P.I. "NATIONAL SERVICE FOR THE RADIO FREQUENCIES MANAGEMENT "

TECHNICAL REQUIREMENTS
regarding to acquisition of a specialized Software for operating spectrum monitoring stations with the possibility of storing data on a dedicated server (3 licenses)

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	It will be completed by the tenderer	
	Guaranteed technical specifications	Deviations / Remarks (to be specified)
1. GENERAL NOTES		
The Technical Requirements is an integral part of the Standard Documentation and contains whole set of requirements which is the basis for Technical Proposal preparation by each bidder. The imposed requirements will be considered as a minimum and mandatory. In this order, any submitted tender offer, which deviates from these Technical Requirements, will be taken into consideration only if the Technical Proposal implies the ensuring a qualitative level superior to the minimum requirements of these Technical Requirements. The offer containing technical characteristics of products inferior to those specified in the Technical Requirements will be considered inconsistent and will be rejected.		
2. OBJECT OF THE ACQUISITION		
The object of the procurement procedure is the supply (develop) and installation at three spectrum monitoring stations within the National Radio Monitoring System (hereafter - NRMS) of a specialized Software for operating the spectrum monitoring stations with the possibility of data storage on a dedicated server (hereafter – monitoring software). The given procedure provides the purchase in the first tranche, three licenses from the total of 23 licenses of the monitoring software, expected to be purchased and implemented during the next 5 years.		

3. PURPOSE OF THE ACQUISITION

The purpose of the acquisition of the monitoring software is to modernize the NRMS by replacing the existing ARGUS monitoring software application, so that in addition to the existing functionalities of the NRMS, additionally to be add:
- the possibility of integration the monitoring equipment from different manufacturers within the NRMS;
- aggregation of all measured results, regardless of radio frequency band, duration, time and place of monitoring, on a dedicated server;
- expanding the functionality and possibilities of NRMS, such as: automatic recognition of the received signal type, "machine learning" techniques, measurement/monitoring tasks calendar with automatic feedback of measurement results, etc.

4. THE AMOUNT

- 3 full licenses of monitoring software.

5. MINIMUM REQUIREMENTS

5.1 General Requirements
- Monitoring software must be compatible and work flawlessly with all existing of NRMS hardware. The detailed list of equipment will be presented to potential bidders upon request.
- The monitoring software must be compatible or, if necessary, allow receiving the necessary updates (submodules, options) to be compatible with all the monitoring equipment of the main manufacturers in the field (Rohde&Schwarz, Narda, SAF Tehnika, etc.).

- The monitoring software itself must combine a powerful monitoring tool with easy and efficient operation. - The user interface of the monitoring software, should have an intuitive and easy-to-use graphical interface, to be user friendly. - The monitoring software must perform the measurements and analysis of the results in accordance with the ITU Spectrum monitoring handbook and the ITU-R recommendations: - SM.443-5 (Bandwidth measurement); - SM.1268-5 (Measurement of frequency deviation); - SM.377-4 (Frequency measurement); - SM.1880-2 (Measurement of spectrum occupancy). - The monitoring software will include security elements that ensure access for authorized personnel and allow the identification of the person who performed the measurements. - The monitoring software must be compatible with Windows 10 and 11 (64-bit) operating systems. - The monitoring software must support the IPv6 protocol. - Until the complete replacement of the existing software is completed, the monitoring software must allow operation in hybrid mode together with the existing ARGUS application, i.e. be able to import measurement results from ARGUS. - The monitoring software must be fully licensed without limitations in operation, such as limited duration for one of the options or for the entire application. No shareware, adware or similar applications are allowed. - The monitoring software interface must be in at least three languages: Romanian, English, Russian. If the interface does not have the possibility of being displayed in Romanian and Russian, the developer will assume the obligation to translate the interface into Romanian and Russian within 6 months at most.		

- The monitoring software must allow lossless recording of all measurement results in a database on the local computer on which the monitoring software is running, as well as being automatically or manually transmitted to a dedicated server.

5.2 Dedicated (centralized) server
- The server will be used to save, store and analyze the measurement results and maintain the information about the approved frequencies.
- The server must have a web interface (can be accessed through a web browser) without the need to install any additional applications on the client computers.
- The server interface must be in at least three languages: Romanian, English, Russian. If the interface does not have the possibility of being displayed in Romanian and Russian, the developer will assume the obligation to translate the interface into Romanian and Russian within 6 months at most.
- The server must allow the use of digital maps, which support TMS (Tiled Map Service) and WMS (Web Map Service) protocols.
- The server will include security elements to ensure access only to authorized personnel, with the possibility of setting different levels of privileges (reading, writing, modifying, etc.) for each individual user.
- The server must have the connection interface with ATDI spectrum management applications (Manager, HTZ Communications, etc.) to access radio station information from the databases of these applications, import it and display at least the following fields, with the possibility of introducing other additional fields:
    - Station owner;
    - Radio communications service (e.g. broadcasting service, land mobile, landline, etc.);
    - Transmitting frequency;
    - Receiving frequency;
    - Effective Radiated Power (ERP);

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– Location;
    – Geographical coordinates;
    – The height of the transmitting antenna;
    – Number of the notice, emission license and/or EMC contract;
    – Date of the notice, emission license and/or EMC contract;
    – Station status.
 	
• The server must allow saving, storing and displaying the results of measurements and monitoring. Saving and storage must be possible to perform automatically and/or on demand.
 	
• The server must allow the following measurement and monitoring data to be stored and displayed:
    – Frequency;
    – Electromagnetic field strength;
    – The direction to the transmitter;
    – The degree of spectrum occupancy;
    – Signal bandwidth;
    – Modulation measurements;
    – Timestamp;
    – Position;
    – Station identifier;
    – Settings used during measurements.
 	
• The server must allow all data to be displayed simultaneously in the table and on the map.
 	
• The server must be able to display color markers of signal levels.
 	
• The server must allow sorting of the data of interest by different parameters as well as filtering by any field.
 	
• The functionality of the map of authorized users must provide the possibility to view all authorized users, which are located in a certain location of interest (all authorized users are displayed on the map if the map marker is clicked).		

- The server must allow importing and exporting data in .CSV format.
- Server must provide functionality to provide saving and storing of sample spectra.

5.3 Geographic information system (GIS)

The monitoring software must include GIS program modules, with the possibility of displaying the direction to the transmitter, the positions of the transmission sources, the spectrum monitoring stations overlaid on the digital map of the area.

Map control must include:

- Selection of the map of interest;
- Select and display different types of information (monitoring results, authorized users) over the selected map;
- Possibility of zoom and panorama;
- Indication of the position on the map of the cursor, selectable by the user, in degrees, minutes, seconds;
- Possibility to measure distance and azimuth between two points;
- Screen and map printing.

The application of the geographical information system must allow:

- Presentation of the location of all existing spectrum monitoring and DF (direction finding) stations in the NRMS (fixed stations and mobile stations);
- Presentation on the map of the direction of arrival of the signal with the specification of the azimuth to the signal source, provided by a DF station or several DF stations at the same time;
- Presentation on the map of the approximate location of the emission source, calculated by triangulation;

- Cumulative presentation on the map of several directions of arrival of the signal transmitted by the detection receiver with the possibility of selecting the number of directions of arrival;
- Presentation on the map of the positions of the emission sources, of the monitoring stations with the possibility of sorting the objects and areas of interest;
- Use of digital maps, which support TMS protocols (Tiled Map Service) and WMS (Web Map Service);
- Export of geographic data in formats KML, KMZ, etc.
 	
5.4 Main operating facilities of the monitoring software
• To allow setting all the necessary parameters of the monitoring receiver, by selecting:
   - receiving frequency;
   - frequency band;
   - modulation type;
   - IF bandwidth;
   - used antenna;
   - reference level (amplification, attenuation);
   - measurement speed;
   - detector type;
   - filter bandwidth selection, etc.;
• Display the signal spectrum;
• To have the possibility of directing the reception antennas (changing azimuth, polarization, height) and switching all existing equipment (receivers, antennas) at the monitoring station;
• To receive the demodulated audio signal, ensuring hearing on headphones/speakers connected to the work computer and storing digital audio files;		

- To command the DF equipment to obtain line of bearing results of the selected transmitter and plot the results on the digital map; - To be able to define: "start/stop" frequencies, channel bandwidth and duration of the scan process; - To allow simultaneous measurement for a single frequency of at least the following parameters: - Frequency; - Electromagnetic field strength level; - Modulation parameters; - Occupied bandwidth; - The direction to the transmitter and the quality of determination; - RDS parameters; - Spectrogram of the signal; - Audio demodulation. - The process of measuring parameters and displaying their values in numerical format must take place instantly, without the need for additional manipulations, such as, for example, the use of markers. - To allow sequential measurements of multiple frequencies based on a list of frequencies. - Allow scheduled measurements and real-time (live) measurements; - Have resources of verifying the acceptance of orders and notifying their status; - To have additional functions such as: markers, max-hold, waterfall, etc.; - To allow the mutual tracing of commands to all monitoring and DF stations (fixed and mobile) of the NRMS, in order to monitor (measure) one or more frequencies/frequency bands, as well as take over the obtained data from any of this stations; - To allow mutual tracing of commands to all DF stations (fixed and mobile) of the NRMS, in order to locate (obtain the "line of bearing" results) the		

signal source, with the presentation of the obtained results, including their appearance on the map (the location of the used DF stations, the direction of receiving signal for each station and the location of the signal source);

- To have facilities for creating tasks in automatic measurements and monitoring mode with the issuance of predefined alerts and measurement/monitoring results.

5.5 Scanning functions
The spectrum scan feature will allow:

- Determining the degree of spectrum occupancy. This operation must allow spectrum occupancy to be investigated and the operator must be able to select one or several of the channel characteristics results.

- Determination of unauthorized and non-compliant emissions. This operation must allow investigation of the scanned spectrum by automatically comparing the list of detected signals with the list of authorized emissions or with the predefined spectral mask in the respective frequency band.

5.6 Automatic signal type detection features

- It must be possible to set number of frequency ranges for detection of signal. Set ranges must be scanned sequentially and each frequency channel inside range must be evaluated for possible signal;

- The following signal detection modes must be available: by spectrum shape mode and "machine learning" mode.

- In the detection mode by spectrum shape, the signal must be considered detected if the spectrum shape in a given channel corresponds to one of the predefined samples. The operator must be able to set the threshold, how close the shape of the signal and that of the sample must be to be considered as a detected signal.

- The monitoring software must include a sample set of generic spectrum shapes that allow most signals to be detected.
- Monitoring software must include "machine learning" functionality to generate samples of spectrum shapes from measurement results.
- The detection time and field strength for each signal should be recorded and displayed.
- For each frequency channel in which the signal was detected, the following statistics should be visible: spectrum of all combined signals (except spectrum without signals), maximum values of electromagnetic field strength and occupied bandwidth, number of detections, field strength and the occupancy graph as a function of time.
- For each frequency channel where signal was detected, the owner should be shown and if location is available it should be shown on the map. The necessary license information must be extracted from the management database with the possibility of local additions.
- Signal detection results must be stored on the dedicated (centralized) server.

5.7 Scheduled operations (automatic measurements)

This mode shall allow the operator to schedule measurements for one or more monitoring and/or DF stations. Once scheduled no further connection to the station should be required until the results are retrieved.

- Scheduled operations must allow measurements of the following parameters:
    - Frequency
    - Electromagnetic field strength
    - Occupied bandwidth
    - The direction to the transmitter
    - The degree of occupancy.

- The application must provide resources to verify acceptance of planned operations and notify when results are available for presentation.
- Scheduling must allow:
    - Establishing multiple tasks simultaneously.
    - Setting the start/stop date and time and the duration of each task.
    - Task priority type.
    - Operator review of any scheduled operation, before or after transmission to the monitoring and DF station.
    - Sending various types of alerts by e-mail in case of errors such as interrupting the measurement work, blocking the equipment, etc.

5.8 Displays

The monitoring software must allow the results to be displayed in tabular and/or graphical format.

Display formats must include at least:
- Spectrum display:
    - Frequency domain panorama (signal level as a function of frequency)
    - Spectrogram (frequency band versus time with color-coded level). View in 2D format (waterfall).
- Signal parameters (depending on receiver capabilities):
    - Frequency
    - Electromagnetic field strength (with the possibility of indicating the maximum value)
    - Modulation parameters
    - Occupied bandwidth
    - Frequency tolerance (offset)
    - RDS parameters for sound broadcasting signals.

- The direction and location of the transmitter, where applicable:
  - List of results
  - The direction to the transmitter on the displayed map
  - Localization (triangulation) results, including cumulative display of measured directions and establishment of average direction, calculated with maximum likelihood.
- Spectrum occupancy:
  - Occupancy as a function of frequency or channel in various time intervals
  - Electromagnetic field strength as a function of frequency or channel.
- Unauthorized emissions. Tabular presentation of unauthorized transmitters based on a list (spectral masks) of authorized transmitters.

5.9 Alerts

The monitoring software must allow the setting and transmission of alerts in case of exceeding predefined values such as: change (increase/decrease) with predefined values of the signal level, frequency/amplitude modulation; the appearance of a new signal or the disappearance of an existing one. Alert notification must be sent by email.

5.10 Reports

The results of measurements and monitoring must be presented as reports in tabular and/or graphical format. The available standard reports must be able to be modified as needed. Possibility to create reports by combining several files with the measured results. Reports must be compatible with Word, Excel, etc.

6. WARRANTY AND TECHNICAL SUPPORT		
The warranty period must be at least 24 months for all components of the monitoring software and will start from the date of signing the acceptance report without objection, under the conditions stipulated in the purchase contract. During the entire warranty period, the supplier has the obligation to ensure, without additional costs and without any conditions, the following: • resolving all functionality errors (bugs, non-conformances and others); • periodic delivery and implementation of updates; • technical support for the staff who will use the monitoring software. In case if during the warranty period the supplier will implement a new version of the monitoring software, which will be incompatible with the previous version, and the previous version will no longer have technical support and updates, the supplier will deliver and implement the new version at no additional cost. During the warranty period, at NSRFM request, the supplier will develop and deliver any update, driver, option necessary for the integration of new equipment, without any additional conditions and costs. With the purchase of new licenses in the following installments, the warranty period of these licenses will also extend to previously purchased licenses.		
7. POST WARRANTY		
The supplier has the obligation to ensure, after the expiration of the warranty period, under the terms of a subsequent contract, the availability of updates and technical support for a period of at least 10 years for all the components of the offered monitoring software.		

8. SOFTWARE INSTALLATION AND PERSONNEL TRAINING		
The supplier will install and set up all monitoring software components at 3 monitoring stations and the necessary applications for the organization of the dedicated server. The supplier will organize staff training on the architecture, composition and use of the monitoring software at the NSRFM headquarter or online.		
9. ELIGIBILITY CRITERIA FOR TENDERERS		
The tenderer will provide documents establishing the experience and capacity, as follows: • The bidder will have a minimum 3 years of experience in providing similar software applications; • The bidder/developer must have at least 5 years of experience in the development of specialized software in the domain of radio frequency spectrum monitoring. *Note:* *If the bidder is not the developer of the monitoring software, the references of the solution developer are accepted, by presenting the authorization from the developer and the proof of partnership and proof of proficiency in servicing and operating the monitoring software.*		
10. METHOD OF EVALUATION OF OFFERS		
The Bidder must provide for testing and evaluation a "demo" version (without any functional restrictions) of the monitoring software with a license validity of at least 14 days and provide the necessary support for its installation and testing.		

The offer that fully meets the above requirements and meets the score with the highest result from the application of the following evaluation factors will be selected:

1. Total price for 3 licenses (**P1**), in Lei without VAT – **70** points;
2. The graphical interface (**P2**), evaluated as result of testing the "demo" version – **30** points.

The maximum total score of the offer can be equal to 100 points and will be calculated according to the formula:

$$P_{total} = P1 + P2,$$

from which:

P1 – the score for the total price for 3 licenses, is granted as such:
  a) for the lowest total price for 3 licenses (**price$_{minim}$**) **70** points are awarded;
  b) for another total price (**price$_{(n)}$**) than the one provided in pt. a) the score is awarded as follows:
  $$P1_n = (price_{minim} / price_{(n)}) \times 70.$$

P2 – the score for the graphical interface is awarded as follows:
  a) for the most intuitive and easy-to-use graphical interface **30** points are awarded;
  b) for other graphical interfaces than that provided in pt. a) the corresponding score is awarded in descending order **25, 20, 15, 10, 5, 0**.

11. PRESENTATION MODE OF COMPLIANCE WITH THE ABOVE REQUIREMENTS

Conformity and compliance with all the requirements presented above must be provided in detail for each requirement in the **Guaranteed Technical Specifications** column with technical support documents, illustrations, schematics, diagrams, drawings, catalogs of the software suppliers offered. Upon request, the bidder will present live demonstrations of the possibilities and facilities of the monitoring software.