travel costs. For example, staging of equipment at a central location for subsequent installation at distributed sites.

3.1.2 Location of work shall be specified in a DND 626 – TASK AUTHORIZATION. The majority of pre-staging and any development work may be performed at the Contractor's facility. The Technical Authority or other authorized government representatives shall have access at all times to the work in progress and to premises where any part of the work is being performed at the Contractor's facility.

3.2 Language of Work

3.2.1 The Contractor's resources must be fluent in English.

3.3 Hours of Work

3.3.1 The majority of the work to be conducted at DND facilities will be performed between 0700 and 1800 hours daily. In some cases, work may have to be performed outside of above noted working hours to minimize disruption and/or to support experimentation.

3.4 Equipment and Software

3.4.1 This work may require the Contractor to acquire specific equipment, including necessary hardware, software packages, software upgrades or other items essential to support the development or implementation effort. At the request of the Technical Authority, purchases may be initiated under this contract. The portion of funds allocated for possible purchases will be reviewed by the Technical Authority and authorized by means of the DND 626 – Task Authorization. When authorised, any acquisition shall be done in accordance with prevailing Government of Canada requirements, rules and regulations for equipment and software procurement.

3.4.2 The TA or authorized government representative will control the installation of software on DND computers and will also approve the deployment and removal of Contractor equipment to and from DND facilities. Approval by the Technical Authority is required before any equipment procured outside DND, may be brought into DND facilities.

3.5 Travel

3.5.1 Travel required for project management and other tasks within the NCR will not be reimbursed. It is anticipated that limited travel outside of the NCR will be required in support of some trial and experimentation tasks. Travel outside the NCR for will be paid in accordance with current Treasury Board Guidelines for government contracted personnel at the time of the travel. Travel outside the NCR will be specified for each individual task using DND form 626.

3.6 Equipment Provided by Canada

3.6.1 The Contractor will be provided access to facilities and technology supporting the TEC3 testing as established in the Core Contract in support of the Optional Services Requirement. The Contractor may be provided access to allied developed software to support experimentation and testing at DRDC Shirley's Bay for the duration of the Optional Services Requirement. Canada may provide the Contractor additional hardware, Canada-developed software and/or related artefacts at the Contractor request, if these requests are considered relevant to the task. Use of Government Furnished Equipment (GFE) will be coordinated and authorized by the Technical Authority, through the appropriate DND agency and specified for the task using DND form 626.

3.7 Documents to Be Provided to the Contractor

3.7.1 Canada will provide the Contractor any reference and technical documentation deemed necessary for the conduct of the work and these will be specified in an approved DND 626 – Task Authorization. This could include, for example, documentation related to previous research under Tactical Network Operations (TNO), DRDC-developed source code and prototypes. The Contractor may request

documents at any time during the contract period and these requests will be evaluated and approved on a case-by-case basis by the Technical Authority.

4. List of acronyms

API	application programming interface
C2	command and control
CAF	Canadian Armed Forces
CDRL	contract data requirement list
CO	cyber operations
COSW	Cyber Operations and Signals Warfare section
COTS	commercial off the shelf
DID	data item description
DND	Department of National Defence
DRDC	Defence Research and Development Canada
GUI	graphical user interface
HQ	headquarters
HW	hardware
IDE	integrated development environment
IEEE	Institute of Electrical and Electronics Engineers
IP	intellectual property (or Internet Protocol, depending upon context)
ISO	International Organization for Standardization
IT	information technology
MANET	mobile ad hoc network
MOTS	military off the shelf
MS	Microsoft
OCI	office of collateral interest
OPI	office of primary interest
OS	operating system
PC	personal computer
PM	Project manager (or project management, or senior project manager, depending upon context)
RFP	request for proposals
SA	situational awareness
SA&A	system authorization and accreditation
SDK	software development kit
SEI	Software Engineering Institute
SOR	statement of requirement
SRCL	security requirements check list
SRS	system requirements specification
SW	software
TA	technical authority
TEC3	Tactical Edge Cyber Command and Control
V&V	verification and validation
WBS	work breakdown structure

APPENDIX 2 TO ANNEX A

FUNCTIONAL SPECIFICATION

Tactical Edge Cyber Command and Control (TEC3) Functional Specification

Version 6.0

May 2017

Abstract

Tactical Edge Cyber Command and Control (TEC3) is a Technology Demonstrator intended to demonstrate a tool suite that provides network and security situational awareness in a tactical edge network, command and control of the network, and cyber operations in the network. This document contains the functional specification for the TEC3 Technology Demonstrator and represents the minimum functionality required to provide the TEC3 TD capability.

1   Introduction

The importance of timely and accurate battlefield situational awareness information is well recognized in military doctrine. The Canadian Armed Forces' (CAF) Network Enabled Operations (NEOps) concept (see reference [1] and reference [2] for details) acknowledges the importance of such information by embracing a philosophy of extending the nation's command and control network out to the tactical edge to ensure the 'right information' is delivered to the 'right place' at the 'right time'. Recent advances in commercial and military wireless networking technology are poised to make such capability a reality, making possible a future where tactical users have access to high-speed, dynamic, data networks to acquire and disseminate the information necessary to complete their missions. To defend and sustain these networks in contested environments, the CAF will require advanced network management and security solutions.

1.1   Objectives of the TEC3 demonstrator

The Tactical Edge Cyber Command and Control (TEC3) Technology Demonstrator (TD) will implement and demonstrate a capability that provides network situational awareness, network management, and network command and control (C2) for tactical networks. TEC3 will provide users at the edge of tactical networks with insight into geographic positional information and network health. Tactical commanders and analysts using TEC3 will see a representation of network communication links, the level of trust in operational network nodes, and indicators of potential attacks and vulnerabilities within the network. In addition, TEC3 will give commanders and analysts the ability to secure and manage their tactical networks and mitigate threats and attacks.

1.2   Concept of system operation

The TEC3 concept of system operation is described in detail in the report 'Tactical edge cyber command and control (TEC3) concept: A vision for network situational awareness and network command and control at the tactical edge', available at reference [3].

1.3   About this document

This document presents the TEC3 functional specifications. These specifications are derived from the TEC3 concept document, (available at reference [3] and on request), as well as from a number of DRDC-sponsored studies and proof-of-concept prototypes documented in the following reports:

- G. Henderson, W. Pase, 'Emerging radio and MANET technology study', DRDC-RDDC-2014-C208, October 2014, (available at reference [4]);

- W. Pase, G. Henderson, 'Advanced architectures for MANET-based signalling devices', DRDC-RDDC-2015-C206, April 2015, (available at reference [5]);

- W. Pase, 'Software support for a risk reduction platform for mobile ad hoc networks', DRDC-RDDC-2015-C207, June 2015, (available at reference [6]);

- C. McKenzie, 'TEC3 REALTIME blue force tracking proof-of-concept development report', DRDC-RDDC-2015-C150, April 2014, (available at reference [7]); and

- C. McKenzie, 'Android application for measuring TEC3 situational awareness dissemination protocol efficiency', DRDC-RDDC-2015-C232, June 2015, (available at reference [8]).

The functional specifications described in this document represent the functionality required to provide the TEC3 TD capability.

1.4   Scope

The focus of the TEC3 TD is on situational awareness and C2 for tactical edge networks—specifically on networks that include dismounted soldiers equipped with data communication and display devices. However, it should be noted that many of the concepts to be demonstrated by the TEC3 TD apply equally well to other military wireless networks deployed in contested environments where no fixed infrastructures exist.

1.5   A note on terminology

This document frequently uses the terms 'TEC3 device', 'TEC3 user', 'TEC3 node', and simply 'TEC3' when specifying requirements and functionality. In general, the terms 'TEC3 device' and 'TEC3 node' are synonymous and refer to the hardware and software operated by a 'TEC3 user', where a 'TEC3 device' is specified in Section 2.1. When the term 'TEC3' is used on its own, it generally refers to the TD system taken in its entirety—for instance, a requirement specifying that 'TEC3 must…' is taken to mean that the demonstrated delivered system consisting of all hardware, software, and users functioning together must achieve the stated requirement. As such, depending upon the context in which it is used, the terms 'TEC3 must…' may place requirements on hardware, software, architecture, or user interface.

Terms appearing in between double quotation marks, "…", have specific meanings and are defined either upon first use or in the glossary at the end of this document.

2 General design requirements

This section discusses general design requirements for TEC3. It specifies the three types of TEC3 users and TEC3 devices, the expectation of modularity in the design, and the need for configurability and management.

A basic TEC3 device consists of a primary communication radio component for communication and networking with other TEC3 devices, a secondary sensing radio component that will provide network and spectral sensing functionality, and a Graphical User Interface (GUI) display component for visual situational awareness and management of the network (see Figure 1). Network situational awareness (SA) and network command and control (C2) tools in TEC3 are implemented in software as a suite of plug-ins to the TEC3 GUI application. Plug-ins should be independent and should be able to be added or removed depending upon mission requirements. As shown in Figure 1, the GUI display would consume information from lower layers in the network stack in order to provide high-level network SA. The GUI would also send (automated) controls to the lower layers to carry out C2 commands[1].

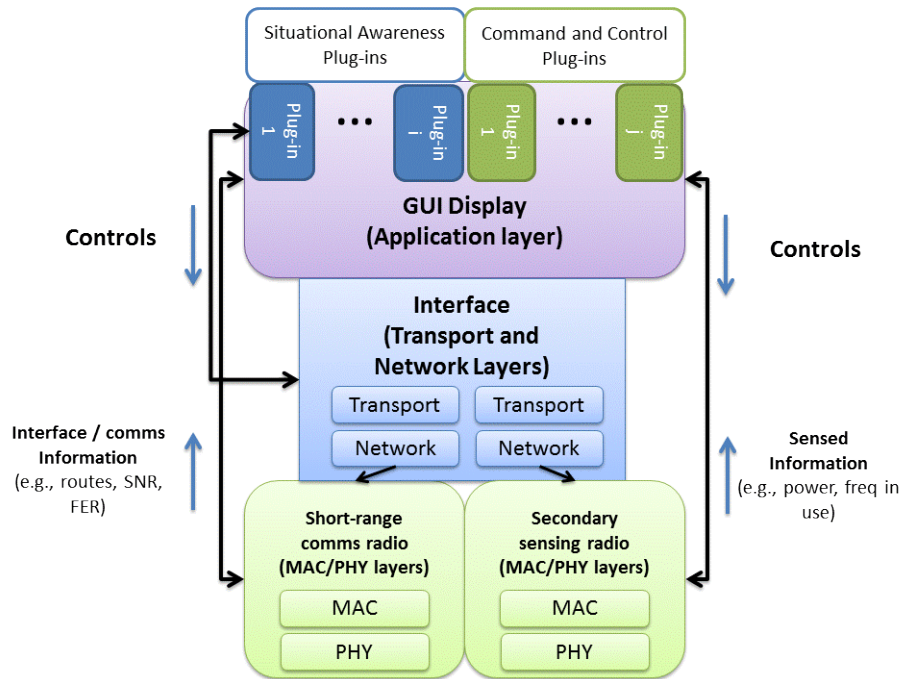Figure 1: TEC3 radio interfaces with a GUI display. The plug-ins in the display can be used to control the communication radio and secondary sensing radio, with both radios providing feedback to the display.

---

[1] Whether the network and transport layers are provided by the radio devices or the GUI display is an implementation decision; the Figure is for architectural purposes only and does not reflect hardware implementation.

2.1   TEC3 devices

The form-factor and capabilities of TEC3 devices differ depending upon the role of the user. We specify three TEC3 form-factors: a basic node, a commander node and an analyst node. Users of basic nodes will generally be dismounted units with a need for minimal network SA and C2 capability; commander node users may or may not be dismounted and will require enhanced network SA and some C2 capability; analyst node users will be non-mobile and will require complete network SA and C2 capabilities. Note that for the TEC3 demonstrator all nodes are equipped with short-range communication radios to minimize cost/complexity.

This section describes the three types of TEC3 devices, all of which have as a foundation the same general architecture as the basic device shown in Figure 1.

DEVICE.1   TEC3 must support three models of TEC3 device: 1) a "basic node", 2) a "commander node", and 3) an "analyst node"; each device model is used by a particular type of TEC3 user—respectively a "basic node" operator, a "commander node" operator, and an "analyst node" operator.

DEVICE.2   Every TEC3 node must have a unique ID (hereafter referred to as a "TEC3 UID").

DEVICE.3   The TEC3 "basic node" must consist of a GUI display, a short-range communication radio (where short-range radio specifications are provided in Section 3), and a sensing radio (where the sensing radio is required to provide the functionality discussed in Section 5.8) as depicted in Figure 1.

DEVICE.4   The TEC3 "basic node" must be designed to be carried and operated by a dismounted soldier; this could include wrist- or chest-mounted configurations.

DEVICE.5   The TEC3 "basic node" GUI display component must consist of a programmable touch-screen display device; one option is to utilize a tablet or smartphone that uses the Android operating system.

DEVICE.6   The TEC3 "basic node" GUI display component should have an output screen measuring no smaller than 4 inches and no larger than 6 inches.

DEVICE.7   The TEC3 "commander node" must consist of a GUI display, a short-range communication radio (where short-range radio specifications are provided in Section 3) and a sensing radio.

DEVICE.8   The TEC3 "commander node" should be designed to be carried and operated by a dismounted soldier.

DEVICE.9   The TEC3 "commander node" GUI display component should consist of a programmable touch-screen display device; one option is to utilize a tablet that uses the Android operating system.

DEVICE.10   The TEC3 "commander node" GUI display component should have an output screen measuring no smaller than 8 inches.

DEVICE.11   The TEC3 "analyst node" must consist of a GUI display and a short-range communication radio (where short-range radio specifications are provided in Section 3).

DEVICE.12   The TEC3 "analyst node" should be designed to be operated by an analyst in a fixed location.

DEVICE.13   The TEC3 "analyst node" GUI display component must consist of a laptop or desktop PC.

DEVICE.14   For all TEC3 nodes (basic, commander and analyst), the radios should be connected to the GUI display using a wired or wireless interface (if not already integral to the GUI display).

DEVICE.15   All TEC3 devices should be hardened to protect all interfaces and secure all communications in accordance with industry best practices in addition to any security requirements specified herein.

DEVICE.16   All TEC3 devices must have strong user authentication mechanisms to prevent unauthorized users from operating the devices; devices will require users to perform strong user authentication upon power up and wake up.

DEVICE.17   All TEC3 devices should be capable of operating without degradation in the full range of temperatures between 10 and 30 degrees Celsius.

DEVICE.18   All TEC3 devices must have sufficient battery power to support continuous operation for at least 4 hours.

DEVICE.19   All TEC3 devices must be capable of fully re-charging (from empty) within 10 hours.

2.2   Modularity of design

TEC3 embraces a design philosophy of modularity. Users need to be able to add or remove functionality and components tailored to the mission at hand. In addition, developing new functionality for TEC3 must be as simple as developing a plug-in or new app for the GUI display component using well-documented APIs and SDKs.

MOD.1   TEC3 software developed for the GUI display component must support a modular 'plug and play' architecture in which new functionality and plug-ins can be added without disrupting existing features and functionality.

MOD.2   TEC3 network SA and network C2 features (i.e., features described in Sections 5 and 6) should be implemented in a modular fashion such that they can be individually disabled without affecting the functionality of the remaining TEC3 features.

MOD.3   TEC3 should utilize open non-proprietary interfaces between the components comprising every TEC3 device (i.e., open interfaces between the radio components and the display component).

MOD.4   TEC3 must support extensibility and the addition of new functionality through the inclusion of well-documented and non-proprietary application programming interfaces (APIs) and software development kits (SDKs).

2.3   Configuration and management

The TEC3 system must be readily configurable for each deployment. The configuration may include, but is not limited to: networking, security, sensing and GUI parameters.

CONFIG.1   Prior to "mission deployment", all devices in the TEC3 system must be configurable from a centralized location through a GUI configuration tool running on a TEC3 "analyst node"; the configuration may be accomplished through wired or wireless interfaces (proposals must specify which type of interface—wired or wireless—the system will support for performing configuration).

CONFIG.2   The TEC3 configuration tool must support bulk-configuration (i.e., each device will not need to be configured individually).

CONFIG.3   Notwithstanding CONFIG.2, TEC3 must allow for the configuration of individual devices in addition to bulk-configuration.

CONFIG.4   Prior to "mission deployment", configuration options for TEC3 devices must include (but are not limited to) the following: periodicity of data dissemination (for parameters listed in Table 3 of Section 7); routing and message delivery options; utilized icons; available mapping imagery (i.e., all maps required for the "mission" will be pre-loaded); encryption and key management parameters; and any other configurable parameters explicitly specified elsewhere in this document.

CONFIG.5   Post "mission deployment", TEC3 devices must be configurable 'on-the-fly' during the "mission" by "commander node" and "analyst node" users; on-the-fly configuration options may be more limited than pre-"mission deployment" options specified in CONFIG.4.

3   Communications and networking

3.1   Networking requirements

The fundamental communication network in TEC3 is envisioned to be a so-called "local group". Nodes in a "local group" will operate as a mobile ad hoc network (MANET), where any node in the "local group" can serve as a relay to enable multi-hop communication to other nodes in the "local group" as a form of range extension. Due to the known scalability concerns associated with MANETs, "local groups" in TEC3 will be required to be no larger than 20 nodes (approximately the size of two Light Infantry sections in the Canadian Armed Forces). Each "local group" will consist of one "commander node" and several "basic nodes". It is envisioned that most communication within a TEC3 "local group" will be broadcast-based: situational awareness, all-informed voice, and sharing of imagery (or other data). However, there will also be a requirement for unicast communication between nodes in a "local group", especially between a "commander node" and individual "basic nodes" in the group.

Communication between "local groups" will be facilitated by "gateways". A node is considered a "gateway" when its "gateway" functionality is enabled, either through automated or manual means. A "gateway" will need to aggregate information from one "local group" and pass it to a "gateway" in a second "local group", as depicted in Figure 2. "Gateways" will also allow a "local group" to connect to an "analyst node" (if the "analyst node" is not already a part of the "local group"). In a practical deployment, "gateway" nodes would likely be equipped with longer-range communication radios (e.g., the "commander nodes" could serve as the "gateway" nodes) to enable reach-back and communication to distant networks, but this is beyond the scope of the TEC3 demonstrator.
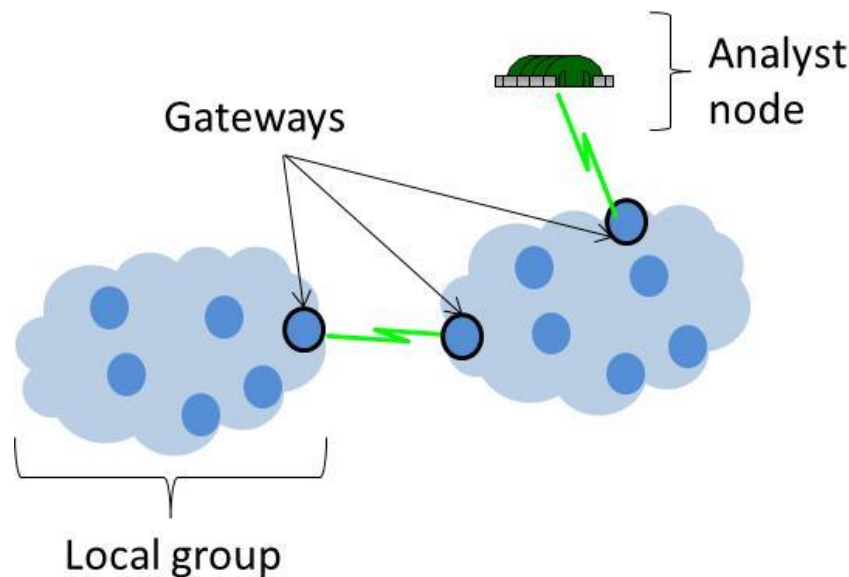

Figure 2: Conceptual network architecture for a TEC3 system operating with two "local groups" and one "analyst node".

NETWORK.1 TEC3 must use Internet Protocol (IP) addressing (specifically IPv4) and support IP networking among nodes.

NETWORK.2 TEC3 must support mobile ad hoc network communication among nodes in "local groups" as defined below.

NETWORK.3 Nodes in a TEC3 "local group" must operate as a mobile ad hoc network (MANET), where every TEC3 node can serve as a potential relay to forward information to other nodes in the "local group".

NETWORK.4 The TEC3 "local group" network must be robust against errors or anomalies generated by the interruption of network connectivity due to node mobility.

NETWORK.5 Every TEC3 "local group" must have a unique group ID (hereafter referred to as a "group UID").

NETWORK.6 TEC3 must employ MANET routing protocols to achieve broadcast and unicast communication among members of a "local group".

NETWORK.7 TEC3 must support networks in which "basic nodes" and "commander nodes" are mobile, and where these nodes may travel at speeds up to at least 5 m/s.

NETWORK.8 Upon "mission deployment", default TEC3 "local groups" must comprise 8 nodes, consisting of 7 "basic nodes" and 1 "commander node".

NETWORK.9 Notwithstanding NETWORK.8, TEC3 should support "local groups" as small as 2 nodes and as large as at least 20 nodes.

NETWORK.10 TEC3 must support multi-relay range extension within a "local group" up to a minimum of 3 hops (i.e., 2 relays).

NETWORK.11 Every TEC3 "local group" must contain exactly one "commander node".

NETWORK.12 Nodes in different TEC3 "local groups" should be able to communicate through "gateways" in the "local groups" (assuming the "gateways" are within communication range of each other, as per Figure 2).

NETWORK.13 In the event that a subset of TEC3 nodes from a "local group" becomes disconnected from the "commander node", nodes within the disconnected subset must continue to communicate with one another.

NETWORK.14 If a disconnected subset of TEC3 "basic nodes" comes within range of another "local group", the disconnected subset should join the new "local group" until such time as it returns within range of its original "commander node".

NETWORK.15 If a TEC3 "basic node" joins another "local group" as per NETWORK.14, the "basic node" should adopt the "local group key" of the "local group" as specified in ENCRYPT.26, ENCRYPT.27, and ENCRYPT.28.

NETWORK.16   If a "local group" exceeds the size limits established in NETWORK.9, additional disconnected subsets attempting to join (as per NETWORK.14) should be blocked from joining the "local group" and should instead communicate to the "local group" through "gateways".

NETWORK.17   Nodes in a TEC3 "local group" must communicate with non-mobile "analyst nodes". This could be performed through a "gateway" in the "local group" (assuming the "gateway" is within communication range of the "analyst node" and the "analyst node" is not already part of the "local group", as per Figure 2).

NETWORK.18   Upon "mission deployment", all "local groups" should contain a minimum of 2 TEC3 nodes capable of functioning as "gateways"[2].

NETWORK.19   All TEC3 nodes should be capable of functioning as "gateways".

NETWORK.20   TEC3 "gateways" should be selected in an automated fashion.

NETWORK.21   Notwithstanding NETWORK.20, TEC3 should provide a mechanism to manually assign a node as a "gateway" and override automated decisions.

NETWORK.22   A TEC3 node functioning as a "gateway" should aggregate data from one "local group" to share it with an "analyst node" or with another "local group".

3.2   Data services

DATASERV.1   <deleted>

DATASERV.2   TEC3 must provide all-informed digitized voice communication among all nodes in a "local group".

DATASERV.3   TEC3 should provide unicast voice communication between the "commander node" and any commander-selected node in a "local group".

DATASERV.4   TEC3 must provide general service broadcast data to all nodes in a "local group".

DATASERV.5   TEC3 must provide general service unicast data between the "commander node" and any commander-selected node in a "local group".

DATASERV.6   TEC3 should provide general service unicast data between any two nodes in a "local group".

DATASERV.7   <deleted>

---

[2] Note that for a node to function as a "gateway" it may require an additional communication radio—one radio for communications within the "local group" and a separate radio for communications outside the "local group". Although means may exist to provide "gateway" functionality with a single communication radio, this is not required by this functional specification. To reduce the complexity of implementation, NETWORK.18 specifies a mandatory requirement of only two "gateways" per "local group".

DATASERV.8   TEC3 should provide all-informed voice communication among all nodes in a configuration with up to two "local groups" and one analyst connected by "gateways" (per configuration in Figure 2).

DATASERV.9   TEC3 should provide general service broadcast data to all nodes in a configuration with up to two "local groups" and one analyst connected by "gateways" (per configuration in Figure 2).

DATASERV.10   TEC3 should provide unicast data services between any two nodes in a configuration with up to two "local groups" and one analyst connected by "gateways" (per configuration in Figure 2).

3.3   Communications requirements

TEC3 will make use of short-range communication radios. It is anticipated that short-range communication will have a higher throughput than traditional long-range VHF military communication, operating at higher frequencies and over shorter distances.

COMM.1   TEC3 must support short-range local area radio communication as defined in COMM.4.

COMM.2   TEC3 nodes utilizing short-range communication radios must support the concurrent delivery to all nodes within the "local group" (as defined in Section 3.1) of the following data services:

    a.   broadcast of periodic situational awareness data where all nodes must be able to exchange a minimum of 1 kbyte of application-layer data to every other node at intervals of no less than once every 5 seconds[3];

    b.   general purpose broadcast data where a single node must be able to successfully deliver 1 Mbyte of application-layer data to all other nodes in no less than 20 seconds[4];

    c.   general purpose unicast data between a minimum of one pair of nodes in the "local group" where one node must be able to exchange 1 Mbyte of data with the other in no less than 20 seconds (where this pair may consist of the "commander node" and one other node);

    d.   all-informed real-time digitized voice where all nodes must receive a voice signal sent by a single node in the "local group"; and

    e.   real-time unicast (digitized) voice between a minimum of one pair of nodes in the "local group" (where this pair may consist of the "commander node" and one other node).

---

[3] Note that periodic situational awareness data includes elements such as those discussed in Sections 5.2, 5.3, 5.4, 5.6, and 5.7.

[4] Note that general purpose broadcast data includes elements such as the non-real-time user communication services text chat and pushpins (as discussed in Sections 5.1.2 and 5.1.3), and direct commander C2 instructions and responses (as discussed in Sections 5.8, 5.9 and section 6).

COMM.3   The TEC3 short-range communication services specified in COMM.2 must operate without degradation at the rates specified regardless of the topology of the "local group" within the topology limits specified in Section 3.1 (i.e., for a "local group" containing up to 8 nodes that achieves range extension using two consecutive relays).

COMM.4   TEC3 short-range radio communication must support point-to-point 'one hop' communication between nodes at distances up to at least 150 meters (where range extension beyond one hop is provided in the "local group" by means of multi-hop relay communication as specified in Section 3.1).

COMM.5   TEC3 short-range radio communication must utilize the industrial, scientific and medical (ISM) radio bands, operating in one or more of the following radio frequency ranges: 2.4 GHz to 2.5 GHz; or 902 MHz to 928 MHz. The power levels of emissions for the short-range communications radio must be such that the TEC3 devices can be operated in Canada in the ISM bands without a license.

COMM.6   TEC3 "gateways" connecting "local groups" should support the exchange between "gateways" of the following data services:

       a.   <deleted>

       b.   aggregated situational awareness data consisting of no fewer than 5 kbytes every 5 seconds unicast between two "gateways"; and

       c.   general purpose unicast data between two "gateways" where one "gateway" should be able to exchange 1 Mbyte of data with the other in no less than 20 seconds.

COMM.7   A TEC3 "gateway" connecting a "local group" and an "analyst node" should support the following data services:

       a.   real-time unicast (digitized) voice between the "gateway" and "analyst node";

       b.   aggregated situational awareness data consisting of no fewer than 5 kbytes every 5 seconds unicast between the "gateway" and "analyst node"; and

       c.   general purpose unicast data between the "gateway" and "analyst node" where one node should be able to exchange 1 Mbyte of data with the other in no less than 20 seconds.

4 Encryption and key management

TEC3 will encrypt all communications to ensure message confidentiality and will use cryptographic signatures to ensure message integrity. The encryption and key management strategy will use both symmetric and asymmetric encryption. TEC3 will make use of a trusted certificate authority and four types of encryption keys as discussed below; exact usage is specified in the requirements following this introduction:

- **Certificate Authority (CA)**: A public key infrastructure (PKI) certificate authority will provide signed public key certificates for all TEC3 users. The certificate authority serves as the ultimate root of trust in TEC3. Note that for the purposes of TEC3, a single entity that can create and sign certificates (and self-sign its own certificate) is sufficient to serve as a root of trust.

- **Public/Private Key pairs**: These are generated and issued by the certificate authority. All nodes in TEC3 will have unique public/private key pairs to support device authentication, digital signature, and establishment of group and session keys. Public/private key pairs will be pre-loaded into each TEC3 device prior to "mission deployment" and will remain constant for (at least) the duration of the "mission". Prior to "mission deployment", all nodes will also be provided with an updated certificate revocation list (CRL) and with the public keys of all the members of relevant "local groups".

- **Mission Key**: All nodes on a common "mission" will have a shared symmetric "mission key" to support initial communication prior to establishing "local group keys".

- **Group Keys**: Most multicast and broadcast network communication in TEC3 will take place using symmetric group keys. We consider two main types of group keys: "local group keys" and community-of-interest (COI) group keys. "Local group keys" will be established in each "local group" dynamically at the beginning of a "mission" and refreshed/updated periodically during the "mission" using over-the-air rekeying. "COI group keys" will be established during the creation of a COI (as specified in Section 6.4).

- **Session Keys**: These are used for unicast communication; "session keys" are generated at the beginning of a unicast communication session and expire at the end of the session.

4.1 Pre-shared keys – creation and storage

ENCRYPT.1   Prior to "mission deployment", every TEC3 node must securely store public/private encryption key information and certificate information as per the guidance specified in Table 1 and Table 2.

ENCRYPT.2   Prior to "mission deployment", every TEC3 node must securely store a symmetric pre-shared key called the "mission key" as per the guidance specified in Table 1.

ENCRYPT.3   TEC3 must include a mechanism to perform bulk-configuration of encryption material in nodes prior to "mission deployment", as per CONFIG.2.

ENCRYPT.4   Public/private encryption key pairs should be created by the TEC3 certificate authority; public key certificates should be signed by the TEC3 certificate authority.

Key	Purpose
Symmetric "mission key"	Entry point into the network; basic encryption on startup
Public keys of all nodes in the "local group"	Device authentication, message non-repudiation, and establishment of group and session keys
Public key of self, public key certificate signed by CA	
Private key of self	
Public key of "analyst node"	Device authentication, message non-repudiation, and establishment of group and session keys

Table 1: Keys and certificates required by all nodes prior to "mission deployment".

Key	Purpose
All public keys for all TEC3 nodes in the network (for the demonstrator, this will not be an onerous number of keys).	Device authentication, message non-repudiation, and establishment of group and session keys

Table 2: Keys required by "analyst nodes" prior to "mission deployment" (in addition to keys in Table 1).

4.2   Group and session keys – creation and storage

ENCRYPT.5   All "analyst nodes" must be capable of generating "local group keys".

ENCRYPT.6   All "commander nodes" must be capable of generating "local group keys".

ENCRYPT.7   Every TEC3 "basic node" and "commander node" must securely store the current "local group key" in use by its TEC3 "local group" and the past 5 "local group keys" used by the "local group" (if these keys exist); keys older than this will be deemed "expired".

ENCRYPT.8   Every TEC3 "analyst node" must securely store the current "local group keys" in use by all TEC3 "local groups" with which the "analyst node" communicates and all previous "local group keys".

ENCRYPT.9   All keys must each be associated with a unique identifier (henceforth referred to as a "key ID") such that TEC3 nodes can indicate which key or group key has been used to encrypt data (e.g., a node can indicate that an element of "encrypted data" is encrypted using group key 'A').

ENCRYPT.10   TEC3 nodes should delete "local group keys" once they have "expired" (based on the expiration criteria in ENCRYPT.7).

ENCRYPT.11   All TEC3 nodes should be capable of generating and storing symmetric "session keys"; TEC3 nodes should delete "session keys" that are no longer in use.

4.3   Use of encryption keys

ENCRYPT.12   When TEC3 nodes transmit wireless data packets, all information (including applicable packet headers) must be encrypted as follows:

    a.   All information at or above the transport layer of the network protocol stack must be encrypted; these packets are henceforth referred to as "encrypted packets".

    b.   All information at or above the IP layer of the network protocol stack should be encrypted; these packets are henceforth referred to as "encrypted packets".

ENCRYPT.13   An "encrypted packet" must be comprised of at least two parts: the "mission header" and the "encrypted data".

ENCRYPT.14   The "mission header" must have a predictable structure and must be encrypted using "mission key" symmetric encryption.

ENCRYPT.15   In the event that a node becomes disconnected (e.g., see ENCRYPT.27, ENCRYPT.28) and is not in possession of the current "local group key", the node must be able to detect that it is not in possession of the current "local group key" and must subsequently request a new key from the "commander node" when it comes back in range of the network. Note that one possible method to achieve this functionality is for the "mission header" to include sufficient information for a node in possession of only the "mission key" to detect a nearby "local group" and then request the key from the "commander node" using the "mission key"—for instance, the "mission header" could include the "TEC3 UID" (as defined in DEVICE.2) and the "Group UID" (as defined in NETWORK.5).

ENCRYPT.16   The "mission header" should not include any network-layer information (e.g., IP addresses or routing information); this information may be included only in the "encrypted data".

ENCRYPT.17   The "mission header" should contain information on the "encrypted data" structure; this information is included to aid in the decryption of the "encrypted data".

ENCRYPT.18   When a TEC3 node is sending "encrypted data" intended for broadcast, the node must encrypt the data using a valid (non-"expired") "local group key"; if no valid "local group

key" is available (e.g., during start-up), the node must encrypt the data using the "mission key".

ENCRYPT.19   ~~When a TEC3 node is sending "encrypted data" intended for unicast, routing information must be encrypted using either "local group key" or "mission key" symmetric encryption.~~

ENCRYPT.20   When any "encrypted packet" contains key management information, the "encrypted data" must include a digital signature (i.e., must be signed by the originating authority using PKI) to ensure the authenticity of the message.

ENCRYPT.21   If any node receives digitally signed data with an invalid digital signature, the node must raise an alarm to the operator.

4.4   Key management operations and transactions

ENCRYPT.22   In any TEC3 "local group", the "commander node" must generate and disseminate the "local group keys" to all members of the "local group".

ENCRYPT.23   Dissemination of the "local group key" to members of the "local group" must be performed over-the-air using unicast transmission; the "local group key" must be encrypted specifically for each recipient node using asymmetric encryption.

ENCRYPT.24   The TEC3 "commander node" must automatically refresh the "local group key" in accordance with a pre-configured refresh rate; refreshing the key consists of generating and disseminating a new "local group key" to the members of the "local group" in accordance with ENCRYPT.23.

ENCRYPT.25   When "local group keys" are refreshed, TEC3 must ensure that data in transit is not lost (due to key mismatches) while the keys are cycled[5].

ENCRYPT.26   By observing transmissions of other TEC3 nodes in its "local group", a TEC3 node must be able to detect when it is not in possession of the current "local group key".

ENCRYPT.27   A TEC3 node not in possession of the current "local group key" must request the key from the "commander node" of the "local group".

ENCRYPT.28   A TEC3 node not currently connected to its "local group" must be able to detect and join a new "local group" as per NETWORK.14.

ENCRYPT.29   TEC3 nodes functioning as "gateway" nodes between two "local groups" (or between a "local group" and an "analyst node") should create and share a "session key" for the exchange of information between the two "local groups" (or between the "local group" and the "analyst node").

---

[5] Note that one possibility is to disseminate new "local group keys" and use the previous "local group key" for a brief duration before switching keys to ensure that all members of the "local group" have the new key.

ENCRYPT.30   The TEC3 "commander node" must provide an updated "local group key" to TEC3 nodes requesting the key (per ENCRYPT.27, ENCRYPT.28) except in the case where the TEC3 node requesting the key has been "revoked" from the network and appears on the certificate revocation list (CRL) per Section 6.3.

4.5   Encryption algorithms

ENCRYPT.31   Public/private encryption should use RSA encryption algorithms with key lengths of at least 1024 bits.

ENCRYPT.32   "Mission key" encryption should use AES encryption algorithms with key lengths of at least 128 bits.

ENCRYPT.33   "Local group key" and "COI group key" encryption should use AES encryption algorithms with key lengths of at least 256 bits.

ENCRYPT.34   "Session key" encryption should use AES encryption algorithms with key lengths of at least 256 bits.

ENCRYPT.35   For all ciphers, the choice of initialization vector and mode of operation must be in accordance with well-documented industry best practices.

5   Network situational awareness features

5.1   User communication services

As discussed in Section 3, TEC3 will provide basic communication services to users in and across "local groups", including voice and data services in both broadcast and unicast modes. This section refines the requirements for these services including the required user interfaces.

5.1.1   Voice services

UCS.1   All TEC3 users must be able to transmit broadcast voice using a simple push-to-talk interface, where additional broadcast voice service requirements are described in Sections 3.2 and 3.3.

UCS.2   The push-to-talk interface (in UCS.1) must be accessible using one of the following options: from an external mechanical button connected to the TEC3 device or from a software button on the TEC3 "home screen" GUI.

UCS.3   All "basic nodes" in a TEC3 "local group" must be able to transmit unicast voice to the "commander node" using a simple interface accessible from the "home screen" GUI, where additional unicast voice service requirements are described in Sections 3.2 and 3.3.

UCS.4   All "commander nodes" must be able to transmit unicast voice to any "basic node" in their "local group" and to the "analyst node" using a simple interface accessible from the "home screen" GUI (from which the "commander node" user can select the recipient node).

5.1.2   Text chat services

UCS.5   All TEC3 devices must have a service to send simple broadcast text messages (a text chat service).

UCS.6   The text chat service must support text messages up to at least 160 characters in length.

UCS.7   The text messages from the text chat service must be efficiently disseminated to other TEC3 devices within the ranges specified in Section 3.3 and in accordance with the dissemination requirements specified in Section 7.

UCS.8   The text chat service must be accessible from the TEC3 "home screen" GUI.

UCS.9   The text chat service must provide an indicator on the TEC3 "home screen" GUI indicating when new messages have arrived.

5.1.3 Pushpin services

UCS.10   TEC3 must provide a service for all users to add geographically-positioned markers (or TEC3 pushpins) to the blue force tracking TEC3 "home screen" (this service is known as the TEC3 pushpin service).

UCS.11   The TEC3 pushpin service must allow users to associate/attach data elements to the pushpins upon pushpin creation.

UCS.12   The TEC3 pushpin service must provide the ability for users to associate/attach the following data elements to a TEC3 pushpin:

         a.   (must provide) Text;

         b.   (must provide) Image/picture captured using the camera on the TEC3 device during pushpin creation;

         c.   (should provide) Audio captured using the microphone on the TEC3 device during pushpin creation; and/or

         d.   (should provide) File stored on the TEC3 device created prior to pushpin creation.

UCS.13   TEC3 pushpins must be efficiently disseminated to other TEC3 devices within the ranges specified in Section 3.3 and in accordance with the dissemination requirements specified in Section 7.

UCS.14   Upon receiving a TEC3 pushpin, a TEC3 device must add the geographically positioned marker to the TEC3 "home screen" in the appropriate location.

UCS.15   TEC3 users must be able to access/view the data elements attached to pushpins from the TEC3 "home screen".

UCS.16   TEC3 users must be able to edit and/or delete the data in TEC3 pushpins.

UCS.17   Any changes made to TEC3 pushpins by any user must be efficiently disseminated to other TEC3 devices within the ranges specified in Section 3.3 and in accordance with the dissemination requirements specified in Section 7.

UCS.18   Updated or edited pushpins must indicate the time that the update was performed and the ID of the user who performed the update.

UCS.19   TEC3 users must be able to delete pushpins; the delete function must support deletion of individual pushpins and bulk deletion of all pushpins.

5.2   Blue force tracking with GPS

TEC3 will provide geographical friendly-force situational awareness relevant to the "mission", indicating the user's current location and the location of nearby TEC3 users. Geographical situational awareness is important for wayfinding, navigation, and understanding one's position in relation to other allied forces.

Each TEC3 device will contain embedded Global Positioning System (GPS) receiver hardware, whereby TEC3 nodes in the network obtain their own geographical position using their onboard GPS. Nodes share their updated position with other members of the network to provide near real-time blue force tracking and situational awareness.

BFT_GPS.1   Every TEC3 device must contain a Global Positioning System (GPS) receiver.

BFT_GPS.2   Every TEC3 device must obtain its geographic position and the correct time of day (coarse synchronization) using its GPS receiver when a GPS signal is available.

BFT_GPS.3   Every TEC3 device must update its position on the GUI display when updated GPS information is available.

BFT_GPS.4   Every TEC3 device must disseminate the following information at intervals defined by BFT_GPS.6: Current position (or last known position if current position unavailable); estimated position error; timestamp associated with position; and 'Measurement type', indicating how the device obtained the position (e.g., from GPS, from user input, etc.).

BFT_GPS.5   TEC3 positional information as described in BFT_GPS.4 must be efficiently disseminated to other TEC3 devices within the ranges specified in Section 3.3 and in accordance with the dissemination requirements specified in Section 7.

BFT_GPS.6   The interval for transmitting positional information as described in BFT_GPS.4 must be configurable on-the-fly (during operations) by "commander node" and "analyst node" operators such that the information will be transmitted: Periodically with a configurable time period; after a change in geographical position greater than a configurable value; or based on a hybrid approach that uses a configurable period and change in position as a trigger to send information.

BFT_GPS.7   All TEC3 nodes in a "local group" must use the same broadcast interval configuration described in BFT_GPS.6.

BFT_GPS.8   Every TEC3 device must display the positions of the TEC3 devices (for which it has known positions) on the TEC3 GUI display.

BFT_GPS.9   The TEC3 GUI must visually indicate when (previously connected) nodes have been non-communicative for longer than a configurable period of time.

5.3   Blue force tracking without GPS

Each mobile TEC3 device has an embedded GPS receiver. Under some circumstances (e.g., under cover, indoors, in the presence of electromagnetic interference or GPS jamming) the GPS signal may not be available to all members of a "local group". This GPS-denied blue force tracking feature will automatically

initiate when some nodes have GPS information and some do not. This function will allow the nodes without GPS to obtain an estimate of their current location based using techniques such as dead reckoning, inertial motion sensors, and the knowledge of other friendly nodes' locations.

The primary application for this feature is to maintain geographical situational awareness of friendly forces in the absence of GPS information.

BFT_NOGPS.1   Every TEC3 device must detect when it fails to receive a GPS signal.

BFT_NOGPS.2   When a GPS signal is unavailable, a TEC3 device should compute estimates of its position; bids must contain a description of the proposed estimation techniques and their expected efficacy. Possible estimation techniques may include a combination of the following: Use of outputs from on-board or connected inertial motion sensors; dead reckoning; or knowledge of other TEC3 nodes' locations and observed signals obtained from the secondary sensing radio (see DEVICE.3).

BFT_NOGPS.3   TEC3 devices must allow users to override their own current estimated positions (e.g., based on a user's knowledge of landmarks or other visual indicators); the chosen override position must expire after a configurable time duration.

BFT_NOGPS.4   When GPS data is not available, TEC3 devices must broadcast and exchange estimated positional information (or the most recent GPS co-ordinates available) in the same manner as specified in section 5.2 for GPS positional information.

BFT_NOGPS.5   All data dissemination configurations for estimated positional information must be inherited from the GPS data dissemination configurations.

BFT_NOGPS.6   TEC3 devices should compute an error estimate associated with the estimated position.

BFT_NOGPS.7   TEC3 devices must distinguish on the GUI which nodes' GPS signals are unavailable.

5.4   Blue force status updates

In addition to blue force position information, TEC3 nodes will exchange status information. This includes static administrative information such as the user's name and node type, along with dynamic information such as remaining battery power.

STATUS.1   All TEC3 nodes must exchange information and updates regarding their status and capabilities to other TEC3 devices within the ranges specified in Section 3.3 and in accordance with the dissemination requirements specified in Section 7.

STATUS.2   Further to STATUS.1, TEC3 nodes must automatically exchange static information regarding capabilities and status including information such as[6]: User name (e.g., Private Bloggins); Node type (e.g., "commander node", "analyst node" or "basic

---

[6] Note that the information in this requirement is static in that it is not expected to change very often (or ever) during a "mission". As such, it is not necessary for nodes to repeatedly send out this information—likely at the beginning of the "mission", as required as new nodes join, and when solicited by a "commander node" or "analyst node".

node"); Platform (e.g., LAV, dismounted soldier, UAV, etc.); and Role/capabilities (e.g., sniper, sensor, etc.).

STATUS.3   Further to STATUS.1, TEC3 nodes must automatically exchange dynamic information regarding node status including information such as: Power level (i.e., remaining battery power in TEC3 device).

STATUS.4   All TEC3 users must be able to view the status information of any other TEC3 node displayed on their TEC3 GUI.

STATUS.5   "Commander node" operators and "analyst node" operators must be able to view aggregate status information of a "local group" or a selected group of TEC3 nodes.

5.5 Direction of travel

TEC3 devices will be able to calculate and display the direction of travel of selected nodes in the network; users will be able to toggle the directionality display on or off. If multiple nodes are selected as a group, the display will indicate the aggregate average direction of the group.

This feature allows users to monitor the direction of travel of any node or selected group of interest to confirm that selected troops are progressing towards intended destinations or to coordinate rendezvous.

DIRECTION.1   Every TEC3 device must locally compute the direction of travel of any other selected node (or group of nodes) based on received current and historical location data of the selected node(s).

DIRECTION.2   The amount of historical location data to be used in computing the direction of travel must be configurable (before "mission deployment").

DIRECTION.3   To compute the aggregate direction of travel of a group of nodes, TEC3 must compute a vector sum of the directions of travel of each of the individual nodes in the group.

DIRECTION.4   The direction of movement information must be displayed as a map overlay on the TEC3 GUI, where the overlay can be toggled on or off by the user.

5.6 Link and route quality

All TEC3 users will be able to toggle overlays on or off that graphically display the connection quality of all the existing links among nodes in a "local group" or other area of interest. The display can be configured to show link-level connection quality (i.e., for point-to-point links between neighbouring nodes) or end-to-end connection quality (i.e., for an end-to-end route traversing multiple relays).

Link-level connection quality overlays could be used to assist users in determining how best to navigate and/or manoeuver to improve network connectivity between immediate neighbours.

Route-level connection quality overlays could be used to allow users to rapidly assess the type of connection / communication fidelity they should expect from another (non-neighbouring) node in the network.

LR_QUAL.1   Every TEC3 device must continuously compute link-level connection quality metrics to characterize the quality of the link between the TEC3 device and all neighbouring TEC3 devices.

LR_QUAL.2   The link-level connection quality metric between two neighbouring TEC3 devices must be computed individually by each node based on locally observed information and calculated over a sliding window; information including (but not limited to) the following may be used in the quality metric computation: Signal to interference noise ratio (SINR) for the link; Frame error rate (FER) for data traversing the link; and Link delay.

LR_QUAL.3   Whenever possible, the computation of link-level connection quality metrics must be based on the observation of existing traffic and physical layer emissions in the network (e.g., by examining periodic situational awareness messaging) without resorting to the transmission of additional probe signals.

LR_QUAL.4   TEC3 nodes must disseminate link-level connection quality information to other TEC3 devices within the ranges specified in Section 3.3   and in accordance with the dissemination requirements specified in Section 7.

LR_QUAL.5   Every TEC3 device must compute end-to-end route-level connection quality metrics to characterize the quality of the end-to-end route between the TEC3 device and all other TEC3 devices for which link-level connection data is available.

LR_QUAL.6   The end-to-end route-level connection quality metric between any two TEC3 devices should be computed based on the individual link-level connection quality metrics comprising the route between the two devices.

LR_QUAL.7   The link-level connection quality information and end-to-end route-level connection quality information must be graphically displayed as map overlays on the TEC3 GUI, where the overlays can be toggled on or off by the user.

LR_QUAL.8   When the link-level connection quality overlay is selected, the TEC3 display must display link-level connection quality between all one-hop neighbour nodes for which the user has link-level information (obtained through the disseminations specified in LR_QUAL.4).

LR_QUAL.9   When the end-to-end route-level connection quality overlay is selected, the TEC3 display must display the end-to-end connection quality between the user's node and the other nodes for which the user has link-level information (obtained through the disseminations specified in LR_QUAL.4).

LR_QUAL.10   The visual representation of the link-level connection quality information must be expressed in an informative and user-friendly manner (e.g., lines of different colours or widths between neighbouring nodes representing differing connection qualities).

LR_QUAL.11   The visual representation of the end-to-end route-level connection quality information must be expressed in an informative and user-friendly manner that can co-exist with the representation in LR_QUAL.10 (e.g., signal strength bars above each node to denote end-to-end connectivity).

LR_QUAL.12   TEC3 "analyst nodes" should be able to access more detailed information about displayed link-level or end-to-end route-level connection quality through their TEC3 GUI.

5.7   Node-level trust

Commanders and analysts will have the ability to toggle overlays on or off that display a computed level of trust associated with the other nodes in the network. Trust in other nodes can be computed based on a number of factors including strong and/or continuous authentication, proximity to known enemies, and expected versus actual behaviour. This feature is intended to assist commanders and analysts in answering the question, 'Who in the network can I trust and which nodes may have been compromised?' Based on the computed level of trust assigned to each node in the network, the commander or analyst can make network- and security-related C2 decisions.

TRUST.1   TEC3 "commander nodes" must continuously compute a numerical "trust value" for each TEC3 node in their "local group"; the "trust value" of a node is intended to represent the TEC3 system's degree of confidence that the node has not been captured or otherwise compromised (where a larger value indicates that the node is more trusted).

TRUST.2   The "trust value" of each node in the "local group" must be computed by the "commander node" based on a combination of some of the following information and calculated over a sliding window:

    a.   (computation must include) The results of continuous authentication checks performed by the node, as per TRUST.6;

    b.   (computation must include) The results of the node's most recent strong user authentication check, as per DEVICE.16;

    c.   (computation should include) The node's leave/join history (i.e., the frequency with which the node is not connected to the MANET and the duration of its disconnection intervals – this could be derived from information produced for requirement LR_QUAL.2);

    d.   (computation should include) The node's physical proximity to known adversaries and its physical proximity to allies (where TEC3 will have this information from features provided in Sections 5.2, 5.8, and 5.9, along with any ancillary information provided from external sources);

    e.   (computation should include) Any anomalous mobility behaviour (e.g., a node moving much faster than expected); and

    f.   (computation must include) Direct information provided by a "commander node" or "analyst node" as per TRUST.13.

TRUST.3   Every TEC3 "commander node" and "basic node" device must perform continuous user authentication to ensure continuity and proof-of-life of the authenticated user (i.e., of the user that initially authenticated to the device as per DEVICE.16).

TRUST.4   TEC3 continuous authentication must use one or more biometric techniques to ensure continuity and proof-of-life; these techniques may include elements such as electrocardiogram (ECG) monitoring (see reference [9]), heart rate monitoring (see reference [10]), or gesture profiling (see reference [11]).

TRUST.5   TEC3 continuous authentication techniques must be non-intrusive to the user.

TRUST.6   TEC3 devices in a "local group" must periodically communicate the results of continuous authentication checks to the "commander node" of the group.

TRUST.7   If a user fails a continuous authentication check, the TEC3 device must "lock" and the user will be required to re-authenticate as per DEVICE.16 to unlock the device; the user's node must also immediately notify the "commander node" of the failure.

TRUST.8   A "locked" TEC3 device must continue to send and receive all TEC3 data (i.e., generate location data, forward messages as part of the MANET, etc.), while the un-authenticated user is unable to access the device until re-authentication is complete.

TRUST.9   All trust-related local measurements (i.e., continuous authentication measurements) should take place in a secure partition of the node's operating system.

TRUST.10   The "trust values" computed by the "commander node" in TRUST.2 must be efficiently disseminated to other TEC3 devices within the ranges specified in Section 3.3 and in accordance with the dissemination requirements specified in Section 7.

TRUST.11   If the computed "trust value" of any TEC3 node in the "local group" falls below a configurable threshold, the TEC3 "commander node" must immediately raise an alarm to the "commander node" operator.

TRUST.12   The alarm raised in TRUST.11 must indicate the reason(s) why trust in the node is reduced and provide a recommended course of action (e.g., could recommend prompting the user to re-authenticate, performing an out-of-band verification, etc.).

TRUST.13   The "commander node" or the "analyst node" operator must be able to manually update a node's "trust value".

TRUST.14   "Trust value" information must be graphically displayed as a map overlay on the "commander node" and "analyst node" TEC3 GUIs, where the overlays can be toggled on or off by the users.

TRUST.15   The visual representation of the "trust value" information in the overlays from TRUST.14 must be expressed in an informative and user-friendly manner (e.g., bars below each node where the colour of the bar represents a level of trust).

TRUST.16   TEC3 must always compute and disseminate "trust values" in the manner specified herein whether or not the trust overlay is enabled.

5.8 Geolocation of non-allied emitters

"Analyst node" operators will have the ability to initiate a scan for "non-allied emitters". Upon initiation, a group of selected TEC3 nodes will use their secondary radios to tune to a frequency range specified by the analyst and will listen for "non-allied emitter" radio frequency (RF) emissions during a specified time window. The observations recorded by the sensing nodes will be shared with the analyst or with a previously agreed-upon local processing node. The processing node or analyst will use techniques and algorithms such as power of arrival (POA), power difference of arrival (PDOA) or time difference of arrival (TDOA) on the collected data to compute an estimate of the location of the non-allied node(s) and will send this estimate back to the requesting analyst. While this feature leverages the secondary radios of "basic nodes", it must not require direct input or interaction by "basic node" operators. In fact, the application must be transparent to these users and run in the background on their devices when initiated by the analyst.

GEO_THREAT.1 "Analyst node" operators must be able to issue a command to a selected group of "basic nodes" to request a "non-allied emitter" geolocation function be performed over a specified duration. Hereafter, the selected nodes will be referred to as 'sensing nodes' and the initiating "analyst node" operator will be referred to as the 'initiator'.

GEO_THREAT.2 The initiator must be able to select the sensing nodes from the TEC3 GUI.

GEO_THREAT.3 When issuing the command in GEO_THREAT.1 to the sensing nodes, the initiator must provide the range of frequencies over which to perform the "non-allied emitter" geolocation and the duration over which the sensing nodes must perform this function.

GEO_THREAT.4 Upon receiving the command from the initiator, the sensing nodes must use their secondary radio to gather data or statistics[7] on the RF emissions from "non-allied emitters" in the frequency range specified by the initiator.

GEO_THREAT.5 Statistics or data gathered by the sensing nodes must be returned to the initiator or to a locally nearby "commander node" that has been previously identified to receive and process the data or statistics. The recipient—whether it is the initiator or local "commander node"—will be hereafter referred to as the 'processing node'.

GEO_THREAT.6 The processing node should use techniques such as time difference of arrival (TDOA), power difference of arrival (PDOA), or power of arrival (POA) to analyze the statistics or data gathered by the sensing nodes in order to compute an estimate of the position(s) of "non-allied emitter(s)"[8].

GEO_THREAT.7 The processing node should return estimates of the "non-allied emitter" position(s) and estimated position error to the initiator.

GEO_THREAT.8 Estimated positions of "non-allied emitters" and estimated position error returned from the processing node should be displayed on the initiator TEC3 GUI display as a map overlay, where the overlay can be toggled on or off.

---

[7] Note that proposals must include a description of the data or statistics that will be gathered.
[8] Note that proposals should include a description of the algorithms that will be employed and how effective these are expected to be.

GEO_THREAT.9 <deleted>

GEO_THREAT.10   At a minimum, the sensing nodes must be able to gather statistics on RF emissions of "non-allied emitter" signals operating using WiFi (802.11) in radio frequency band 2.4 GHz – 2.5 GHz.

GEO_THREAT.11   The sensing nodes should be able to gather statistics on RF emissions of "non-allied emitter" signals operating using the Family Radio Service (FRS) in radio frequency band 462.5625 MHz – 467.7125 MHz.

5.9   Identification of network threats

TEC3 will include algorithms to detect targeted attacks against tactical networks and communications. Mobile ad hoc networks can be vulnerable to certain network attacks that focus on disrupting the routing, topology, communications, and/or availability of the network. Specifically, an undefended MANET can be vulnerable to wormhole attacks (see reference [12]), protocol jamming attacks (see reference [13]), and conventional jamming attacks. While encryption can be used to protect the confidentiality of data in transit and frustrate eavesdroppers, an adversary can nevertheless attack the availability and integrity of a wireless network by disrupting networking and routing protocols and introducing interference. Often a targeted network-layer attack can be difficult to detect since it may appear to the victim (and the rest of the network) that the victim has simply wandered out of communication range of its peers.

The purpose of this TEC3 feature is to perform passive network monitoring to identify anomalies or threats as well as to perform more powerful active network scans to refine the accuracy of threat detection.

NET_THREAT.1 All TEC3 devices must periodically execute algorithms to detect "wormhole" attacks[9], "protocol jamming" attacks[10], and network interference.

5.9.1   Wormhole attack detection

NET_THREAT.2 TEC3 must support both continuous/passive "wormhole" attack detection algorithms and on-demand/active "wormhole" attack detection algorithms.

NET_THREAT.3 TEC3 continuous/passive "wormhole" attack detection algorithms must run continuously on every node in the network and must use information available locally at the node[11].

NET_THREAT.4 TEC3 continuous/passive "wormhole" attack detection algorithms must be based on documented and tested techniques – such techniques may include (but are not limited to) examining routing table anomalies (see reference [14]), examining the timing of

---

[9] Note that "wormhole" attacks were originally defined in reference [12]. In this functional specification, the definition of a "wormhole" attack is broadened to include any replay, relay, or man-in-the-middle attack in which one or more adversary nodes captures and retransmits TEC3 traffic for the purposes of creating an (adversary controlled) logical linkage between two TEC3 endpoints.

[10] Note that protocol jamming attacks are defined in reference [13]. For the purposes of TEC3, this functional specification focuses on detecting protocol jammers that specifically target the primary TEC3 routing protocol.

[11] That is, the continuous/passive detection algorithms must not require the exchange of additional information between nodes beyond what TEC3 is already doing. So, for instance, an algorithm that uses information from TEC3 routing protocol messages or from blue force position messages is acceptable since it does not require additional information beyond what is already shared in TEC3.

routing control messages (see reference [15]), and/or using packet leashes (see reference [12]).

NET_THREAT.5   TEC3 continuous/passive "wormhole" attack detection algorithms should be configurable (prior to "mission deployment") such that an "analyst node" operator can adjust the trade-off between the algorithm's rate of false detection and missed detection.

NET_THREAT.6   If a TEC3 node's continuous/passive "wormhole" attack detection algorithm identifies the presence of a "wormhole" for a duration of more than 30 seconds, this should automatically trigger the TEC3 node to run its on-demand/active "wormhole" attack detection algorithm.

NET_THREAT.7   TEC3 on-demand/active "wormhole" attack detection algorithms must run only when triggered automatically as per NET_THREAT.6 or when triggered manually by an "analyst node" operator.

NET_THREAT.8   TEC3 on-demand/active "wormhole" attack detection algorithms should be based on the rapid-fire frequency probe algorithm described in reference [16].

NET_THREAT.9   If the continuous/passive and on-demand/active "wormhole" attack detection algorithms both detect a "wormhole" attack, the node that detected the "wormhole" must automatically raise an alarm to the "commander node" of the "local group" and to the "analyst node".

NET_THREAT.10   The alarm in NET_THREAT.9 must be displayed geographically as a map overlay on the TEC3 GUI, where the overlay can be toggled on or off.

5.9.2   Protocol jamming detection

NET_THREAT.11   All TEC3 nodes must periodically perform "protocol jamming" detection to detect if TEC3 routing control messages are being jammed.

NET_THREAT.12   TEC3 "protocol jamming" detection operates on the premise that an adversary may choose to specifically target only the TEC3 routing control messages (to avoid detection of a larger-scale conventional jamming attack); TEC3 "protocol jamming" detection algorithms must periodically audit the established routes in the network by checking with a secondary (alternate) routing protocol. Note that the alternate routing protocol does not need to be used to route data in the network--only for audit purposes.

NET_THREAT.13   If the results of the primary routing protocol and secondary routing protocol (from NET_THREAT.12) differ, the TEC3 node detecting the discrepancy must raise an alarm to the "commander node" of the "local group" and to the "analyst node".

NET_THREAT.14   The alarm in NET_THREAT.13 must be displayed geographically as a map overlay on the TEC3 GUI, where the overlay can be toggled on or off.

5.9.3   RF noise detection

NET_THREAT.15   All TEC3 nodes must periodically measure the RF noise level in the channel(s) in which TEC3 is communicating (this may be done using either the short-range communication radio or the secondary radio).

NET_THREAT.16   If the RF noise level measured in NET_THREAT.15 exceeds a threshold configurable by the "analyst node" operator, the TEC3 node that detected this must send an alert to the "analyst node".

NET_THREAT.17   The alerts in NET_THREAT.16 must be displayed geographically as a map overlay on the TEC3 GUI where the overlay can be toggled on or off.

6 Network Command and Control features

6.1 Policy-based routing and device management

Policy-based routing and device management provides the ability for "commander node" or "analyst node" operators to control and configure the policies that define how messaging is delivered in the network for each "local group". In TEC3, a "commander node" or "analyst node" operator will choose among the following three policy options: 1) optimize routing and device behaviour to reduce power consumption; 2) optimize routing and device behaviour to increase trust; or 3) optimize routing and device behaviour to improve throughput.

The purpose of this feature is to allow commanders and/or analysts to dynamically optimize network performance based on emerging "mission" constraints. The feature allows a TEC3 commander/analyst to effect low-level change on the network based on high-level intent.

POLICY_RDM.1   During operations (i.e., after "mission deployment"), TEC3 "commander node" and "analyst node" operators must be able to select among a set of "policy options" to optimize TEC3 routing decisions and device configurations based on "mission" constraints.

POLICY_RDM.2   TEC3 must reliably communicate the "policy option" selected in POLICY_RDM.1 to all nodes in the "local group" of the originating "commander node" or to all nodes in the set of "local groups" specified by the "analyst node".

POLICY_RDM.3   All TEC3 nodes receiving a new "policy option" must implement the new policy.

POLICY_RDM.4   TEC3 must provide a minimum of three pre-configured "policy options" from which "commander node" and "analyst node" operators can select; this minimum set of options is: 1) 'conserve power', 2) 'maximize trust', 3) 'maximize throughput' (the default option).

POLICY_RDM.5   When the "policy option" of 'conserve power' is applied to a "local group" (or set of "local groups"), TEC3 devices must perform the following:

    a.   Modify routing selection to select routes for traffic delivery through nodes with higher 'remaining battery power' while minimizing the utilization of nodes with lower 'remaining battery power'[12];

    b.   Reduce the frequency of periodic broadcasts;

    c.   <deleted>; and

    d.   Dim users' screens after a shorter timeout period.

---

[12] Note that TEC3 nodes in a "local group" will be aware of the "remaining battery power" of other nodes in the "local group" based on the information exchange discussed in section 5.4. One strategy for conserving power during broadcast communications is for nodes with lower remaining power to abstain from re-forwarding broadcast messages if other nodes (with higher power) can perform this role instead.

POLICY_RDM.6   When the "policy option" of 'maximize trust' is applied to a "local group" (or set of "local groups"), TEC3 devices must perform some of the following:

      a.   (must perform) Modify routing selection to select routes through nodes that maximize the aggregate trust in a route between two endpoints (based on node "trust values" computed as discussed in Section 5.7);

      b.   (should perform) Increase the "local group key" refresh rate and/or employ a stronger level of encryption (see Section 4 for encryption requirements); and

      c.   (should perform) Reduce thresholds for alerting "commander node" of low "trust values" (as discussed in TRUST.11).

POLICY_RDM.7   When the "policy option" of 'maximize throughput' is applied to a "local group" (or set of "local groups"), TEC3 devices must select routes to maximize throughput without regard to nodes' "trust values" or remaining power levels.

6.2   Go dark (emission control)

"Commander node" and "analyst node" operators will have the ability to issue a "go dark" instruction to selected nodes or to a "local group", directing all nodes in the selected group to cease outgoing RF transmission. The units will continue to receive and process RF, however. Upon timeout, or receipt of a message cancelling the "go dark" instruction, the selected nodes will resume RF transmission functionality. Any node is capable of manually overriding "go dark" commands temporarily to send urgent signalling, with "go dark" resuming once the urgent message is sent.

The primary application for a "go dark" feature is to provide a mechanism for a Commander to instruct units to temporarily cease all RF transmission in order to avoid detection by an adversary (e.g., an adversary using electronic warfare (EW) equipment to detect RF emitters).

DARK.1   "Commander node" and "analyst node" operators should be able to issue commands instructing selected TEC3 devices to cease all outgoing radio communication[13].

DARK.2   "Commander node" and "analyst node" operators should be able to issue commands instructing "dark" TEC3 devices to resume regular communication (i.e., cancelling the "go dark" instruction).

DARK.3   Upon receiving a "go dark" instruction, TEC3 nodes should cease all outgoing RF transmission with the exception of cases specifically highlighted in Section 6.2 (i.e., this section).

DARK.4   "Dark" TEC3 nodes should continue to listen for, receive and process incoming RF signals.

---

[13] In the remainder of this description, a command indicating that nodes cease all outgoing radio communication is referred to as a "go dark" instruction or command. Nodes that have been commanded to "go dark" are called "dark" nodes.

DARK.5   Upon receiving an instruction to resume regular communication, TEC3 nodes should resume regular communication; the network should take no longer than 20 seconds to recover from the "dark" state.

DARK.6   Notwithstanding DARK.3, in the event of emergency a user should have the ability to temporarily manually override the condition of radio silence and send emergency messages.

DARK.7   Notwithstanding DARK.3, if a TEC3 node is a relay for nodes not connected to the issuer of the "go dark" instruction (or the issuer of an emergency message), the TEC3 node should be permitted to forward or re-broadcast the "go dark" instruction (or emergency message).

DARK.8   Any emergency messages sent in accordance with DARK.6 should be clearly identified such that other TEC3 devices recognize that the message is coming from a TEC3 device currently in the "dark" state breaking silence for an emergency broadcast.

DARK.9   Notwithstanding DARK.3, if a TEC3 node in the "dark" state detects another TEC3 node not operating in the "dark" state, the "dark" TEC3 node should be able to forward or re-broadcast the original "go dark" instruction to the non-silent node.

DARK.10   The TEC3 network and GUI display should be robust against any errors or anomalies generated by the interruption of standard network protocols and situational awareness information caused by the "go dark" feature.

DARK.11   The TEC3 "home screen" GUI display should clearly indicate when the device is in a "dark" state.

DARK.12   The appearance of "dark" nodes on the TEC3 "home screen" GUI display should be clearly distinguished from nodes operating under normal conditions.

6.3   Revoke user key

"Analyst node" operators will have the ability to remotely remove compromised nodes from the network to ensure that they cannot eavesdrop on encrypted communications. TEC3 will provide this service by re-keying all non-compromised nodes in a "local group" with a new "local group key", while withholding the new key from the compromised node. At the same time, the "analyst node" will add the public key certificate of the compromised node to a Certificate Revocation List (CRL) to thwart attempts by the compromised node to re-join the network.

REVOKE.1   TEC3 "analyst nodes" and "commander nodes" must have a "revoke" function whereby the operator can select a TEC3 node on the TEC3 GUI interface and cryptographically revoke the selected node from the network (the node to be revoked is herein after referred to as the "revoked node").

REVOKE.2   After the "analyst node" or "commander node" operator has issued a "revoke" command against a TEC3 node, the public key certificate of the "revoked node" must be added to the Certificate Revocation List (CRL).

REVOKE.3   The CRL updated in REVOKE.2 must be distributed to all nodes in the network (i.e, all TEC3 nodes involved in the technical demonstrator) following the update.

REVOKE.4   Following the update of the CRL in REVOKE.2, the "commander node" of the "local group" of a "revoked node" must generate a new "local group key" and disseminate the key to all nodes in the "local group" as per ENCRYPT.23, with the exception of the "revoked node".

REVOKE.5   The TEC3 system must not permit a "revoked node" to re-join the network.

REVOKE.6   "Revoked nodes" must continue to use their old "local group keys" and broadcast out positional information as before they were "revoked".

REVOKE.7   TEC3 devices must display the position of "revoked nodes" (by retaining the old "local group key" and using it to decrypt messages from the "revoked node").

REVOKE.8   "Revoked nodes" must be clearly displayed as adversarial on the valid TEC3 devices' GUI displays.

REVOKE.9   While "revoked nodes" may automatically request to re-join the network and obtain a new valid "local group key", these attempts must be ignored since the requests will have been signed by a revoked certificate.

6.4   Establish encrypted community of interest

"Analyst node" operators and "commander node" operators will have the ability to dynamically establish encrypted communities of interest (COIs) with one or more other users in the network. Establishing an encrypted COI will allow nodes within the COI to confidentially exchange data with one another, where only member nodes will have the ability to decrypt the data. The node establishing a COI must generate a new "COI group key" and disseminate it to the members of the COI. Any node in possession of the "mission key" and "local group key" must be able to relay COI information without access to the COI-encrypted data.

COI.1   TEC3 "analyst nodes" and "commander nodes" should have an "establish COI" function whereby the operator can select a number of TEC3 nodes on the TEC3 GUI interface and establish a community of interest with these nodes, sharing information using a common "COI group key". The operator who establishes the COI will be herein after known as the 'COI originator'.

COI.2   The COI originator should have the ability to assign a name to the COI upon its creation.

COI.3   Upon initiating the "establish COI" function, the COI originator node should automatically generate a symmetric "COI group key".

COI.4   The COI originator node should disseminate the "COI group key" to the members of the COI (selected in COI.1) following a procedure similar to "local group key" dissemination as described in ENCRYPT.23.

COI.5   TEC3 operators should be notified through the TEC3 GUI when they become members of a new COI.

COI.6   By default, all data transmissions in TEC3 should be encrypted as per the specifications in Section 4; the "COI group key" should be used to encrypt application-layer data only, where the application-layer data to be encrypted is specified by the COI member transmitting the data. A packet containing application-layer data encrypted using the "COI group key" is known as a 'COI data packet'.

COI.7   Any member of a COI should be able to use their TEC3 GUI to specify which application data will use the "COI group key" and which application data will use the default key (i.e., "local group key")[14].

COI.8   Nodes sending COI data packets should continue to use the "mission key" to encrypt the "key header" and the "local group key" to encrypt signalling and routing information.

COI.9   All nodes should be capable of relaying/routing COI data packets without access to the "COI group key" data (this requirement follows directly from COI.8).

COI.10   If the members of a COI are from different "local groups", the "gateways" connecting the "local groups" should forward the COI data packets between "local groups" without access to the "COI group key".

COI.11   If a user's node has its public key certificate "revoked" as per Section 6.3, the TEC3 system should ensure that the user no longer has access to new COI-encrypted data for any COIs of which the user was a member[15].

COI.12   The TEC3 GUI should include an overlay that will identify the members of a COI to all other members of that COI.

6.5   Create covert channel

"Analyst node" operators will have the ability to dynamically configure and make use of covert channels between two or more nodes in the network. Whereas an encrypted channel seeks to protect the confidentiality of data exchange, a covert channel intends to obfuscate the existence of the data exchange. The covert channel implemented in TEC3 relies on manipulating the structure of the MAC-layer frame with the intention of obfuscating covert frames, making them appear as errors or 'noise' to recipients unaware of the deliberate manipulation.

---

[14] It is envisioned that COIs will be primarily used for User Communication Services as specified in section 5.1; so, for instance, a user could send a text message to "everyone" (the default) or with "members of COI" (a choice provided to the user when the user creates the message and that user is a member of a COI).

[15] This could be achieved by requiring that all COI data be encrypted with the "local group key" as well as the "COI group key". Thus, when the "local group key" is cycled (and the "revoked node" does not receive the new key), the "revoked node" will not be able to decrypt any "COI data packets" even if it is still in possession of the "COI group key".

COVERT.1   TEC3 "analyst nodes" should have a 'create covert channel' function whereby the operator can select a number of TEC3 nodes on the TEC3 GUI interface and instruct the selected nodes to function as "covert nodes". Nodes selected and instructed in this fashion will be referred to herein as "covert nodes".

COVERT.2   A TEC3 "covert node" should be able to send frames that are obfuscated at the MAC layer to nodes not in possession of the mechanism to observe these frames. One potential implementation of this could be for nodes to send frames in which the MAC frame check sequence[16] has been manipulated such that TEC3 nodes un-aware of the manipulation will identify the frame as containing an error (in which case the frame would normally be dropped). A frame obfuscated in this (or some other fashion) is known herein as a "covert frame".

COVERT.3   A TEC3 "covert node" should be capable of transmitting both 'covert frames' and 'standard frames'.

COVERT.4   The necessary information to identify covert frames (e.g., the process to manipulate the MAC frame check sequence, if the method suggested in COVERT.2 is employed) should be communicated securely by the "analyst node" in COVERT.1 to the TEC3 "covert nodes".

COVERT.5   The "analyst node" in COVERT.1 should have the ability to select the type of data/traffic that will be transmitted using covert frames (e.g., all "covert nodes" could be instructed to send certain data types using covert frames).

COVERT.6   Only frames carrying the specific type of data identified in COVERT.5 should be sent as covert frames; all other frames should be sent without covert manipulation.

COVERT.7   TEC3 nodes supporting the "covert node" functionality should be able to be relay covert frames using the MANET multi-hop capability.

COVERT.8   TEC3 operators should be notified through the TEC3 GUI when they are granted "covert node" functionality.

COVERT.9   The TEC3 "analyst node" should contain an overlay on the TEC3 GUI that identifies the "covert nodes" in the network.

6.6   Send misinformation

An adversary who has captured or taken control of a TEC3 device may intend to use the device as a means to track the location of other TEC3 users. The 'send misinformation' feature allows an "analyst node"

---

[16] Note that this requirement presumes the existence of some form of MAC frame check sequence in the radio protocol. If the proposed TEC3 implementation does not use a MAC frame check sequence, an alternative method for manipulating data at the MAC layer to achieve a comparable level of obfuscation must be proposed. One method of manipulating the frame check sequence in the manner discussed here is to introduce deliberate errors into the frame check sequence in a pattern known to "covert nodes" but unknown to other nodes (see, for instance, reference [17]). In this fashion, the frames will appear as containing errors and be dropped by the nodes that are unaware of the manipulation.

operator to send incorrect and misleading information to the adversary-controlled device. A key element of this feature is that its purpose is to deliberately mislead an adversary, as opposed to simply stopping the adversary from using the TEC3 device. The misinformation transmitted to the captured device will mimic valid messages. To ensure that the adversary does not receive valid data (and receives only misinformation), the node is first cryptographically removed from the network (through key revocation as discussed in Section 6.3) and is then sent misinformation using an old encryption key. To the adversary in control of the TEC3 node, there must not be any immediate way to identify that the misinformation received is not valid.

MISINF.1   TEC3 "analyst nodes" must have a "misinform" function whereby the operator can select a TEC3 node (referred to herein as the "false node") to receive an alternate (and incorrect) set of blue force positional information (referred to herein as "false BFT").

MISINF.2   Immediately after an "analyst node" operator invokes the "misinform" function against a TEC3 "false node", the "analyst node" must initiate a key revocation process to cryptographically eject the "false node" from the network (as described in Section 6.3)[17].

MISINF.3   Following the selection of the "misinform" command, the "analyst node" must send unicast periodic "false BFT" (structured in the same manner as messages sent in Section 5.2) to the "false node".

MISINF.4   The "false BFT" must be encrypted using the "local group key" that was in use prior to invoking the "misinform" function.

MISINF.5   The "false BFT" should be automatically generated by the "analyst node".

MISINF.6   The "false BFT" must not reveal the true positions of TEC3 nodes to the "false node".

MISINF.7   The "false node" must continue to broadcast its own position information using the "local group key" that was in use prior to invoking the "misinform" function.

MISINF.8   TEC3 devices must display the position of the "false node" (by retaining the old "local group key" and using it to decrypt messages from the "false node").

MISINF.9   The "false node" must be clearly displayed as adversarial on the valid TEC3 devices.

MISINF.10   While the "false node" may automatically request to re-join the network and obtain a new valid "local group key", its requests must be ignored since the requests will have been signed by a revoked certificate.

---

[17] Note that following key revocation, the "false node" will continue to have access to an old "local group key" (i.e., the group key that was in use prior to revocation) but will not have access to or knowledge of any current "local group keys". Additionally, as described in Section 6.3, the public/private key pair of the "false node" will be revoked, with the public key certificate of the "false node" added to the CRL.

7   Data dissemination

TEC3 devices are expected to be continually creating and sharing data—both user-created data such as text messages and pushpins (Sections 5.1.2 and 5.1.3) and data that are automatically generated by the TEC3 devices and services such as blue-force position information (Section 5.2). In many cases, guidance for how this information must be disseminated is specified in previous sections of this functional specification. This section is intended to provide general guidance for those cases where data dissemination is not explicitly specified elsewhere.

DISSEM.1   Explicit guidance on data dissemination appearing in other sections of this functional specification that directly conflicts with the guidance provided in this section must take precedence over the guidance provided in this section.

DISSEM.2   TEC3 must disseminate user-created and system-created data according to the guidance provided in Table 3, where definitions of terms in Table 3 are provided in Table 4.

DISSEM.3   Notwithstanding Table 3, "analyst node" operators must have the ability to re-disseminate any data to selected nodes as desired using the TEC3 GUI.

DISSEM.4   TEC3 should adhere to the data prioritization hierarchy specified in Table 5 such that lower-priority data is delayed and/or queued when higher-priority data requires resources to be transmitted and/or processed[18].

---

[18] As an example, if a device is currently broadcasting a large image attached to a pushpin (see section 5.1.3) to the rest of the "local group", this broadcast must be treated as lower-priority to allow for higher-priority traffic such as a blue force tracking message dissemination.

Data	Created by	Received by	Timing	Signature	Confirmation
Local group keys (Sec 4)	Cdr, Anl	Local, Anl	Per, OT	Y	C,DD
Session keys (Sec 4)	Any	USel	OT	Y	C,DD
Broadcast voice (Sec 5.1.1)	Any	Local	OT	N	-
Unicast voice (Sec 5.1.1)	Cdr	USel	OT	N	-
Unicast voice (Sec 5.1.1)	Bas	Cdr	OT	N	-
Text chat (Sec 5.1.2)	Any	Range	OT	N	C
Pushpin (Sec 5.1.3)	Any	Range, Anl	OT	N	C,DD
Blue force tracking (Sec 5.2, 5.3)	Any-All	Range, Anl	Per	Y	-
Blue force status (Sec 5.4)	Any-All	Range, Anl	OC	Y	-
Link quality (Sec 5.6)	Any-All	Range, Anl	Per	N	-
Node-level trust (Sec 5.7)	Cdr	Local, Anl	Per	Y	-

Table 3: Data dissemination guidance.

Definitions for terms appearing in the 'Created by' column of *Table 3*	
Bas	The data is created and transmitted by a "basic node".
Cdr	The data is created and transmitted by a "commander node".
Anl	The data is created and transmitted by an "analyst node".
Any	Any TEC3 node can create and transmit this data. Not all TEC3 nodes will necessarily do so since they may not have an operational requirement to create any data, but they will all have the capability if they need or wish to.
Any-All	All TEC3 nodes must create and transmit this data.

Definitions for terms appearing in the 'Received by' column of *Table 3*	
Local	Only members of the "local group" of the originator of the data will receive this data.
Range	Any TEC3 node less than a configurable distance (i.e., a range) away from the originator will receive this data. Note that all TEC3 nodes in the same "local group" as the originator must receive the data regardless of the configurable distance.
Cdr	Only the "commander node" of the originator of the data will receive this data.
Anl	Only the "analyst node" will receive this data.
USel	Only the node(s) selected by the originator of the data will receive this data (USel = user selected).

Definitions for terms appearing in the 'Timing' column of *Table 3*	
Per	This data is sent periodically, with a configurable period.
OC	This data is sent when it changes (OC = on change), but it is not required to be re-transmitted if it has not changed since the last time it was sent.
OT	This data is sent according to a particular trigger event (OT = on trigger). The trigger event may be a user decision to send the data or an event automatically triggered by TEC3.

Definitions for terms appearing in the 'Signature' column of *Table 3*	
Y	This data must be digitally signed by the originator.
N	This data does not need to be digitally signed by the originator.
Definitions for terms appearing in the 'Confirmation' column of *Table 3*	
-	Confirmation of the message by the recipient is not required.
C	The recipient of the message or data will send a confirmation to the sender when the data has been received.
DD	The sender of the message or data will support delayed-delivery of the message for up to 10 minutes if the recipient is not currently in communication.

Table 4: Definitions for terms appearing in Table 3.

Data	Priority
Broadcast voice (sec 5.1.1)	**1**
Blue force tracking (sec 5.2, 5.3)	**2**
Blue force status (sec 5.4)	
Link quality (sec 5.6)	
Node-level trust (sec 5.7)	
Any instructions from analyst or commander	**3**
Encryption key related information (sec 4)	**4**
Text chat (sec 5.1.2)	**5**
Pushpin including attachments (sec 5.1.3)	**6**
Unicast voice (sec 5.1.1)	**7**
All other general purpose communication	**8**

Table 5: Data prioritization hierarchy.

8   Display and user interface

Each TEC3 device includes a GUI display component. While many details regarding the GUI display are provided elsewhere in this document, this section is intended to provide general guidance on the display and interface.

DISPLAY.1   TEC3 must support and be capable of displaying both vector and raster map imagery.

DISPLAY.2   TEC3 must automatically aggregate information on the mapping display based on the current zoom level in order to avoid clutter; the degree of automated aggregation should be configurable by the user.

DISPLAY.3   The TEC3 display must indicate when geographically-based user position information is known but is outside the field of view of the current display.

DISPLAY.4   TEC3 must make use of standards-based icons to display all geographically-based information.

DISPLAY.5   In addition to the default standards-based icons (specified by DISPLAY.4) TEC3 must supply a set of alternate icon options; all icon options must be configurable by the user.

DISPLAY.6   All symbols used on the TEC3 GUI must be clearly distinguishable from one another.

DISPLAY.7   <deleted>

DISPLAY.8   All TEC3 users must be able to toggle map overlays on or off, where the overlays supported by TEC3 are specified throughout this functional specification.

DISPLAY.9   The TEC3 GUI must be capable of displaying multiple overlays simultaneously.

DISPLAY.10   The TEC3 GUI "home screen" must appear when TEC3 powers on; the "home screen" is a map centered at the user's current location, including the blue-force information from Section 5.2.

DISPLAY.11   <deleted>

DISPLAY.12   For touch-screen devices, user interaction with the TEC3 GUI must consist of standard well-established methods such as screen swiping, two-fingered pinch, short-pressing, long-pressing, etc.

DISPLAY.13   For touch-screen devices, any user operation should not require more than three consecutive user interactions (as defined in DISPLAY.12) with the TEC3 GUI.

Index of terms / glossary

Term	Definition or location in document where first used/defined
Analyst node	This term is introduced and defined in DEVICE.1, DEVICE.11, DEVICE.12, and DEVICE.13. The "analyst node" is a TEC3 device used by an analyst, which will have access to more situational awareness information and network C2 capability than "commander nodes" and "basic nodes".
Basic node	This term is introduced and defined in DEVICE.1, DEVICE.3, DEVICE.4, DEVICE.5, and DEVICE.6. The "basic node" is a TEC3 device used by a basic user, which will have access to less situational awareness information and network C2 capability than "commander nodes" and "analyst nodes".
COI group key	A symmetric encryption key shared among all members of a community-of-interest (COI).
Commander node	This term is introduced and defined in DEVICE.1, DEVICE.7, DEVICE.8, DEVICE.9, and DEVICE.10. The "commander node" is a TEC3 device used by a commander, which will have access to more situational awareness information and network C2 capability than a "basic node", but less than an "analyst node".
Covert node	This term is introduced and defined in COVERT.1 and COVERT.2.
Dark	Nodes that have received the "go dark" command are called "dark" nodes. A "dark" node will cease standard RF transmission.
Encrypted data	The "encrypted data" is the portion of the "encrypted packet" that is encrypted using the keys specified in the "key header". Details on how the "encrypted data" must be structured are provided in ENCRYPT.16, ENCRYPT.18, ~~ENCRYPT.19~~, and ENCRYPT.20.
Encrypted packet	An "encrypted packet" is a TEC3 packet in which all layers of the network protocol stack above the media access control (MAC) or link layers are encrypted. As per ENCRYPT.12, all wireless packets sent by TEC3 devices are "encrypted packets".
Establish COI	This is a command sent by a "commander node" or "analyst node" operator to create a community-of-interest among selected TEC3 nodes.
Expired	This term is introduced and defined in ENCRYPT.7.
False BFT	An alternate—and misleading—set of blue-force tracking information to be sent to compromised nodes (so-called "false nodes").
False node	A TEC3 node believed to be compromised.
Gateway	An automatically- or manually-selected TEC3 node in a "local group" that can communicate with another "gateway" in another "local group", or directly with an "analyst node". All communications between "local groups" take place via "gateways".
Go dark	This is a command sent by a "commander node" or "analyst node" operator instructing selected TEC3 devices to cease all outgoing RF transmission.
Group UID	This term is introduced and defined in NETWORK.5.
Home screen	This term is defined in DISPLAY.10.
Key header	The "key header" is a portion of the "encrypted packet" encrypted with the "mission key" and containing information regarding the structure of the "encrypted data" including the "key IDs" of the key(s) required to decrypt the "encrypted data".

Key ID	A unique identifier for each encryption key used in TEC3. The "key ID" allows a recipient to determine which key(s) is(are) required to decrypt "encrypted data".
Local group	A "local group" is a mobile ad hoc network (MANET) comprised of a single "commander node" and 1 to 19 additional TEC3 "basic nodes"; the "local group" will have a unique "group UID" and all nodes in the "local group" will share a common symmetric encryption key (the "local group key"). It is envisioned that members of a "local group" will typically travel and operate together.
Local group key	This is a symmetric encryption key shared by members of a "local group" to encrypt broadcast traffic.
Lock	A TEC3 device that has been locked will have its display obscured such that no information regarding the device or the network is visible; the only permissible input for a locked device is for performing user authentication or powering off the device.
Misinform	This is a command sent by an "analyst node" to send "false BFT" to a TEC3 node that is believed to be compromised.
Mission	The time from the beginning of "mission deployment" to the completion of mobile operations and the return to a fixed location.
Mission deployment	The point at which TEC3 devices and users depart from a fixed and centralized location and begin mobile operations.
Mission key	This is a shared symmetric key common to all nodes on a "mission". It supports initial communication prior to establishing "local group keys"; in addition, the "key header" is encrypted with the "mission key".
Non-allied emitters	A "non-allied emitter" is a device that is not operated by known allies and that is emitting RF radiation. For simplicity of demonstration purposes this could be any non-TEC3 device operating at the frequencies specified in GEO_THREAT.10.
Policy option	A "policy option" is a preconfigured set of network management, device management, and routing behaviours selected by a "commander node" or "analyst node".
Protocol jamming	A "protocol jamming" attack uses RF energy to specifically target certain types of application traffic (as opposed to targeting all communications).
Revoke	This is a command sent by an "analyst node" to cryptographically eject a selected TEC3 node from the network. The "revoked node" will have its public key certificate added to the certificate revocation list.
Revoked node	A node that has been cryptographically ejected from the network is called a "revoked node". A "revoked node" does not have the current "local group key" and its public key certificate is on the certificate revocation list.
Session key	Symmetric encryption keys used for unicast communication between two TEC3 nodes.
TEC3 UID	A unique identifier associated with every TEC3 node.
Trust value	This term is introduced and defined in TRUST.1.
Wormhole	In a "wormhole" attack, an adversary uses techniques such as replay, relay, or man-in-the-middle, to capture and retransmit traffic for the purposes of creating an (adversary controlled) logical linkage between two endpoints in a mobile ad hoc network.

References

[1]   Directorate of Land Concepts and Design, *Toward Land Operations 2021 – Studies in Support of the Army of Tomorrow Force Employment Concept*, Department of National Defence, ISBN: 978-1-100-11775-1, Kingston ON, 2009.

[2]   Canadian Army Land Warfare Centre, *Future networks: A concept for the army of tomorrow*, Department of National Defence, ISBN: 978-1-100-23023-8, Kingston ON, 2013.

[3]   J.D. Brown, M. Salmanian, D. Simmelink, H. Tang, R. Song, "Tactical edge cyber command and control (TEC3) concept: A vision for network situational awareness and network command and control at the tactical edge", DRDC-RDDC-2014-R155, December 2014.

[4]   G. Henderson, W. Pase, "Emerging radio and MANET technology study", DRDC-RDDC-2014-C208, October 2014.

[5]   W. Pase, G. Henderson, "Advanced architectures for MANET-based signalling devices", DRDC-RDDC-2015-C206, April 2015.

[6]   W. Pase, "Software support for a risk reduction platform for mobile ad hoc networks", DRDC-RDDC-2015-C207, June 2015.

[7]   C. McKenzie, "TEC3 REALTIME blue force tracking proof-of-concept development report", DRDC-RDDC-2015-C150, April 2014.

[8]   C. McKenzie, "Android application for measuring TEC3 situational awareness dissemination protocol efficiency", DRDC-RDDC-2015-C232, June 2015.

[9]   Nymi wristband, description available at https://www.nymi.com/

[10]   MIO wristband, description available at http://www.mioglobal.com/

[11]   T. Feng et. al., "Continuous mobile authentication using touchscreen gestures", IEEE Conference on Technologies for Homeland Security, November 2012.

[12]   Y. Hu, A. Perrig, D. Johnson, "Wormhole attacks in wireless networks", IEEE Journal on Selected Areas in Commuications, vol. 24, no. 2, pp. 370 – 380, February 2006

[13]   M. Salmanian, J.D. Brown, M. Li, P.C. Mason, "A covert system monitoring function", in Proceedings of NATO Information Systems Technology Panel Symposium, Information Assurance and Cyber Defence (IST-111/RSY-026), September 2012.

[14]   J.D. Brown, "Detecting wormholes in mobile ad hoc networks through hop count analysis", DRDC Ottawa Technical Memorandum, TM 2012-118, December 2012.

[15]   M.A. Gorlatova, P.C. Mason, M. Wang, L. Lamont, R, Liscano, "Detecting wormhole attacks in mobile ad hoc networks through protocol breaking and packet timing analysis", in Proceedings of IEEE MILCOM 2006, Washington D.C., USA, October 2006.

[16]   R. Song, P.C. Mason, M. Li, "Wormhole attack detection in tactical mobile ad hoc networks", DRDC Ottawa Technical Memorandum, TM-2013-138, November, 2013.

[17]   M. Salmanian, M. Li, "A high throughput covert overlay network within a MANET", IEEE MILCOM 2013, San Diego, CA, November 2013.

List of symbols/abbreviations/acronyms/initialisms

AES	Advanced Encryption Standard
API	application programming interface
BFT	blue force tracking
C2	command and control
CA	certificate authority
CAF	Canadian Armed Forces
COI	community-of-interest
CRL	certificate revocation list
DND	Department of National Defence
DRDC	Defence Research and Development Canada
DSTKIM	Director Science and Technology Knowledge and Information Management
ECG	electrocardiogram
EW	electronic warfare
FER	frame error rate
FRS	Family Radio Service
GPS	Global Positioning System
GUI	graphical user interface
IP	Internet Protocol
IPv4	Internet Protocol version 4
ISM	industrial, scientific and medical
LAV	Light Armoured Vehicle
MAC	media access control
MANET	mobile ad hoc network
PDOA	power difference of arrival
POA	power of arrival
PKI	public key infrastructure
RF	radio frequency
SA	situational awareness
SDK	software development kit
SINR	signal to interference noise ratio
TD	technical demonstrator
TDOA	time difference of arrival
TEC3	Tactical Edge Cyber Command and Control
UAV	unmanned aerial vehicle
UID	unique identifier
VHF	very high frequency

APPENDIX 3 TO ANNEX A
SPECIFICATIONS FOR ADVANCED CAPABILITIES OF THE TACTICAL EDGE CYBER COMMAND AND CONTROL (TEC3) PROJECT

It is mandatory to consult this document for the conduct of the work.

Due to its classified nature, general public distribution of Appendix 3 to Annex A is restricted. This means that it contain information that cannot be released to public and may only be distributed to Bidders who meet the security requirements. For more information or to get a copy of this classified document, please contact the Contracting Authority identified at Article 5.1 of Part 7 of this solicitation document.

ANNEX B
BASIS OF PAYMENT

A.   **Basis of payment related to the Core Work identified at Annex A, Statement of Requirements only:**

A1.0   **LABOUR:** at the following firm all-inclusive hourly rates
(Rates table to be inserted at contract award)

A2.0   **EQUIPMENT:** at laid down cost without markup   **Est.: $ _____**
- *Items to be inserted at contract award*
- *Etc...*

A3.0   **RENTALS:** at actual cost without markup   **Est.: $ _____**
- *Items to be inserted at contract award*
- *Etc...*

A4.0   **MATERIALS AND SUPPLIES:** at laid down cost without markup   **Est.: $ _____**
- *Items to be inserted at contract award*
- *Etc...*

A5.0   **TRAVEL AND LIVING EXPENSES:**   **Est.: $ _____**

(a)   Canada will not accept any travel and living expenses incurred by the Contractor in the performance of the Work, for:

   (i)   services provided within the National Capital Region (NCR). The National Capital Region (NCR) is defined in the *National Capital Act*, R.S.C. 1985, c.N-4, S.2. The *National Capital Act* is available on the Justice Website: http://laws.justice.gc.ca/eng/N-4/20100210/ and

   (ii)   any travel between the Contractor's place of business and the NCR.

(b)   For services to be provided outside the NCR, the Contractor will be reimbursed its authorized travel and living expenses reasonably and properly incurred in the performance of the Work, at cost, without any allowance for profit and/or administrative overhead, in accordance with the meal, private vehicle and incidental expenses provided in Appendices B, C and D of the Treasury Board Travel Directive (http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php), and with the other provisions of the directive referring to "travellers", rather than those referring to "employees". The Treasury Board Secretariat's Special Travel Authorities, http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/tbm_113/statb-eng.asp, also apply.

(c)   Canada will not accept any travel and living expenses incurred by the Contractor as a consequence of any relocation of personnel required to satisfy the terms of this Contract.

(d)   All travel must have prior authorization of the Technical Authority. All payments are subject to government audit.

A6.0   **SUBCONTRACTS:** at actual cost without markup   **Est.: $ _____**
- *Items to be inserted at contract award*
- *Etc...*

A7.0   OTHER DIRECT CHARGES: at actual cost without markup   **Est.: $ _____**
   - *Items to be inserted at contract award*
   - *Etc…*

A8.0   PROFIT: at a firm rate of __% of item(s) __ above   **Est.: $ _____**

Estimated Cost to a Ceiling Price Core Work: $ _____
(Applicable Taxes extra)

B.   For the optional work identified at Appendix 1, Statement of Optional Requirements to the Annex A, Statement of Requirements, as and when applicable:

B1.0   LABOUR: at the following firm rates
(Rates table to be inserted at contract award)

B2.0   TRAVEL AND LIVING EXPENSES:

(a)   Canada will not accept any travel and living expenses incurred by the Contractor in the performance of the Work, for:

   (i)   services provided within the National Capital Region (NCR). The National Capital Region (NCR) is defined in the *National Capital Act*, R.S.C. 1985, c.N-4, S.2. The *National Capital Act* is available on the Justice Website: http://laws.justice.gc.ca/eng/N-4/20100210/ and

   (ii)   any travel between the Contractor's place of business and the NCR.

(b)   For services to be provided outside the NCR, the Contractor will be reimbursed its authorized travel and living expenses reasonably and properly incurred in the performance of the Work, at cost, without any allowance for profit and/or administrative overhead, in accordance with the meal, private vehicle and incidental expenses provided in Appendices B, C and D of the Treasury Board Travel Directive (http://www.njc-cnm.gc.ca/directive/travel-voyage/index-eng.php), and with the other provisions of the directive referring to "travellers", rather than those referring to "employees". The Treasury Board Secretariat's Special Travel Authorities, http://www.tbs-sct.gc.ca/pubs_pol/hrpubs/tbm_113/statb-eng.asp, also apply.

(c)   Canada will not accept any travel and living expenses incurred by the Contractor as a consequence of any relocation of personnel required to satisfy the terms of this Contract.

(d)   All travel must have prior authorization of the Technical Authority. All payments are subject to government audit.

B3.0   ALL OTHER FINANCIAL TERMS REQUIRED TO BE NEGOTIATED BEFORE ISSUANCE OF THE TASK AUTHORIZATION (E.G. EQUIPMENTS, MATERIALS, SUBCONTRACTORS) AND WILL BE INSERTED HERE BY A FORMAL CONTRACT AMENDMENT.

With the exception of the firm rate(s) and price(s), the amounts shown in the various items specified above are estimates only. Minor changes to these estimates will be accepted for billing purposes as the Work proceeds, provided that these changes have the prior approval of the Technical Authority and provided that the estimated cost does not exceed the aforementioned Ceiling Price.

ANNEX C
SECURITY REQUIREMENTS CHECK LIST

THE ATTACHED SRCL FORMS PART OF THE SOLICITATION DOCUMENT AND THE RESULTING CONTRACT.

Please refer to the "Attachments" section of this PDF document.
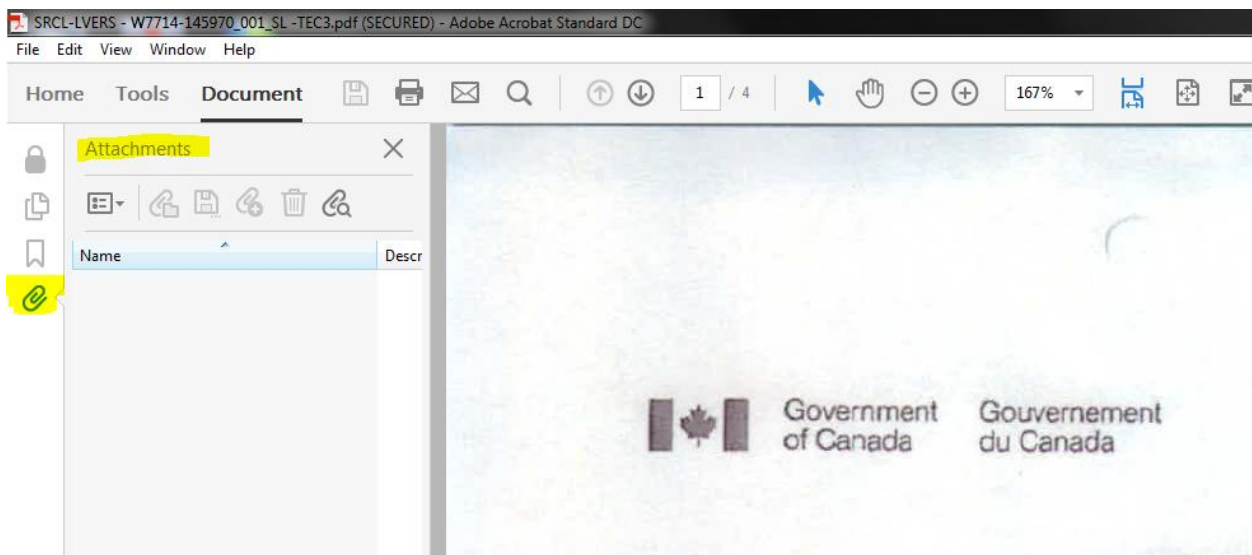
ANNEX D
NON-DISCLOSURE AGREEMENT (when applicable)

I, _____, recognize that in the course of my work as an employee or subcontractor of _____, I may be given access to information by or on behalf of Canada in connection with the Work, pursuant to Contract Serial No _____ between Her Majesty the Queen in right of Canada, represented by the Minister of Public Works and Government Services and _____, including any information that is confidential or proprietary to third parties, and information conceived, developed or produced by the Contractor as part of the Work. For the purposes of this agreement, information includes but not limited to: any documents, instructions, guidelines, data, material, advice or any other information whether received orally, in printed form, recorded electronically, or otherwise and whether or not labeled as proprietary or sensitive, that is disclosed to a person or that a person becomes aware of during the performance of the Contract.

I agree that I will not reproduce, copy, use, divulge, release or disclose, in whole or in part, in whatever way or form any information described above to any person other than a person employed by Canada on a need to know basis. I undertake to safeguard the same and take all necessary and appropriate measures, including those set out in any written or oral instructions issued by Canada, to prevent the disclosure of or access to such information in contravention of this agreement.

I also acknowledge that any information provided to the Contractor by or on behalf of Canada must be used solely for the purpose of the Contract and must remain the property of Canada or a third party, as the case may be.

I agree that the obligation of this agreement will survive the completion of the Contract Serial No:_____

_____
Signature

_____
Date

ANNEX E
DND 626, TASK AUTHORIZATION FORM

Please refer to the "Attachments" section of this PDF document.