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LETTER OF INTEREST
LETTRE D'INTÉRÊT

Title - Sujet
RFI - MOBILE MM-WAVE CHANNEL SOUNDR

Solicitation No. - N° de l'invitation	Date
U6800-208341/A	2019-05-21
Client Reference No. - N° de référence du client	**GETS Ref. No. - N° de réf. de SEAG**
U6800-208341	PW-$$HN-471-77123
File No. - N° de dossier	**CCC No./N° CCC - FMS No./N° VME**
hn471.U6800-208341	

Solicitation Closes - L'invitation prend fin
at - à 02:00 PM
on - le 2019-06-10

Time Zone
Fuseau horaire
Eastern Daylight Saving Time EDT

F.O.B. - F.A.B.
Plant-Usine: ☐ **Destination:** ☐ **Other-Autre:** ☐

Address Enquiries to: - Adresser toutes questions à:
Bisson, Phillipe

Buyer Id - Id de l'acheteur
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INNOV, SCI AND ECON DEVT CAN
3701 CARLING AVE
P.O.BOX 11490 STATION H
COMMUNICATIONS RESEARCH CENTRE
OTTAWA
Ontario
K2H8S2
Canada

Comments - Commentaires

Instructions: See Herein

Instructions: Voir aux présentes

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Raison sociale et adresse du fournisseur/de l'entrepreneur

Delivery Required - Livraison exigée	Delivery Offered - Livraison proposée
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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)

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Issuing Office - Bureau de distribution
Electrical & Electronics Products Division
L'Esplanade Laurier
East Tower, 4th floor,
Ottawa
Ontario
K1A 0S5

Canada

REQUEST FOR INFORMATION (RFI)
MOBILE MM-WAVE CHANNEL SOUNDER
PUBLIC SERVICE AND PROCUREMENT CANADA (PSPC)
2019

PART 1 – PURPOSE AND NATURE OF THE REQUEST FOR INFORMATION (RFI)

PART 2 – INSTRUCTIONS TO RESPONDERS

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PART 1 – PURPOSE AND NATURE OF THE REQUEST FOR INFORMATION (RFI)

1.1 Introduction

Public Works and Government Services Canada on behalf of the Communications Research Centre Canada (CRC) is seeking feedback from industry related to equipment for mobile channel sounding in the millimetre-wave (mm-wave) frequency bands (i.e., in practical terms, 26 GHz and above).

1.2 Purpose

The CRC has a requirement for a mobile millimetre-wave (mm-wave) channel sounder (MMCS) capable of wideband, double-directional propagation measurements. It is Canada's intention to issue one (1) contract to the winning bidder on a future RFP to supply a system capable of fulfilling this requirement.

The purpose of this RFI is to assess industry capability in mobile channel sounding of mm-wave frequency bands including relevant expertise, equipment, software, and services (e.g., relating to channel sounding and characterization, hardware capability, software development, system integration). To this end, knowledgeable industry suppliers/vendors are invited to submit responses to the questions contained in this document and to the draft Statement of Work (SOW) contained in the attachment. In addition, Canada invites vendors to supply any additional information and observations that they believe would inform this procurement process.

1.3 Background

With current cellular technologies approaching their technical limits, the mobile wireless landscape is seeing a strong, worldwide push toward the deployment of more powerful "fifth-generation" (5G) wireless technology. The Government of Canada[1] recognizes the many potential benefits of 5G wireless services to Canadians, and is playing an active role in its introduction to Canada. Key elements in this pursuit are increasing the spectrum supply by opening up mm-wave frequencies for commercial wireless applications, developing effective means to measure the radio spectrum, and understanding the implications of 5G technology for spectrum management.

As the government's primary applied research centre for advanced telecommunications, the CRC is helping to address these needs via its research and development (R&D) programs. In particular, it aims to determine how to effectively characterize and use mm-wave frequencies in mobile urban environments. The MMCS is viewed as a key toolset that will enhance CRC's R&D capabilities in this space.

1.4 Objectives

The objectives of this RFI process are as follows:

A. To seek feedback from industry on the proposed technical requirements to support the finalization of the intended RFP. This includes the desire for a better understanding of
    - industry capabilities and constraints;

[1] Particularly, the Spectrum & Telecommunications Sector (STS) of the Department of Innovation, Science, and Economic Development (ISED), which regulates the radio spectrum in Canada.

- time and cost estimates of the technical components of proposed capability (e.g., hardware, software, software development);
- time estimates of the acquisition component of the proposed capability;
- time and cost estimates of the support component of the proposed capability; and
- required adjustments/changes to the technical requirements, if any, that are required to ensure that a viable system can be delivered at an acceptable cost.

B. To confirm potential bidder compliance with the technical requirements in the draft SOW; and
C. To establish a formal communication channel with industry that will remain open until a formal RFP is released.

PART 2 – INSTRUCTIONS TO RESPONDERS

2.1 Format of Responses

Respondents are requested to provide their comments, concerns, and, where applicable, alternative recommendations regarding how the requirements or objectives described in this RFI could be satisfied. Respondents should explain any assumptions they make in their responses.

Notes to Interested Suppliers

- This RFI for the supply of a mobile mm-wave channel sounder is not a bid solicitation and does not constitute a commitment, implied or otherwise, that the Government of Canada will take procurement action in this matter. The issuance of this RFI is not to be considered in any way a commitment by the Government of Canada, nor as authority to potential respondents to undertake any work that could be charged to Canada. The issuance of the RFI does not create an obligation for Canada to issue a subsequent RFP, and does not bind Canada legally or otherwise, to enter into any agreement or to accept any suggestions from suppliers. Canada reserves the right to accept or reject any or all comments received.

- The Government of Canada will not be responsible for any cost incurred by suppliers in furnishing responses to the RFI process.

- A review team composed of representatives of PSPC and ISED will review the responses on behalf of Canada.

- There will be no short listing of suppliers for purposes of undertaking any future work, as a result of the RFI. Also, participation in the RFI is not a condition or prerequisite for participation in a future RFP.

- Confidentiality:

    - Suppliers are advised that any information submitted to Canada in response to this RFI may be used by Canada in the finalization of a competitive solicitation.

    - All industry consultations will be documented and this information is subject to the Access to Information Act. Suppliers should identify any submitted information that is to be considered as either company confidential or proprietary. Canada will not reveal any designated confidential or proprietary information to the public and/or third parties.

2.2 Submission of Responses

Responses are not considered bids but, for expediency purposes, the PSPC Bid Receiving Unit is the designated location where written responses shall be sent. However, electronic submissions are also acceptable and may be sent by email to the RFI Authority as described herein.

Bid Receiving Unit
Public Works and Government Services Canada
Place du Portage
Level OB2-103, Phase III
11 Laurier Street,
Gatineau, Quebec, K1A 0S5

Telephone: (819) 420-7200 Fax: (819) 997-9776

The Respondent's name, return address, RFI number and closing date should be clearly visible on the response. Responses to this RFI will not be returned.

2.3 RFI Authority

The Public Service and Procurement Canada (PSPC) RFI Authority is responsible for the management of the procurement and RFI process.

Phillipe Bisson
Public Service and Procurement Canada (PSPC)
Acquisitions Branch
Logistics, Electrical, Fuel and Transportation Directorate
"HN" Division
7B3, Place du Portage, Phase III
11 Laurier Street
Gatineau, QC, K1A 0S5
Telephone: (873) 469-3345
Facsimile: (819) 953-4944
E-mail address: phillipe.bisson@pwgsc-tpsgc.gc.ca

2.4 Enquiries

PSPC will not necessarily respond to enquiries in writing or by circulating answers to all potential suppliers as this is not a bid solicitation process. However, respondents with questions regarding this RFI may direct their enquiries to the RFI Authority named above.

2.5 Official Languages

Responses may be in English or French, at the preference of the Respondent.

2.7 Response Confidentiality

Respondents are requested to clearly identify those portions of their response that are proprietary. The confidentiality of each Respondent's response will be maintained. Items that are 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 questions or may request that the respondent do so, so that the proprietary nature of the question is eliminated, and the enquiry can be answered with copies to all interested parties.

2.8 Methods of Communication

Communication between CRC, PSPC, and respondents as part of this RFI process will consist of

- written exchanges via email and,
- optionally, verbal exchanges via either (i) a teleconference or (ii) a face-to-face meeting.

Written responses to the RFI questions must be submitted by email. Potential respondents may pose clarifying questions in writing via email; all such questions will be published as part of the RFI record.

Verbal exchanges will be limited to a single one-on-one meeting between CRC/PSPC and each interested respondent to communicate and clarify the goals, draft requirements, and questions in the RFI. Respondents are requested to specify (a) whether or not they wish to participate in a one-on-one meeting and (b) which type of meeting they prefer (teleconference or face-to-face).

PART 3 – QUESTIONS AND COMMENTS ON THE DRAFT STATEMENT OF WORK

In the following, references to 'requirements' refer to the contents of the attached draft SOW.

3.1 Questions for Industry

Technical

Question 1:
What system design would meet the draft requirements? Please provide a reasonably detailed technical description.

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Question 2:
Are there particular requirements and/or parameters that are especially challenging and/or difficult to achieve with current technology, or that could make it infeasible to deliver a compliant system?

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Question 3:
Is there additional technical information (e.g., alternative equipment or designs) that would inform this procurement process and potentially result in a superior technical solution and/or reduced cost? Specifically:

a. What are the relative benefits and drawbacks of a design based on transceivers, transmitter/receiver pairs, or a combination of both of these configurations?

b. What options exist for phased-array directional antennas that meet the specifications in ANNEX C of the attachment? What options exist for phased-array antennas that do not meet the specifications but could be used in a compliant system (e.g., dual-polarized arrays)?

COST

Question 4:
What would be the approximate estimated procurement cost (i.e., to procure initial hardware and software) of a system that meets the technical requirements? Please include a breakdown of commercial-off-the-shelf (COTS) components versus custom development.

Question 5

What required features or parameters could result in a significant reduction in cost if they were modified and/or relaxed? What would be the approximate percentage change in cost in each case? Specifically:

a. What would be the additional complexity and cost of including a data acquisition function in the system, where 'data acquisition' refers to the ability to capture and store complex baseband time-domain sample of the radio spectrum for large bandwidths (i.e., ≥100 MHz)?

b. What would be the additional complexity and cost of integrating a light detection and ranging (LiDAR) device described by the requirements in the attachment into the system? What would be the impact on performance and cost of integrating an alternative LiDAR solution with less stringent specifications?

Question 6

What would be the approximate estimated cost of after-sales service and maintenance for a procured system?

TIMING/DELIVERY

Question 7

How could the system design enable a procurement process that is phased over more than one (1) fiscal year?

3.2 Comments

In this section of the RFI, PSPC invites Respondents to provide their general comments on the draft SOW or to propose ideas not envisioned by the draft SOW. Please note, the draft SOW is subject to change at PSPC's discretion.

ANNEX A

STATEMENT OF WORK (DRAFT)

Mobile Mm-Wave Channel Sounder

1.0 Requirement

The Communications Research Centre Canada (CRC) has a requirement for a mobile millimetre-wave (mm-wave) channel sounder (MMCS) capable of wideband, double-directional propagation measurements.

2.0 Aim, Scope, and Priorities

With current cellular technologies approaching their technical limits, the mobile wireless landscape is seeing a strong, worldwide push toward the deployment of more powerful, so-called fifth-generation (5G) wireless technology. The Government of Canada[2] recognizes the many potential benefits of 5G wireless services to Canadians, and is playing an active role in its introduction to Canada. Key elements in this pursuit are increasing the spectrum supply by opening up new bands at mm-wave frequencies, developing effective means to measure the radio spectrum, and understanding implications of 5G technology on spectrum management. As the government's primary applied research centre for advanced telecommunications, the CRC is helping to address these needs via its research and development (R&D) programs. In particular, it aims to determine how to effectively characterize and use mm-wave frequencies in mobile urban environments, and envisions the MMCS specified herein as a common hardware and software platform supporting multiple areas of mm-wave wireless R&D.

The purpose of the MMCS is to substantially enhance CRC's R&D capabilities in mm-wave channel sounding with the goal of more effectively addressing these challenges.

3.0 Key Functions and Features

The solution must permit fast and accurate unidirectional measurements of the double-directional channel using two physically-separable, untethered[3] terminals, one (1) transmitter (Tx) and one (1) receiver (Rx). That is,

(i) measurements are performed only from transmitter to receiver ("unidirectional"), and
(ii) measurements are performed with steerable, directional antennas at both terminals ("double-directional").

Each terminal must provide one or more "ports" implemented either as transceivers or as separate transmit and receive units, where each port must be terminated with a phased-array antenna complying with the specifications listed in ANNEX C, section 2.0. Define the combination of the number of active ports on the transmit terminal (M) and the number of ports on the receive terminal (N) as the "multiple-input multiple-output (MIMO) configuration," denoted M x N. The number of ports for each terminal must be reconfigurable so that 1x1, 1x2, and 1x3 MIMO configurations are supported.

The solution must provide real-time visualization of measured channel data in the time, frequency, and spatial/directional domains. Directional visualization must include the display of customizable heat maps of

[2] Particularly, the Spectrum & Telecommunications Sector (STS) of the Department of Innovation, Science, and Economic Development (ISED), which regulates the radio spectrum in Canada.
[3] The terminals can be tethered (i.e., they can utilize a cabled/wired connection) during a synchronization phase, but must be untethered during typical operation.

double-directional channel data overlaid on panoramic photographic images recorded at both ends of the radio channel.

Since the scenarios of primary interest involve mobile urban environments, the offered solution must support independent movement of both terminals at velocities up to 50 km/h. Both terminals must be installed in equipment racks on casters; any subsequent installation in vehicles will be addressed by CRC. To facilitate analysis and interpretation of measured data in terms of the environment of operation, the solution must automatically generate and record metadata from a variety of sources, including satellite-aided inertial geolocation devices, panoramic cameras, and (optionally) light detection and ranging (LiDAR) devices.

4.0 Mandatory Minimum Requirements

4.1 Functional Requirements

1. The solution must provide all the hardware necessary to operate as described in ANNEX A, section 3.0.
2. The typical configuration of the hardware component of the solution must involve the hardware mounted in 19” racks that are equipped with locking casters.
3. The solution must integrate two (2) customer-provided Ladybug5 panoramic cameras.
4. The solution must integrate four (4) customer-specified phased-array antennas, described in ANNEX C, section 2.0.
5. The solution must provide automatic generation and recording of metadata required for the analysis and visualization of propagation data, including line items A.2 and A.3 of section 4.2.
6. The solution must include all software required for its operation and maintenance, including but not limited to software to perform calibration, control, configuration, post-processing, analysis, visualization, and baseband processing.
7. The solution must provide the source code for all the solution-specific developed software components, excluding commercial-off-the-shelf (COTS) software, which permits the modification of processing schemes, control, and analysis functions.
8. The solution must provide the ability to change the sounding waveform and adjust all measurement parameters.
9. The solution must support mobility (i.e., relative motion between the Tx and Rx terminals) up to 50 km/h.

A. **Table of *General***			
A.1	Frequency band	Frequency range over which system can be operated	27.5-29.5 GHz
A.2	Navigation accuracy	Horizontal position error (GNSS) Horizontal position error after loss of satellite signal (inertial) Heading error	< 2.5 m CEP[4] < 10% of distance < 1°
B. Channel sounder			
B.1	Configuration	The solution must support the functionality described in Section 3.0.	N/A
B.2	Sounding bandwidth[5]	Max. bandwidth over which system measures channel frequency response	≥ 1 GHz

[4] CEP = Circular error probability.
[5] Parameter must be continuously controllable by the user.

B.3	Sounding rate[5]	Max. rate at which system measures channel frequency response	≥ 10 kHz
B.4	Dynamic range	Instantaneous dynamic range of measured channel frequency response	> 50 dB
B.5	Amplitude accuracy	Max. amplitude error	< 0.5 dB
B.6	Phase accuracy	Max. phase error	< 5°
B.7	Transmit power[5]	Max. transmit power at antenna input	> 0 dBm
B.8	Noise figure	Receiver noise figure	< 10 dB
B.9	Timing stability	Max. delay drift (over 1 hour, untethered)	< 0.1 µs
B.10	Phase stability	Max. phase drift (over 1 millisecond, untethered)	< 5°

4.2 Contractor/Manufacturer requirements

- The Contractor must offer after sales service through a three (3) year support contract that commences on the product delivery date and includes:
    - software updates;
    - bug fixes;
    - telephone support during regular business hours;
    - one (1) hardware calibration operation per year for a period of three (3) years.

  Whenever the unit must be sent to the contractor for service, the CRC will pay for shipping to the contractor and the contractor will pay for shipping to the CRC.
- The Manufacturer must have valid ISO 9001 certification for at least the previous three (3) years (copies of certifications must be provided).
- The components must be commercially available products.
- A user guide and all specification sheets and manuals must be supplied in English in Portable Document Format (PDF).
- The Contract must include on-site system verification and training as per below:
    - Up to five (5) days training for up to ten (10) people at CRC Facilities located at 3701 Carling Ave., Ottawa, Ontario, Canada. Training must be offered in English.

ANNEX B
BASIS OF PAYMENT

TABLE 1 – INITIAL DELIVERABLES				
	Item Nº	**Initial deliverable description**	**Period (Delivery Date)**	**Quantity**
Goods	1.	All hardware equipment.	**TBD**	1
	2.	All required COTS software.	**TBD**	1
Service	3.	Completion of required software integration and specialized software.	**TBD**	1
	4.	Demonstration and training.	**TBD**	1

TABLE 2 - OPTIONAL DELIVERABLES					
Item Nº	**Optional deliverable description**	**Sub-Option Nº**	**Status**	**Period (Delivery date)**	**Quantity**
1	Frequency band (see sect. 5.2, Item A.1)	37– 40 GHz	Non-Evaluated Option (NEO)		4 transceivers OR 4 transmitters and 4 receivers
2	MIMO Configuration	Ability to configure the system with 2 active Tx ports and 2 active Rx ports (2x2 MIMO)	NEO		
3	Data acquisition Coordinated multi-channel acquisition of digital complex baseband data (I/Q samples) at each terminal • One (1) complex data stream per RF channel • Continuous (“gapless”) for a	Instantaneous bandwidth per channel: 1 channel: ≥ 400 MHz 2 channels : ≥ 200 MHz 3 channels : ≥ 132 MHz	NEO		

	minimum bandwidth value, a minimum duration, and up to three (3) frequency- and phased-locked channels (i.e., for 0x1, 0x2, and 0x3 MIMO configurations) at each terminal.				
4	Integrated LiDAR	Measurement Range: ≥ 200 m Horizontal Field of View: 360° Vertical Field of View: ≥ 30° (min of -15° to +15°) Angular Resolution (Vertical): ≤ 0.35° Angular Resolution (Horizontal/Azimuth): ≤ 0.1° @ 5 Hz rotation/frame rate / ≤ 0.4° @ 20 Hz rotation/frame rate	NEO		1

ANNEX C

SUPPORTING INFORMATION

1.0 Definitions

For the purposes of this document:

- A *channel* is the signal propagation medium between a pair of (radio) terminals.
- *Bidirectional* (as opposed to *unidirectional*) transmission indicates the transmission of signals from one terminal to the other and vice versa in the course of operation (i.e., without reconfiguring the system).
- A *port* is a termination point on a terminal at which an antenna can be connected to the radio-frequency (RF) front-end.
- A *bidirectional port* is a port that can be used both to transmit and to receive signals.
- A *MIMO configuration*, specified by MxN (with integer M, N≥0), indicates a specific combination of ports on a pair of terminals. For example:
    - A 2x2 configuration indicates two (2) ports on each of two (2) terminals.
    - A 1x3 configuration indicates that one terminal has one (1) port, and the other has three (3) ports.
    - A 0x2 configuration, while not a MIMO configuration in the conventional sense, indicates a single terminal with 2 ports.
- The *channel response* is the frequency response, in amplitude and phase, of a channel over a user-specified frequency range.
- A *channel measurement* is a measurement of the channel's properties of interest, generally the channel response.
- The *sounding rate* is the rate at which the channel response is measured.
- *Double-directional* transmission indicates transmission between two terminals equipped with phased array antennas. This term is not to be confused with bidirectional transmission; double-directional transmission (and channel measurements) can be unidirectional.
- The *double-directional channel response*, which characterizes the double-directional properties of a channel, is the channel response as a function of the beam pointing directions of the phased array antennas at both terminals.

- A *double-directional channel measurement* is a measurement of the double-directional channel response.
- The *beam update rate* is the maximum rate at which the beam pointing direction of a phased array antenna can be changed from one direction to another.

- A *beam scan pattern* is a sequence of beam pointing directions used to measure the double-directional channel response.

2.0 Antenna Specifications

Frequency range	27.5-30 GHz
Number of elements	64 (8x8 grid for 2D scanning, i.e., scanning in azimuth and elevation)
Beam pattern	Single beam with programmable scan angle (±60°)
3-dB beamwidth	20° or less in both azimuth and elevation
Directional coverage	360° (3 array antennas x 120° azimuth) and 120° elevation
Beam update rate	15 μs or better
Transmit and receive	Supported

Polarization	Linear (vertical, depending on orientation)
Interfaces	LVDS (control) 2.92mm, “K” connector or equivalent (RF port)
EIRP at 1 dB compression point (i.e., at P1dB)	+50 dBmi
Receiver sensitivity (G/T)	-7 dB/K or better