VAS
Elektroniskie
sakari

Valsts akciju sabiedrība "Elektroniskie sakari"
Reģistrācijas Nr. 40003021907
Eksporta iela 5, Rīga, LV-1010, Latvija
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Riga 7th of November 2022

POWER OF ATTORNEY Nr. 4.4-8.1/18/2022

State Joint Stock Company „Electronic Communications Office" (hereinafter referred to as - Electronic Communications Office), registration No. 40003021907, legal address: Eksporta street 5, Riga, Latvia, LV-1010, represented by its Chairman of the Management Board Jānis Bārda and Member of the Management Board Laila Līduma, hereby authorizes the Head of the Radiofrequency monitoring department **Māris Aleksandrovs**, to unilaterally:

1) represent Electronic Communications Office and to act in the name of Electronic Communications Office regarding any action of Electronic Communications Office in the Public and private procurement system of Moldova (achizitii.md);

2) submit procurement documents in the Public and private procurement system of Moldova and receive any documents, decisions related to the submitted documents.

The power of attorney authorizes to perform all activities, including signing papers, documents, contracts, in the name of Electronic Communications Office related to the above mentioned task.

The power of attorney has been issued without the right of sub-authorization.
This power of attorney becomes effective immediately.

Chairman of the Management Board Jānis Bārda

Member of the Management Board Laila Līduma

Chapter II. Information on the economic operator

The section is filled in only by the economic operators.

Position code	Requirements content	Response
1	2	3
A. Information on the economic operator		
2A.1	Name of economic operator	VAS „Elektroniskie sakari" State Join Stock Company Electronic Communication Office
2A.2	Country	Latvia
2A.3	Postcode	LV-1010
2A.4	City / Town	Riga
2A.5	Legal address	Eksporta street 5, Riga, Latvia, LV-1010
2A.6	Web page	www.vases.lv
2A.7	Contact person or persons	Māris Aleksandrovs
2A.7.1	*Telephone*	+371 29168983
2A.7.2	*E-mail address*	*maris.aleksandrovs@vases.lv*
2A.8	Unique identification number (IDNO / IDNP)	40003021907
2A.9	VAT code number	LV 40003021907
2A.10	Organizational-legal form of entrepreneurial activity	State Join Stock Company
2A.11	Information on the names of the shareholders/ associates/ beneficial owner	
2A.11.1	Names of shareholders / associates	The Ministry of Environmental Protection and Regional Development
2A.11.2	Name of the beneficial owner [beneficial ower – a natural person who ultimately owns or controls a natural or legal person or a beneficiary of an investment company or an administrator of the investment company, or a person in whose name an activity is carried out or a transaction is carried out and/or holding, directly or indirectly, property right or control of at least 25% off the shares or voting rights of the legal person or over assets under fiduciary administration]	State Join Stock Company Electronic Communication is owned by the Republic of Latvia, therefore a beneficial owner cannot be established
2A.11.3	Citizenship of the beneficial owner (permanent legal-political link of the natural person defined in heading 2A.11.2)	State Join Stock Company Electronic Communication is owned by the Republic of Latvia, therefore a beneficial owner cannot be established
2A.12	The economic operator is: • small enterprise • medium enterprise • and others ☐	Medium enterprise
2A.13	If the procurement is reserved: is the economic operator a secured workshop or a social enterprise,	☐Yes ☐**No**

	or will it ensure the fulfillment of the contract in the context of secured employment programs?	
2A.13.1	*If Yes, what is the appropriate percentage of disabled or disadvantaged workers?*	*| number |*
2A.13.2	*Specify which category or which categories of disabled or disadvantaged workers belong to the employees concerned?*	*|text|*
2A.14	*Does the economic operator participate in the public procurement procedure together with other economic operators?*	☐Yes ☐**No**
2A.14.1	*If Yes, specify the role of the economic operator within the group (leader, responsible for performing specific tasks, etc.).*	*|text|*
2A.14.2	*Name the economic operators participating in the respective public procurement procedure.*	*|text|*
2A.14.3	*Specify the name of the participating group.*	*|text|*
Note. If you answered Yes to question 2A.14, make sure that the economic operators mentioned submit a separate ESPD form.		
B. Information on the representatives of the economic operator		
Indicate the name of the person (s) empowered to represent the economic operator for the purposes of this public procurement procedure.		
2B.1	Name and surname	Māris Aleksandrovs
2B.2	Position / acting as …	Head of the Radiofrequency monitoring department POWER OF ATTORNEY Nr. 4.4-8.1/18/2022
2B.3	Country	Latvia
2B.4	Phone	+371 29168983
2B.5	E-mail address	*maris.aleksandrovs@vases.lv*
C. Information on the use of the capacities of other entities		
2C.1	Does the economic operator use the capacities of other entities to meet the selection criteria set out in Chapter IV, as well as (if applicable) the criteria and rules set out in Chapter V below?	☐Yes ☐**No**
Note. If you answered Yes to question 2C.1, submit a separate ESPD form containing the information required in Sections A and B of that Chapter and Chapter III for each of the entities concerned, duly completed and signed by the entities concerned. We draw attention to the fact that the technicians or technical bodies involved must also be included, whether or not they are part of the economic operator's enterprise, in particular those responsible for quality control and, in the case of public works contracts, technicians or technical bodies used by the economic operator in order to perform the works. To the extent relevant to the specific capacity (ies) used by the economic operator, include the information set out in Chapters IV and V for each of the entities concerned.		
D. Information on subcontractors on whose capacities the economic operator relies		
2D.1	Does the economic operator intend to subcontract any part of the contract with other economic operators?	☐Yes ☐**No**
2D.1.1	*If Yes, list the proposed subcontractors.*	*|text|*

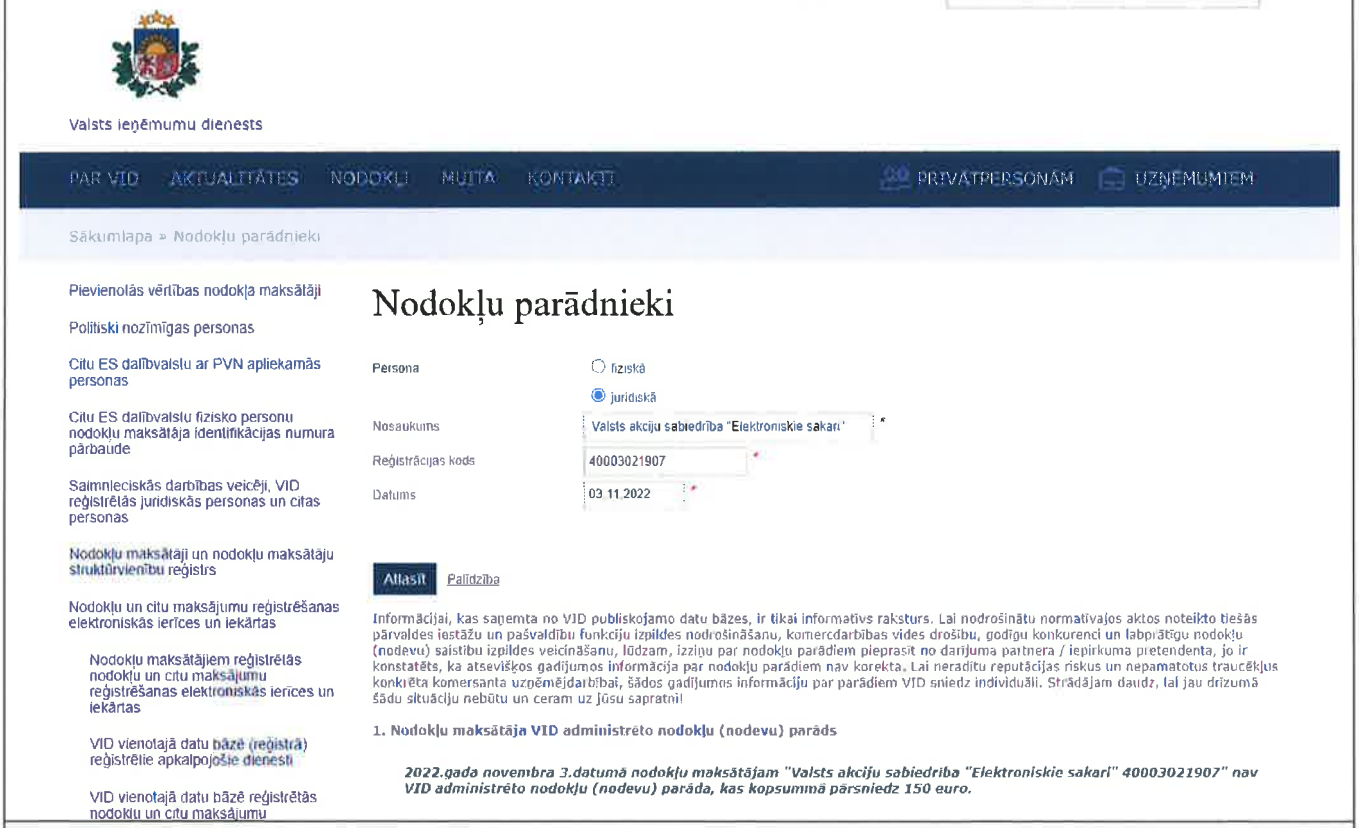
Chapter III. Reasons for exclusion from the public procurement procedure

The section is filled in by the economic operators.

Position code	Requirements content	Response
A. Reasons on convictions by the final judgment of a court		
1	2	3
3A.1	**Participation in a criminal organization.** The economic operator itself or any person who is a member of its administrative, management or supervisory body or who is empowered for representation, decision or control within it has been convicted by a final judgment for participating in a criminal organization, by a conviction ruled less than five years ago or in which a period of exclusion provided for directly in the conviction continues to apply?	☐Yes ☐**No**
3A.2	**Corruption.** The economic operator itself or any person who is a member of his administrative, management or supervisory body or who is empowered for representation, decision or control within it has been the subject of a final conviction for corruption, by a conviction ruled less than five years ago or in which a period of exclusion provided for directly in the conviction continues to apply?	☐Yes ☐**No**
3A.3	**Fraud.** The economic operator itself or any person who is a member of its administrative, management or supervisory body or who is empowered for representation, decision or control within it has been convicted of fraud by a final judgment, by a conviction ruled less than five years ago or in which a period of exclusion provided for directly in the conviction continues to apply?	☐Yes ☐**No**
3A.4	**Terrorist crimes or crimes related to terrorist activities.** The economic operator itself or any person who is a member of its administrative, management or supervisory body or who is empowered for representation, decision or control within it has been convicted of terrorist crimes or crimes related to terrorist activities, ruled by a final judgment, by a conviction ruled less than five years ago, or in which a period of exclusion provided for directly in the conviction continues to apply?	☐Yes ☐**No**
3A.5	**Money laundering or terrorist financing.** The economic operator itself or any person who is a member of its administrative, management or supervisory body or who is empowered for representation, decision or control within it has been convicted of terrorist crimes or crimes related to terrorist activities, ruled by a final judgment, by a conviction ruled less than five years ago, or in which a period of exclusion provided for directly in the	☐Yes ☐**No**

	conviction continues to apply?	
3A.6	**Child labour and other forms of human trafficking.** The economic operator itself or any person who is a member of its administrative, management or supervisory body or who is empowered for representation, decision or control within it has been convicted by a final judgment for exploitation of child labour and other forms of trafficking in human beings, by a conviction ruled less than five years ago or in which a period of exclusion provided for directly in the conviction continues to apply?	☐Yes ☐**No**
3A.7	If the answer is Yes to at least one of questions 3A.1 to 3A.6, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?	☐Yes ☐No
3A.7.1	*If Yes, describe these measures.*	*|text|*
B. Reasons for the payment of taxes and / or social security contributions		
	Payment of taxes	
3B.1	Has the economic operator fulfilled its obligations regarding the payment of taxes, fees and social contributions in accordance with the legal provisions in force in the Republic of Moldova or in the country where it is established?	☐**Yes** ☐No
3B.1.1	*If No, how was the obligation to pay taxes, fees and social security contributions established?*	*|text|*
3B.1.2	*If the infringement concerning obligations to pay taxes, duties and social contributions has been established by a court or administrative decision, is that decision final?*	☐Yes ☐No
3B.1.3	*If the infringement with regard to the obligations relating to the payment of taxes, duties and social contributions has been established by a court or administrative decision, specify the date and number of the decision.*	*|text|*
3B.2	Does the economic operator benefit, in accordance with the law, from the staggering of the obligations to pay taxes, fees and social security contributions or other facilities for their payment, including late fees (penalties) and / or fines? Note: *To be filled in only if you answered No, to question in 3B.1.*	☐Yes ☐No
3B.2.1	*If Yes, is the economic operator able to provide the act on the staggering of the obligations to pay taxes, fees and social security contributions or other facilities in order to pay them?*	☐Yes ☐No
3B.3	Is the economic operator able to provide a certificate on the payment of taxes or to provide information on the fulfillment of tax obligations?	☐**Yes** ☐No
3B.4	Is the information on the absence / existence of arrears from the national public budget available free of charge to the authorities, by accessing a national database? If so, specify the information that would allow verification.	Internet address: https://www6.vid.gov.lv/NPAR web page only in

		Latvian
		Issuing authority or body: State Revenue Service
		Precise documentation reference: Certificate from 4 November 2022



C. Inclusion of economic operators in the prohibition list		
3C.1	Is the economic operator included in the prohibition list of economic operators?	☐Yes ☐**No**
3C.1.1	*If the answer is Yes to question 3C.1, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3C.1.2	*If Yes, describe these measures.*	*text*
D. Grounds related to insolvency, conflicts of interest or professional misconduct		
	Applicable obligations in the field of environment, labour and social security	
3D.1	Has the economic operator breached its environmental obligations in the last 3 years?	☐Yes ☐**No**
3D.1.1	*If the answer is Yes to question 3D.1, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3D.1.2	*If Yes, describe these measures.*	*text*
3D.2	Has the economic operator violated its social obligations in the last 3 years?	☐Yes ☐**No**

3D.2.1	*If the answer is Yes to question 3D.2, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3D.2.2	*If Yes, describe these measures.*	*|text|*
3D.3	Has the economic operator violated its labour obligations in the last 3 years?	☐Yes **☐No**
3D.3.1	*If the answer is Yes to question 3D.3, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3D.3.2	*If Yes, describe these measures.*	*|text|*
	Insolvency	
3D.4	Is the economic operator in a situation of insolvency or liquidation of the entrepreneurial activity as a result of a court decision?	☐Yes **☐No**
3D.4.1	*If the answer is Yes to question 3D.4, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3D.4.2	*If Yes, describe these measures.*	*|text|*
	Assets managed by the liquidator	
3D.5	Are the assets of the economic operator managed by a liquidator or a court?	☐Yes **☐No**
3D.5.1	*If the answer is Yes to question 3D.5, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3D.5.2	*If Yes, describe these measures.*	*|text|*
	Economic activities are suspended	
3D.6	Are the economic activities of the economic operator suspended?	☐Yes **☐No**
3D.6.1	*If the answer is Yes to question 3D.6, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3D.6.2	*If Yes, describe these measures.*	*|text|*
	Agreements with other economic operators aimed at distorting competition	
3D.7	Has the economic operator, in the last 3 years, concluded agreements with other economic operators that have as object the distortion of competition, fact ascertained by decision of the competent body in this respect?	☐Yes **☐No**
3D.7.1	*If the answer is Yes to question 3D.7, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐*Yes* ☐*No*
3D.7.2	*If Yes, describe these measures.*	*|text|*
	Conflict of interests	
3D.8	Is the economic operator in a situation of conflict of interest that cannot be remedied?	☐Yes **☐No**

3D.8.1	*If the answer is Yes to question 3D.8, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐*Yes* ☐*No*
3D.8.2	*If Yes, describe these measures.*	*|text|*
	Professional ethics	
3D.9	Has the economic operator been convicted, in the last 3 years, by a final decision of a court, for an act that violated professional ethics or for committing a mistake in professional matters?	☐Yes ☐**No**
3D.9.1	*If the answer is Yes to question 3D.9, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐Yes ☐No
3D.9.2	*If Yes, describe these measures.*	*|text|*
	Integrity	
3D.10	Has the economic operator, in the last 3 years, been guilty of a professional misconduct, which calls into question his integrity?	☐Yes ☐**No**
3D.10.1	*If the answer is Yes to question 3D.10, can you provide evidence that the measures taken are sufficient to demonstrate reliability, despite the existence of a ground for exclusion?*	☐*Yes* ☐*No*
3D.10.2	*If Yes, describe these measures.*	*|text|*

Chapter IV. Qualification and selection criteria for economic operators

The section is filled in by the contracting authority / entity (column no. 2) and the economic operators (column no. 3).

Position code	Requirements content	Response
1	**2**	**3**
A. Ability to perform professional activity		
4A.1	Is the economic operator able to provide the document / documents proving its registration?	☐**Yes** ☐No
4A.1.1	*Certificate of registration of the enterprise: Extract from the State Register/ Ascertaining certificate issued by the competent trade register regarding the founders and the administrator (according to point 16 of announcement of participation)*	*REGISTER OF ENTERPRISES OF THE REPUBLIC LATVIA* *Certificate No. 7-3-90439*
4A.1.2	*Are the documents of registration of the entrepreneurial activity available free of charge to the authorities, from a national database? If Yes, specify the information that would allow verification.*	*Internet address: https://www.ur.gov.lv/en/legal-entity/?id=40003021907* *Issuing authority or body: REGISTER OF ENTERPRISES OF THE REPUBLIC LATVIA*

		Exact documentation reference: Certificate No.7-3-90439
4A.2	Does the entrepreneurial activity have a certification and / or an equivalent authorization related to the object of the contract award procedure, within a national system?	☐**Yes** ☐No
4A.2.1	*If Yes, is the economic operator able to provide the document (s) proving the certification and / or authorization of its activity?*	☐**Yes** ☐No
4A.2.3	*Are the certification or authorization documents available free of charge to the authorities, from a national database? If Yes, specify the information that would allow verification.*	*Internet address: No* *Issuing authority or body: VAS „Elektroniskie sakari"* *State Join Stock Company „Electronic Communication Office"* *Exact documentation reference: Regulations of enterprise*
4A.3	Do the types of activity, and / or certification, and / or authorization for entrepreneurial activity, cover the selection criteria imposed by the contracting authority / entity in the notice / invitation to participate?	☐**Yes** ☐No
B. Economic and financial capacity		
	Bank statements	
4B.1	Is the economic operator able to provide bank statements or, where appropriate, evidence of occupational risk insurance in accordance with the requirements of the award documentation?	☐Yes ☐**No**
4B.1.1	*Is the information referred to in point 4B.1 available free of charge to the authorities, from a national database? If Yes, specify the information that would allow its verification.*	*Internet address: |text|* *Issuing authority or body: |text|* *Exact documentation reference: |text|*
	Annual turnover (sales volume) **Not applicable**	
4B.2	The economic operator is able to demonstrate an annual turnover, as follows: Value _____ Period _____ *Note. The contracting authority shall complete the amount and the period*	☐Yes ☐No

4B.2.1	*Specify the annual turnover, according to the data in the financial report.*	*Value [number]* *Year |text|*
	Average annual turnover **Not applicable**	
4B.3	The economic operator is able to demonstrate an average annual turnover, as follows: *The turnover requirements are applicable to the Bidder's company or association, if the Bidder is represented by a form of association of two or more companies. The turnover will be completed for each member of the association, as well as for the association, at a cumulative level.*	☐Yes ☐No
4B.3.1	*Specify the turnover according to the data in the financial report.*	*Value [number]* *Year |text|* *Value [number]* *Year |text|* *Value [number]* *Year |text|* *Total average value [number]*
	Financial report **Not applicable**	
4B.4	Is the economic operator able to provide the registered financial report, extracted from the financial report?	☐Yes ☐No
4B.5	Is information on the economic and financial situation freely available to authorities from a national database? If so, please specify the information that would allow verification.	*Internet address: |text|* *Issuing authority or body: |text|* *Exact documentation reference: |text|*
C. Technical and / or professional capacity		
4C.1	The economic operator is able to provide the documents requested by the contracting authority / entity in the contract notice, which demonstrates the technical and / or professional capacity to perform the future contract.	**☐Yes** ☐No
4C.1.1	*Is information on technical and/or professional capacity freely available to authorities from a national database? If so, please specify the information that would allow verification.*	*Internet address: No* *Issuing authority or body: No* *Exact documentation reference: No*
	The development of the program "SKUDRA" by the personnel forces of the Technical Department of State Join Stock Company „Electronic Communication Office" started in August 2015.	

	In the inventory of fixed assets programme „SKUDRA" is taken on 6 January 2016 (Inventory number PL-3302), from that moment programme „SKUDRA" is put in service	
	Technical installations and quality assurance measures **Not applicable**	
4C.2	Is the economic operator able to provide details of the technicians or technical bodies specified in the contract notice / award documentation that the contracting authority / entity may request, in particular those responsible for quality control in connection with this public procurement exercise ?	☐Yes ☐No
4C.3	Is the economic operator able to provide information on the management and traceability systems used in the supply chain?	☐Yes ☐No
4C.3.1	*Is the information available free of charge to the authorities, from a national database? If Yes, specify the information that would allow verification.*	*Internet address:* *|text|* *Issuing authority or body:* *|text|* *Exact documentation reference:* *|text|*
	Machinery, installations and technical equipment **Not applicable**	
4C.4	Does the economic operator have the machinery and equipment necessary for the proper fulfillment of the public procurement contract?	☐Yes ☐No
4C.5	Is the economic operator able to provide information on the specific endowments, machinery and equipment necessary for the performance of the contract, in accordance with the requirements set out in the contract notice and the award documentation?	☐Yes ☐No
	Professional training and qualification of staff **Not applicable**	
4C.6	Does the economic operator have the specialized personnel, in accordance with the requirements set out in the contract notice and the award documentation?	☐Yes ☐No
4C.7	Is the economic operator able to provide information on the specialized personnel proposed for the execution of the contract, according to the requirements set out in the contract notice and the award documentation?	☐Yes ☐No
4C.8	Indicate the average annual number of staff employed in the last three years of activity.	Year |text| Employees [number] Year | text | Employees [number] Year | text | Employees [number]
	Number of management staff members **Not applicable**	
4C.9	Indicate the number of management personnel of the economic operator during the last three years.	Year | text | Persons [number] Year | text |

		Persons [number] Year | text | Persons [number]
	Samples, descriptions, photos	
4C.10	Is the economic operator able to provide samples (specimen), descriptions and / or photos of the products / services to be supplied / provided, according to the requirements set out in the award documentation? All the requirements presented above must be provided in detail for each requirement in the 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.	☐**Yes** ☐No
	For public procurement contracts of works **Not applicable**	
4C.11	During the reference period, did the economic operator perform works specific or similar to the procurement object indicated in the contract notice and in the award documentation?	☐Yes ☐No
4C.11.1	*If Yes, list them specifying the description of the works, their value, the start date, the date of the receipt at the end of the works, the beneficiary and other relevant information.*	*|text|*
	For public procurement contracts of goods	
4C.12	During the reference period, did the economic operator make deliveries specific to the procurement object indicated in the contract notice and in the award documentation?	☐**Yes** ☐No
4C.12.1	*If Yes, list them specifying the description on the list of main similar goods delivered in last 3 years*	*The first agreement with National Armed Forces on the sale of program „SKUDRA" licenses was concluded on 19 March 2018.* *Agreement No. VASES 2018/7-K "Database server software".* *SKUDRA patrol licences – 3 units SKUDRA server Modul - 1 unit*
	For public procurement contracts of services **Not applicable**	
4C.13	During the reference period, did the economic operator provide services similar to the procurement object indicated	☐Yes ☐No

	in the contract notice and in the award documentation?	
4C.13.1	*If Yes, list them specifying the description of the services, their value, execution time, start date, beneficiary and other relevant information.*	
4C.14	If the answer is Yes to one of questions 4C.11 to 4C.13, can you provide evidence of the completion of the work, the delivery of the goods, the provision of similar services in accordance with the requirements of the award documentation?	☐Yes ☐No
D. Quality assurance standards		
4D.1	Is the economic operator able to provide certificates issued by independent bodies certifying that the economic operator complies with the quality assurance standards according to the requirements set out in the contract notice and in the award documentation?	**☐Yes** ☐No
4D.2	Is the information on quality assurance standards available free of charge to the authorities, from a national database? If Yes, specify the information that would allow verification.	Internet address: No Issuing authority or body: BUREAU VERITAS LATVIA Exact documentation reference: ISO 9001:2015 Certificate No.LV006673 ISO/IEC 27001:2013 Certificate No.LV007320
E. Environmental protection standards **Not applicable**		
4E.1	Is the economic operator able to provide certificates issued by independent bodies certifying that the economic operator complies with environmental protection standards, in accordance with the requirements set out in the contract notice and in the award documentation?	☐Yes ☐No
4E.2	Is the information on environmental protection standards available free of charge to the authorities, from a national database? If Yes, specify the information that would allow verification.	Internet address: | Text | Issuing authority or body: | Text | Exact documentation reference: | Text |
F. Allowing controls **Not applicable**		
4F.1	Does the economic operator allow the contracting authority / entity to carry out verifications regarding the economic and financial, production or technical capacities regarding the	☐Yes ☐No

	execution of the future public procurement contract?	

Chapter V. General guidelines for qualification and selection criteria

The section is filled in by the contracting authority / entity (column no. 2) and the economic operators (column no. 3).

Position code	Requirements content	Response
1	2	3
A. Fulfillment of all required selection criteria		
5A.1	Is the economic operator able to provide in the automated information system "State Register for Public Procurement" or by electronic means, or if necessary, on paper to the contracting authority: forms, certificates, notices and other documents indicated by the authority / the contracting entity in the contract notice and in the award documentation? **Deadline 3 work days from request.** *Note. The number of days shall be indicated by the contracting authority taking into account the quantity and character of the documents requested.*	☐**Yes** ☐No
5A.2	Is the information enabling the contracting authority / entity to obtain the documents indicated in the contract notice and in the award documentation free of charge and directly by accessing a national database in any State? If Yes, specify the information that would allow verification.	Internet address: 1. *https://www.ur.gov.lv/en/legal-entity/?id=40003021907* 2. https://www6.vid.gov.lv/NPAR *web page only in Latvian*
		Issuing authority or body: 1. *REGISTER OF ENTERPRISES OF THE REPUBLIC LATVIA* 2. *State Revenue Service*
		Exact documentation reference: 1. *Certificate No.7-3-90439* 2. *Certificate from 4 November 2022*

Chapter VI. Pre-selection of candidates for the procedure of awarding the public procurement contract

The section is requested by the contracting authority only in the context of public procurement procedures: restricted tendering, negotiation, competitive dialogue and innovation partnership.

Not applicable

Position code	Requirements content	Response
1	2	3
A.	**Fulfillment of all the required selection criteria**	
6A.1	The economic operator / candidate meets the selection criteria set out by the contracting authority in the contract notice and in the	☐Yes ☐No

	award documentation.	
6A.2	The economic operator / candidate has and is able to provide in the Automated Information System "State Register of Public Procurement" or by electronic means, or if necessary, on paper to the contracting authority certified or other forms of supporting documents, as it is required in the contract notice and in the award documentation.	☐Yes ☐No

Chapter VII. Final statements

The economic operator declares that the information given in Chapters II to V (as the case may be II -V) is accurate and correct, and is fully aware of the consequences of serious cases of misrepresentation.

The economic operator formally declares that it may provide, at the request of the contracting authority / entity without delay, the required certificates and supporting documents, unless the contracting authority / entity has the possibility to obtain the supporting documents in question directly by accessing a relevant database, which is available free of charge, provided that the economic operator has provided the necessary information (internet address, issuing authority or body, exact reference of the documentation) to enable the contracting authority or contracting entity to do so and access to that information shall be granted, if necessary.

(To be completed and signed by the economic operator)

Name: Jānis Bārda
Position: Chairman of the Management Board
Date: 08.11.2022.
Address: Eksporta street 5, Riga, Latvia, LV-1010

Signature 

Name: Laila Līduma
Position: Member of the Management Board
Date: 08.11.2022.
Address: Eksporta street 5, Riga, Latvia, LV-1010

Signature 

Annex no. 22
to the Approved Standard Documentation
by Order of the Ministry of Finance
no. 115 from 15.09.2021

Techinal specifications

[This table will be completed by the bidder in columns 2, 3, 4, 6, 7, and by the contracting authority – in columns 1, 5]

Procurement procedure number ocds-b3wdp1-MD-1666087985731 from 18 Oct 2022
The object of the purchase *Specialized software for operating the spectrum monitoring stations with the possibility of data storage on a dedicated server*

The name of the goods	**Model of the goods**	**Country of origin**	**Manufacturer**	**The full technical specification requested by the contracting authority**	**The full technical specification proposed by the bidder**	**Reference standards**
1	2	3	4	5	6	7
Goods/services						
Specialized software for operating the spectrum monitoring stations with the possibility of data storage on a dedicated server	SKUDRA	Latvia	VAS "Elektroniskie sakari" (eng. Electronic Communications Office of Latvia)	*According to the techinical specifications*	1.SKUDRA SERVER v.5.3.2 user guide; 2.SKUDRA TARGET User manual 2022-Q4.1 3.SKUDRA PATROL User manual v.4.5.4 03.11.2022	ITU-R recommendations: - SM.443-5 - SM.1268-5 - SM.377-4 - SM.1880-2
TOTAL						

Signed : _____ Jānis Bārda Chairman of the Management Board (Electronic Communication Office)

Signed : _____ Laila Līduma Member of the Management Board (Electronic Communication Office)

Annex no. 23
to the Approved Standard Documentation
by Order of the Ministry of Finance
no. 115 from 15.09.2021

Price specifications

[This table will be completed by the bidder in columns 5,6,7,8 and 11 if necessary, and by the contracting authority – in columns 1,2,3,4,9,10]

	Procurement procedure number ocds-b3wdp1-MD-1666087985731 from 18 Oct 2022
	The object of the purchase: *Specialized software for operating the spectrum monitoring stations with the possibility of data storage on a dedicated server*

Code CPV	Name of goods/services	Unit of measurement	The amount	Unit price (without VAT)	Unit price (with VAT)	Total amount without VAT	Total amount with VAT	The term of delivery	Budget classification (IBAN)	Discount %
1	2	3	4	5	6	7	8	9	10	11
	Goods/services									
48781000-6	*Specialized software for operating the spectrum monitoring stations with the possibility of data storage on a dedicated server*	unit	3	30 000 EUR	30 000 EUR[1]	90 000 Eur	90 000 EUR[1]	30 calendar days		See the table "Discount proposal"
	TOTAL									

Signed : _____ Jānis Bārda Chairman of the Management Board

Signed : _____ Laila Līduma Member of the Management Board

Bidder: Electronic Communication Office
Address: Eksporta stree 5, Riga, Latvia

[1] VAT is not applicable according to Article 44 of Directive 2006/112/EC.

Table "Discount proposal"

Unit amount	Price per unit (without VAT), Eur[2]	Total amount (without VAT), Eur[2]
4	26 250	105 000
5	23 000	115 000
6	20 833	124 998
7	19 286	135 002
8	18 125	145 000
9	17 222	154 998
10	16 500	165 000
11	15 909	174 999
12	15 417	185 004
13	15 000	195 000
14	14 643	205 002
15	14 333	214 995
16	14 063	225 008
17	13 824	235 008
18	13 611	244 998
19	13 421	254 999
20	13 250	265 000
21	12 857	269 997
22	12 500	275 000
23	12 174	280 002

Signed :  Jānis Bārda Chairman of the Management Board

Signed :  Laila Līduma Member of the Management Board

Bidder: Electronic Communication Office
Address: Eksporta stree 5, Riga, Latvia

[2] VAT is not applicable according to Article 44 of Directive 2006/112/EC.

Public Institution „National Service for the Radio Frequencies Management"
Registration No 1003600042163
Address: mun. Chişinău, or. Durleşti, str. N. Dimo 22/20, MD-2003, Moldova

Riga, November 3, 2022

BID BOND NO GAR.440.23160

We, AS "Citadele banka", registration No 40103303559, legal address - Republikas square 2A, Riga, LV-1010, Latvia (hereinafter called the Bank), have been informed that our customer **VAS "Elektroniskie sakari"**, registration No 40003021907, legal address - Eksporta iela 5, Rīga, LV-1010, Latvia (hereinafter called the Bidder), intends to submit it's bid in accordance with the conditions of Your, **public Institution „National Service for the Radio Frequencies Management"**, registration No 1003600042163, legal address - mun. Chişinău, or. Durleşti, str. N. Dimo 22/20, MD-2003, Moldova (hereinafter called the Beneficiary), tender **"Specialized software for directing monitoring stations with the possibility of storing data on a dedicated server" (identification No 21065699)** (hereinafter called the Tender).
According to the Tender's conditions the Bidder's offer must be supported by a bid bond.

Accordingly, the Bank hereby irrevocably undertakes to pay the Beneficiary any sum or sums not exceeding in total an amount of

EUR 1 900,00 (one thousand nine hundred euro, 00/100),

upon receipt by the Bank of Beneficiary's duly signed and complying demand for payment in writing (hereinafter called the Demand) stating that the Bidder is in breach of its obligations under the Tender conditions and indicating which of the below conditions have occurred:
1. the Bidder has withdrawn its bid during the validity period of this guarantee;
2. the Bidder who has been announced as the winning bidder, has failed to submit the performance bond within the specified time according to the requirements of the Tender conditions and the contract;
3. the Bidder who has been announced as the winning bidder, has failed to sign the contract within the time specified by the Beneficiary.

This guarantee is valid from the date of its issuance and until **January 31, 2023** (hereinafter called the Expiry Date). The Demand has to be received on or before the Expiry Date at the Bank (address: AS "Citadele banka", Trade Finance department, Republikas square 2A, Riga, LV-1010, Latvia) as a manually signed paper document.

For the purpose of identification the Demand has to be presented through a bank confirming that the signatures on the Demand are legally binding upon the Beneficiary

However, after the Expiry Date this guarantee will become null and void whether returned to us or not.

The Bank will cancel the guarantee before the Expiry Date if the Beneficiary presents his signed release from liability to the Bank according to the requirements of presentation of the Demand described above.

With each payment under this guarantee Bank's obligation will be reduced pro rata.

This guarantee is subject to the ICC Uniform Rules for Demand Guarantees (URDG) Revision 2010, ICC Publication No 758. This guarantee and the legal relations related to it shall be governed by the laws of the Republic of Latvia, in so far as the respective questions are not regulated by the above mentioned Uniform Rules for Demand Guarantees.

This guarantee is issued in one original for the Beneficiary.

On behalf of AS "Citadele banka":

AS "Citadele banka"
Tirdzniecības finansēšanas un faktoringa daļa
Inese Pētersone
Projektu vadītāja

Annex no. 7
to the Approved Standard Documentation
by Order of the Ministry of Finance
no. 115 from 15.09.2021

APPLICATION FOR PARTICIPATION

*To the **State Institution "National Service for the Radio Frequencies Management "***
mun. Chișinău, or. Durlești, N. Dimo 22/20 str.
(name of contracting authority and full address)

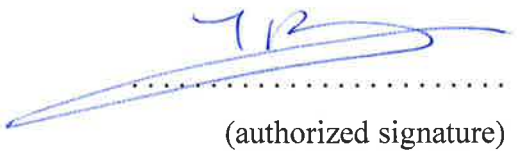
Dear Sirs and Madams,

As a result of the announcement/invitation to participate/pre-selection published in the Public Procurement Bulletin and/or the Official Journal of the European Union, no ocds-b3wdp1-MD-1666087985731 from 18 Oct 2022, regarding the application of the protocol for awarding the contract "Specialized Software for operating spectrum monitoring stations with the possibility of storing data on a dedicated server", we State Join Stock Company Electronic Communication Office, we have become aware of the conditions and requirements set out in the award documentation and hereby express our interest in participating, as a bidder/candidate, having no objections to the award documentation.

Date: 08.11.2022.

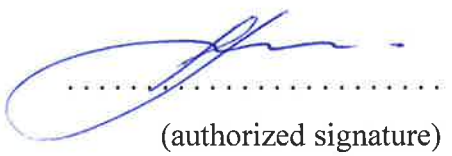
Regards,

State Join Stock Company Electronic Communication Office
Chairman of the Management Board
Jānis Bārda



(authorized signature)

Member of the Management Board
Laila Līduma



(authorized signature)

Annex no. 8
to the Approved Standard Documentation
by Order of the Ministry of Finance
no. 115 from 15.09.2021

STATEMENT
regarding the validity of the offer

To the ***Public Institution "National Service for the Radio Frequencies Management"***
mun. Chișinău, or. Durlești, N. Dimo 22/20 str.
(the name of the contracting authority and the full address)

Dear sirs and madams,

We are committed to keeping the offer valid, **regarding the purchase** "Specialized Software for operating spectrum monitoring stations with the possibility of storing data on a dedicated server" **through the acquirement procedure open tender,**
for a duration of 60 (sixty) days, respectively until the date of 06 Janv 2023, and it will remain mandatory for us and maybe be accepted at any time before the expiration date.

Date: 08.11.2022.

Regards,

State Join Stock Company Electronic Communication Office
Chairman of the Management Board
Jānis Bārda

.....

(authorized signature)

Member of the Management Board
Laila Līduma

.....

(authorized signature)

Annex no. 12
to the Approved Standard Documentation
by Order of the Ministry of Finance
no. 115 from 15.09.2021

STATEMENT
regarding the list of the main deliveries/services performed in the last 3 years of activity

No.	Object of the contract	Name/Name of the beneficiary/ Address	Capacity of the Supplier/Provider*)	Price of the contract/ value of delivered goods	Delivery period (months)
1	"Database server software"	National Armed Forces Vienibas avenue 56 , Riga, Latvia	sole contractor	EUR 117 000 without VAT SKUDRA patrol licences – 3 units SKUDRA server Modul - 1 unit	• Delivery in 7 (seven) days. • Software updates and technical support – 36 (thirty-six) months. Agreement date – 19 March 2018
2	"Purchase of radio monitoring equipment management software"	National Armed Forces Vienibas avenue 56 , Riga, Latvia	sole contractor	EUR 220 800 without VAT SKUDRA patrol licences – 8 units	• Delivery in 5 (five) days. • Software updates and technical support – 24 (twenty-four) months. Agreement date – 11 June 2019
3	"Purchase of programme "SKUDRA" modules"	National Armed Forces Vienibas avenue 56 , Riga, Latvia	sole contractor	EUR146 500 without VAT SKUDRA server Modul - 4 units SKUDRA patrol licence – 1 unit	• Delivery in 5 (five) days. • Software updates and technical support – 24 (twenty-four) months. Agreement date – 18 Dec 2020
4	"Database server software enhancement "	National Armed Forces Vienibas avenue 56 , Riga, Latvia	sole contractor	EUR 119 000 without VAT SKUDRA Target licences – 4 units SKUDRA patrol licence – 1 unit SKUDRA server Modul - 2 units	• Delivery in 5 (five) days. • Software updates and technical support – 24 (twenty-four) months. Agreement date – 27 Dec 2021

*) It is specified the capacity in which he participated in the performance of the contract, which can be: sole contractor or association leader; associate contractor; subcontractor.Signed: _____

Name: _____

Function within the company: _____

Company name: _____

Date: 08.11.2022. Regards,

State Join Stock Company Electronic Communication Office
Chairman of the Management Board
Jānis Bārda

.....

(authorized signature)

Member of the Management Board
Laila Līduma

.....

(authorized signature)

DECLARATION
about expierence

To the ***Public Institution "National Service for the Radio Frequencies Management"***
mun. Chișinău, or. Durlești, N. Dimo 22/20 str.
(the name of the contracting authority and the full address)

Dear sirs and madams,

State Join Stock Company Electronic Communication Office certify that the development of the program "SKUDRA" by the personnel forces of the Technical Department of State Join Stock Company „Electronic Communication Office" started in August 2015.

In the inventory of fixed assets of State Join Stock Company Electronic Communication Office programme „SKUDRA" is taken on 6 January 2016 (Inventory number PL-3302), from that moment programme „SKUDRA" is put in service.

State Join Stock Company Electronic Communication Office have more than 5 years experience in the development of specialized software in the field of radio frequency spectrum monitoring

Date: 08.11.2022.

Regards,

State Join Stock Company Electronic Communication Office
Chairman of the Management Board
Jānis Bārda

.....
(authorized signature)

Member of the Management Board
Laila Līduma

.....
(authorized signature)

LATVIJAS REPUBLIKAS UZŅĒMUMU REĢISTRS

KOMERSANTA REĢISTRĀCIJAS APLIECĪBA

Nosaukums:

Valsts akciju sabiedrība "Elektroniskie sakari"

Veids: Akciju sabiedrība

Vienotais reģistrācijas numurs: 40003021907

Reģistrācijas datums uzņēmumu reģistrā: 23.08.1991

Reģistrācijas datums komercreģistrā: 14.10.2004

Reģistrācijas vieta: Rīgā

Apliecības izdošanas datums: 18.10.2011

Latvijas Republikas Uzņēmumu reģistra
Valsts notāre Skrodere Benita

K 117228

Translation from Latvian

/Coat of Arms/

REGISTER OF ENTERPRISES OF THE REPUBLIC OF LATVIA

MERCHANT'S REGISTRATION CERTIFICATE

Name:

State Joint-Stock Company "Electronic Communications Office of Latvia"
(Valsts akciju sabiedrība "Elektroniskie sakari")

Type: Joint-Stock Company

Unified registration number: 40003021907

Date of registration in the Register of Enterprises: 23.08.1991

Date of registration in the Commercial Register: 14.10.2004

Place of registration: Riga

Date of issuing of the certificate: 18.10.2011

Notary Public of the
Register of Enterprises of the Republic of Latvia Skrodere Benita

/Signature/

/Round seal: REGISTER OF ENTERPRISES OF THE REPUBLIC OF LATVIA 2/

Register of Enterprises of the Republic of Latvia. Pērses iela 2, Riga, LV - 1011, Latvia, Reg. No. 90000270634.
Tel. (371) 67031703, Fax (371) 67031793, e-mail: riga@ur.gov.lv, internet: http//www.ur.gov.lv

K 117228

On 7 November 2022, I, translator and project director of Limited liability company "Skrivanek Baltic", 87C Lāčplēša Street, Riga, Līga Darģe personal identity number 020491-11633, certify that the translation of this document from Latvian into English, certified with my signature, is correct orthographically and in its essence.

TRANSLATION CORRECT.

Līga Darģe

THIS DOCUMENT HAS BEEN ELECTRONICALLY SIGNED WITH A SECURE ELECTRONIC SIGNATURE AND CONTAINS A TIME STAMP

Riga, 10.10.2022.
Nr. 8268-03/1327

Regarding corporate details of SJSC "Elektroniskie sakari"

JSC "Citadele banka", incorporated under laws of the Republic of Latvia with registration number 40103303559, having its registered office at 2A Republic square, Riga, Latvia (hereafter- "Bank") hereby confirms that that:

SJSC "Elektroniskie sakari", registered under laws of Republic of Latvia with registration number 40003021907, having its registered office at 5 Eksporta street, Rīga, Latvia (hereafter- "Client") is the client of the bank since August 25, 1999.

The Bank also confirms that the Client has a valid multicurrency current account No LV14PARX0000231601015 with the Bank.

SWIFT code of the Bank is PARXLV22.

This letter is issued at the request of the Client for information purposes only and can be directed to third parties at Client's own discretion.

This letter is subject to the law of the Republic of Latvia, place of jurisdiction is the republic of Latvia.

On behalf of the Bank:

Ilze Vilsone-Trokša
Client Relationship Manager
Corporate Client Service Division

Prepared by S.Miglāne
+371 26456923

THIS LETTER IS SIGNED BY USING A SECURE ELECTRONIC SIGNATURE THAT CONTAINS A TIME-STAMP.

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)

Prepared by:

Head of DRM **Oleg LEAŞOC**

Approved:

Technical director **Ovidiu SPĂTARU**

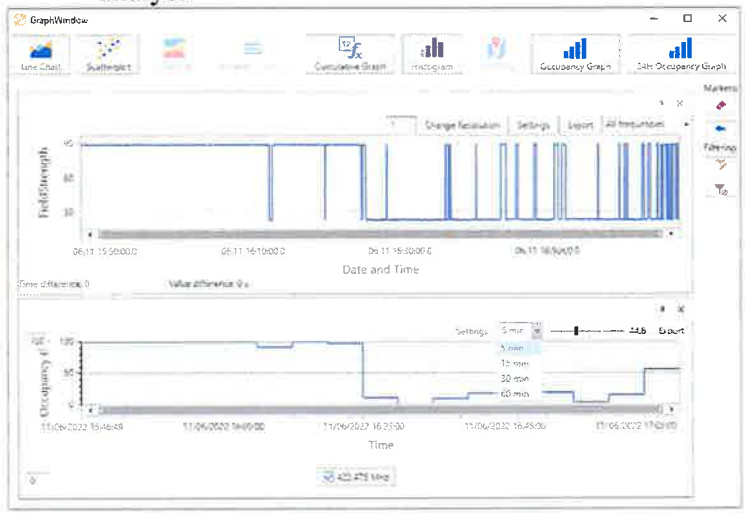
Chişinău – 2022

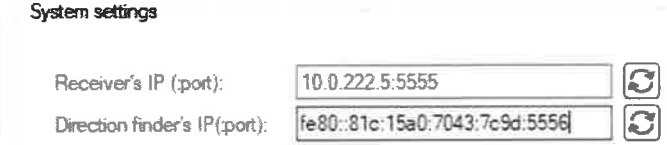
CONTENTS

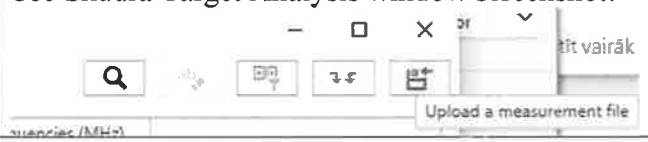
	It will be completed by the tenderer	
	Guaranteed technical specifications	Deviations / Remarks (to be specified)
1. GENERAL NOTES		
The Technical Requirements is an integral part of the Standard Documentation and contains whole set of requirements which is the basis for Technical Proposal preparation 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.	3 licenses	

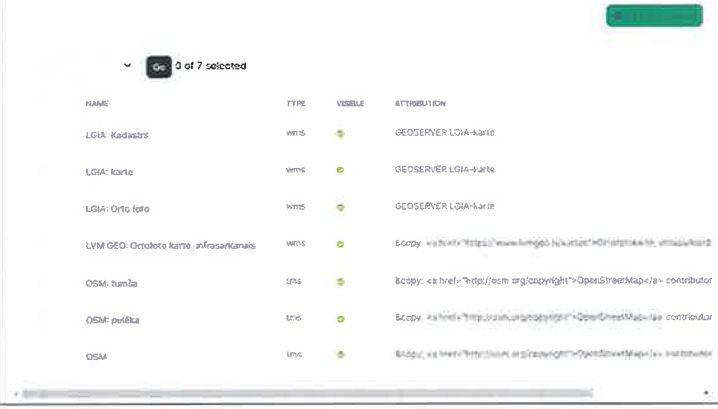
5. MINIMUM REQUIREMENTS		
5.1 General Requirements • Monitoring software must be compatible and work flawlessly with all existing of NRMS hardware. The detailed list of equipment will be presented to potential bidders upon request.	YES See Skudra Target manual section "1.2 Supported devices" and Skudra Patrol manual section "1.1.2 Supported receivers", "1.1.4 Supported direction finders" All supported devices are integrated deeply using direct connection, without using file exchange system, or software not provided by bidder. It is possible to add additional supported devices if there is provides sufficient remote-control documentation.	
• 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.).	YES See Skudra Target manual section "1.2 Supported devices" and Skudra Patrol manual section "1.1.2 Supported receivers", "1.1.4 Supported direction finders"	
• The monitoring software itself must combine a powerful monitoring tool with easy and efficient operation.	YES Monitoring software Skudra provides 3 software modules Skudra Patrol, Skudra Target and Skudra Server. Where each of them provides separate functionality and working together provides powerful monitoring tool with simple user interface to effectively execute daily spectrum supervision tasks.	
• The user interface of the monitoring software, should have an intuitive and easy-to-use graphical interface, to be user friendly.	YES	

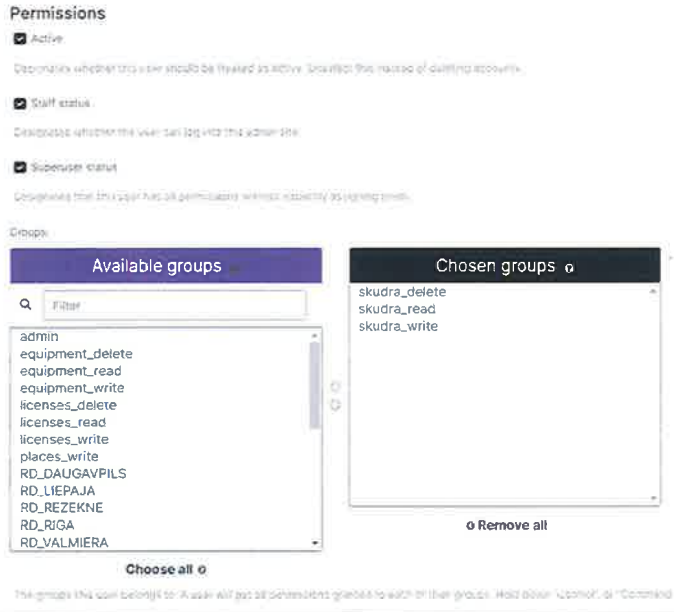
• The monitoring software must perform the measurements and analysis of the results in accordance with the ITU Spectrum monitoring handbook and the ITU-R recommendations: - SM.443-5 (Bandwidth measurement); - SM.1268-5 (Measurement of frequency deviation); - SM.377-4 (Frequency measurement); - SM.1880-2 (Measurement of spectrum occupancy).	YES • Software Skudra provides functionality to perform signal bandwidth measurements according to ITU-R SM. 443-5., if it's supported by receivers, see Skudra Target user manual "4.2 Settings for measuring radio emission parameters" • Software Skudra provides functionality to perform measurement of frequency deviation according to ITU-R SM. 1268-5., if it's supported by receivers, see Skudra Target user manual "4.2 Settings for measuring radio emission parameters" • Software Skudra provides functionality to perform Frequency measurements, if it's supported by receivers according to ITU-R SM. 377-4., see Skudra Target user manual "4.2 Settings for measuring radio emission parameters" • Software Skudra provides functionality to represent spectrum occupancy charts according to ITU-R SM.1880-2. See screenshot from Skudra Target analysis window:  	

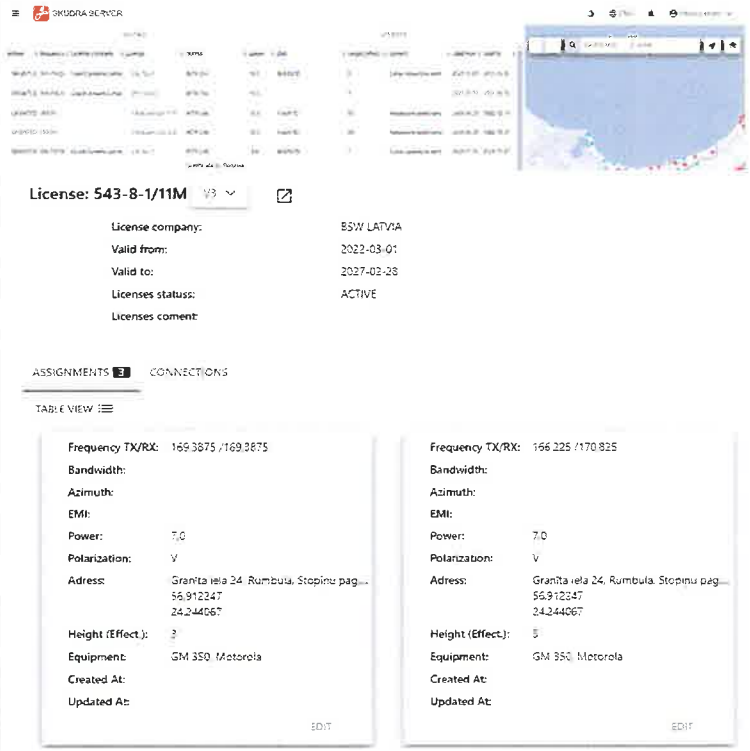
• The monitoring software will include security elements that ensure access for authorized personnel and allow the identification of the person who performed the measurements.	YES Skudra Target allows setting permission to use software only for authorized personnel, 	
• The monitoring software must be compatible with Windows 10 and 11 (64-bit) operating systems.	YES	
• The monitoring software must support the IPv6 protocol.	YES See Skudra Patrol user manual section "1.2.2 IPv6 support" 	

• 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.	YES Skudra Server and Skudra TARGET supports argus csv file import. See Skudra Target Analysis window screenshot: 	
• 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.	YES	

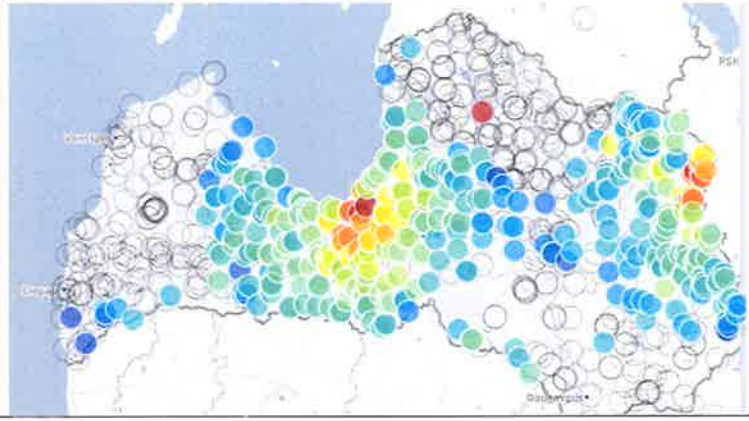
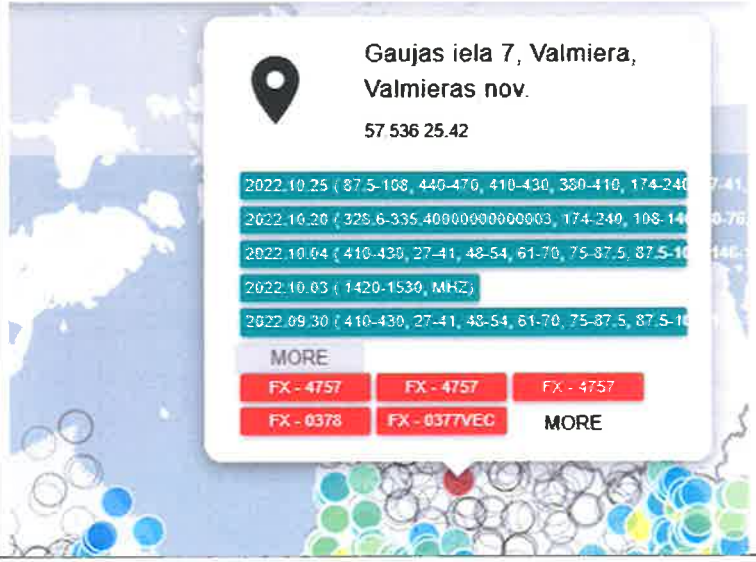
• The monitoring software interface must be in at least three languages: Romanian, English, Russian. If the interface does not have the possibility of being displayed in Romanian and Russian, the developer will assume the obligation to translate the interface into Romanian and Russian within 6 months at most.	YES Skudra Server supports following languages: English, Russian and Rumanian, additional languages can be added on request. Skudra Patrol supports fallowing languages: English, Russian and Rumanian, additional languages can be added on request. Skudra Target support English language. Russian and Rumanian languages will be added within 4 months.	
• 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.	YES All measurement data is recorded to database and can be accessible from Skudra 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.	YES	
• 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.	YES, server is accessible with basic web browser	
• 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.	YES Skudra Server supports following languages: English, Russian and Romanian, additional languages can be added on request.	

• The server must allow the use of digital maps, which support TMS (Tiled Map Service) and WMS (Web Map Service) protocols.	YES Skudra server provides functionality to add WMS and TMS maps using admin interface:  	

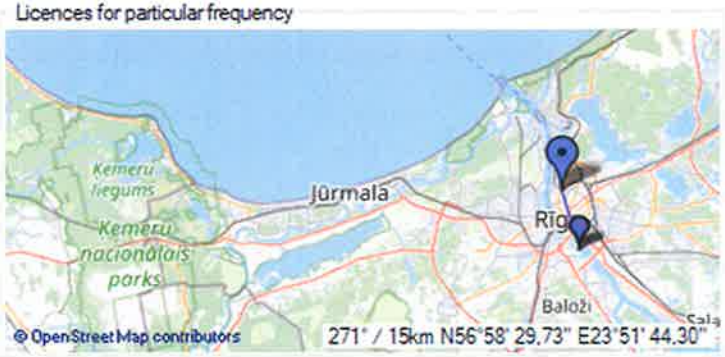
• The server will include security elements to ensure access only to authorized personnel, with the possibility of setting different levels of privileges (reading, writing, modifying, etc.) for each individual user.	YES Skudra Server provides functionality to define user groups for different data stored on server, it is possible to define reading, writing, modifying permission groups for each data type. It is possible to assign user groups separately, for each user. Screenshot from Skudra Server user profile permission section: 	

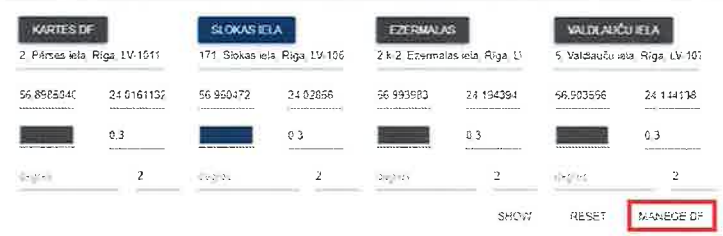
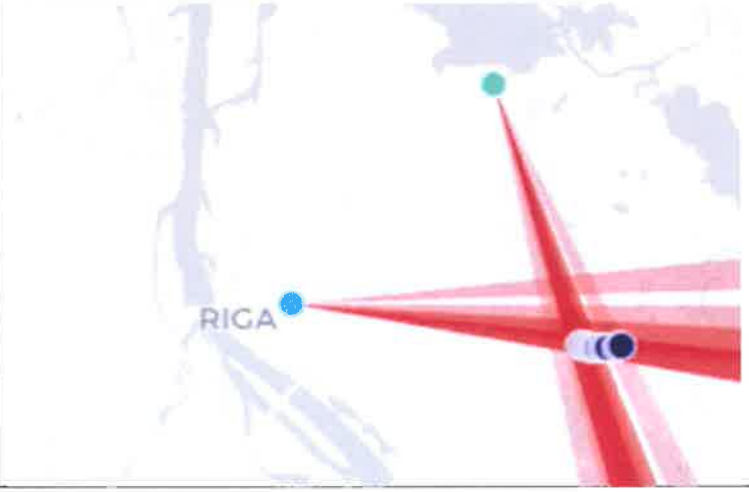
• The server must have the connection interface with ATDI spectrum management applications (Manager, HTZ Communications, etc.) to access radio station information from the databases of these applications, import it and display at least the following fields, with the possibility of introducing other additional fields: – Station owner; – Radio communications service (e.g. broadcasting service, land mobile, landline, etc.); – Transmitting frequency; – Receiving frequency; – Effective Radiated Power (ERP); – 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.	YES Skudra Server provides functionality to access ATDI spectrum management database using SQL requests. See screenshots from Skudra Server license assignments module: 	
• 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.	YES See Skudra Server manual section “3. Map”. Measurement data from Skudra Patrol can be uploaded manually and automatically when using Skudra Server module “Scheduler”	

• 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.	YES See Skudra Server manual section "3. Map" page 6.	
• The server must allow all data to be displayed simultaneously in the table and on the map.	YES See Skudra Server manual section "3. Map". See Skudra Server screenshot 	

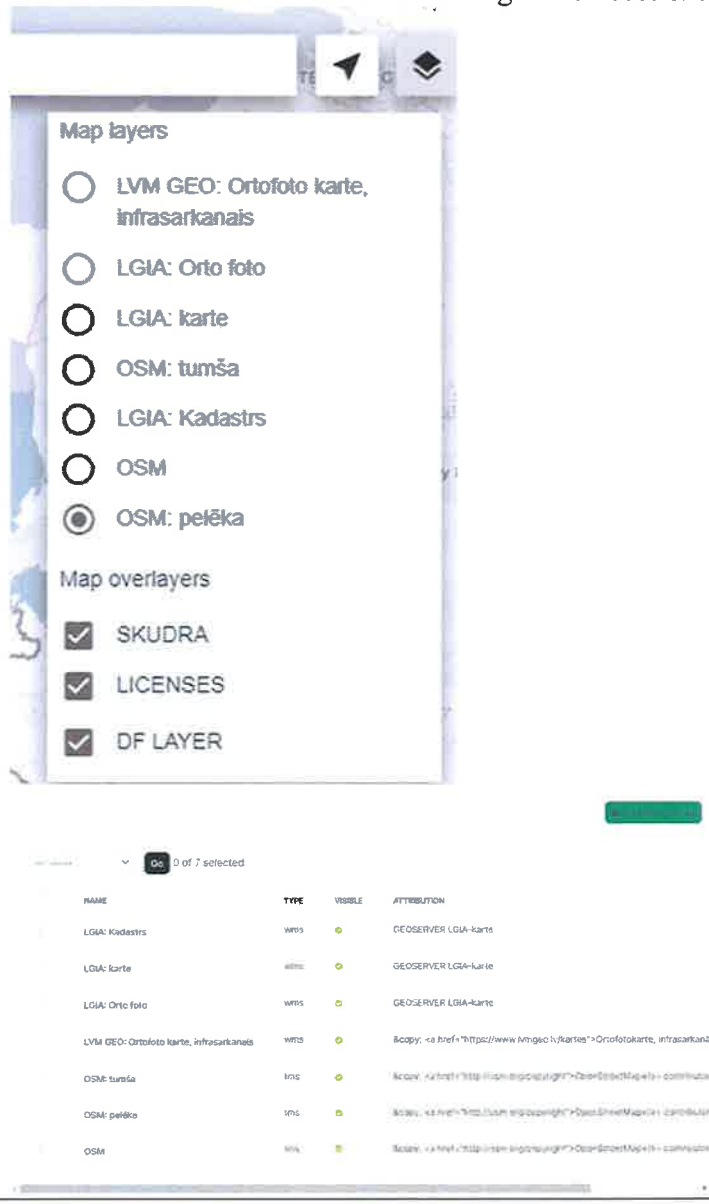
• The server must be able to display color markers of signal levels.	YES See screenshot from Skudra Server 	
• The server must allow sorting of the data of interest by different parameters as well as filtering by any field.	YES See Skudra Server manual section "3. Map" page 6.	
• The functionality of 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).	YES See screenshot from Skudra server: 	

• The server must allow importing and exporting data in .CSV format.	YES See screenshot from Skudra server, export button in data paging area:  	
• Server must provide functionality to provide saving and storing of sample spectra.	YES, See Skudra Server section “9.1 Sample spectra”  	

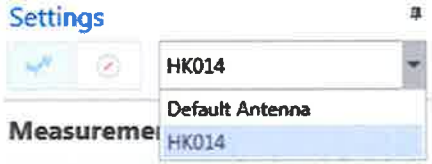
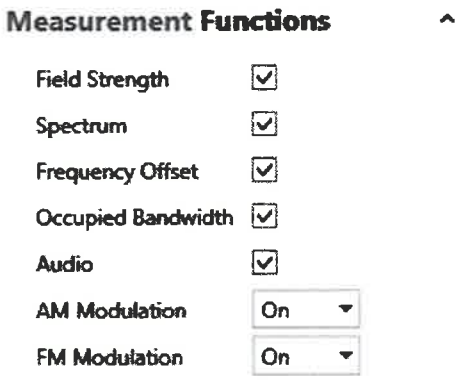
5.3 Geographic information system (GIS) The monitoring software must include GIS program modules, with the possibility of displaying the direction to the transmitter, the positions of the transmission sources, the spectrum monitoring stations overlaid on the digital map of the area. Map control must 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.	YES See Skudra Server manual section "3. Map" Map functionality provides functionality to: • Select map of interest; • View different datapoints; • Zoom in and panorama; • See map point coordinates (WGS84); • Distance between point of interests; • Web page printing See Skudra Patrol screenshot 	

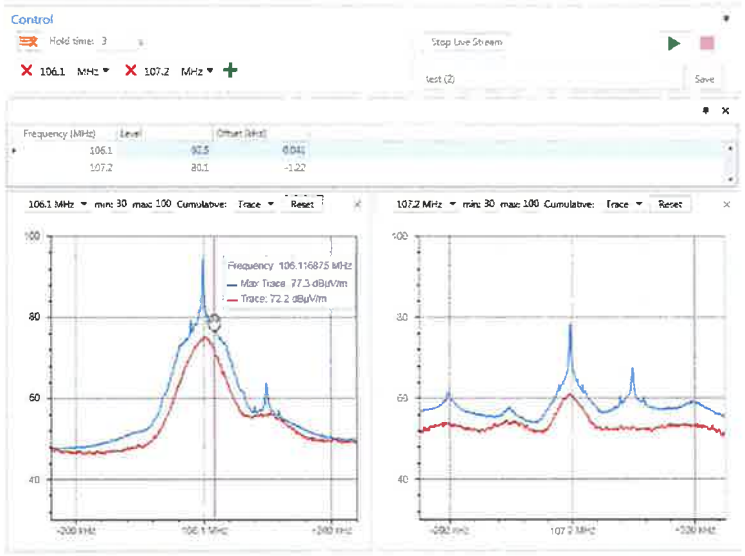
The application of the geographical information system must allow: – Presentation of the location of all existing spectrum monitoring and DF (direction finding) stations in the NRMS (fixed stations and mobile stations); – Presentation of the location of all existing spectrum monitoring and DF (direction 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. –	YES Skudra Server module "map" provides functionality to show fixed site locations and azimuths manually  Skudra Server module "scheduler" provides functionality to show measurement units  Skudra Server module "DF" provides functionality to show from direction finders live measurements including cumulative direction: 	

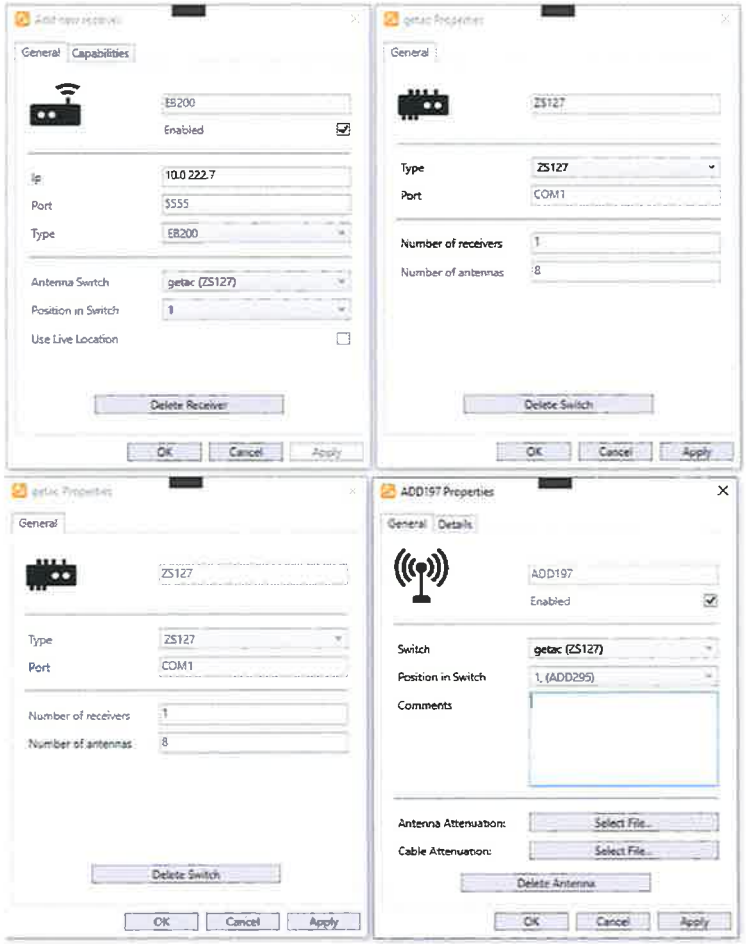
Skudra server map layer switching, WMS and TMS web services defined in Skudra server configuration section.

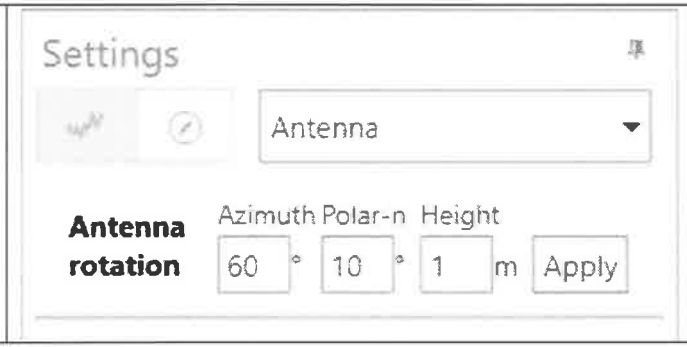


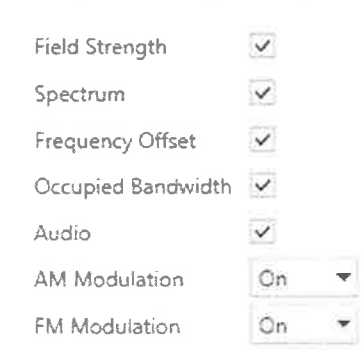
	Skudra server module “frequency” supports KML, KMZ data export: 	

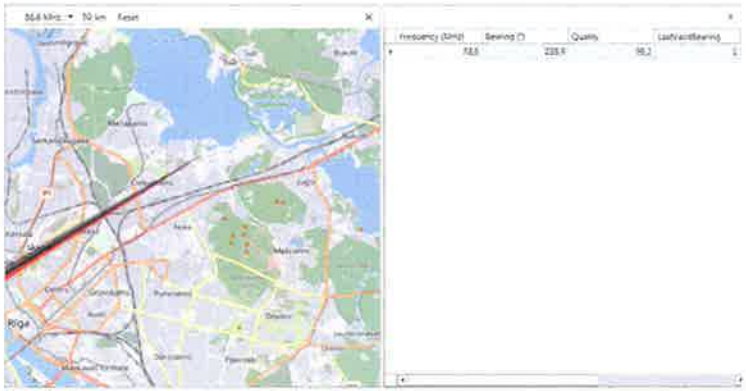
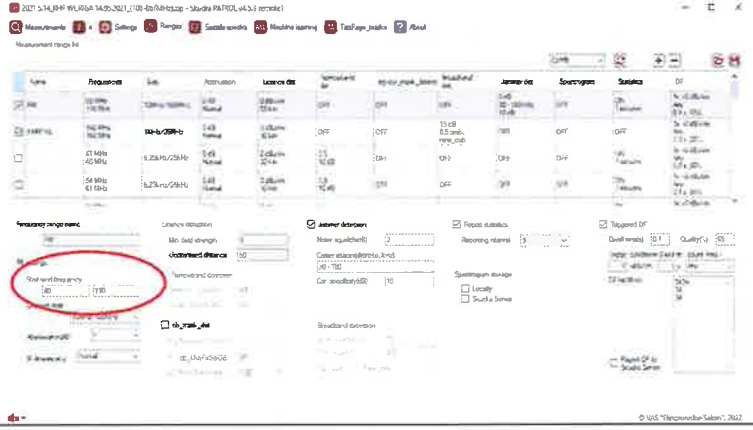
5.4 Main operating facilities of the monitoring software • To allow setting all the necessary parameters of the monitoring receiver, by selecting: – receiving frequency; – frequency band; – modulation type; – IF bandwidth; – used antenna; – reference level (amplification, attenuation); – measurement speed; – detector type; – filter bandwidth selection, etc.;	YES See Skudra Target user manual section "4.2 Settings for measuring radio emission parameters" • Antenna selection: We select the necessary antenna from the available list:  • Selection of parameters to be measured (what the receiver will measure):  	

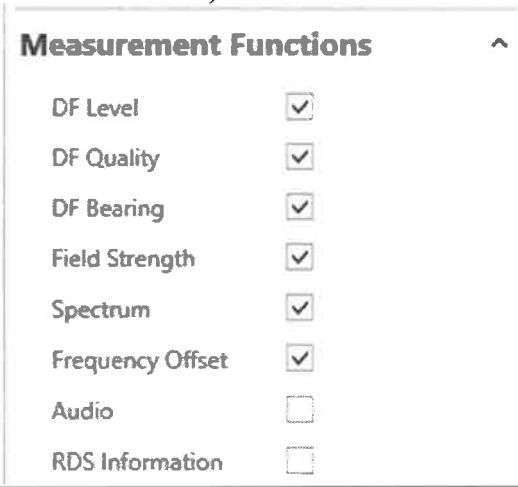
• Display the signal spectrum;	YES 	

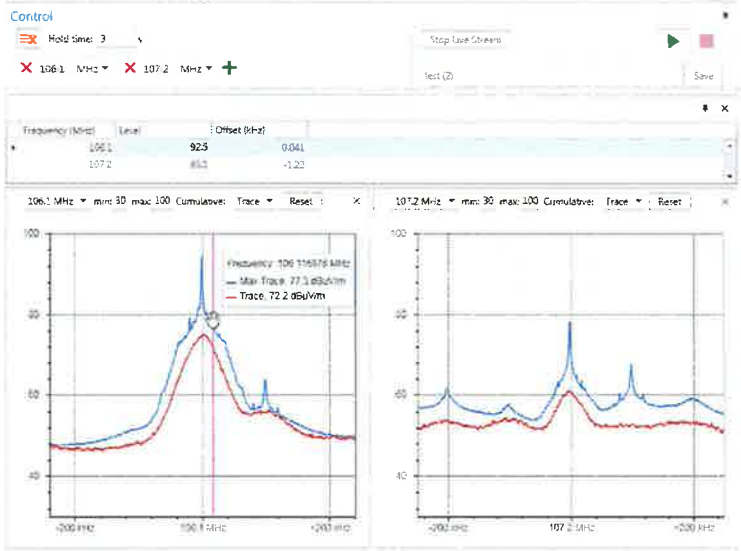
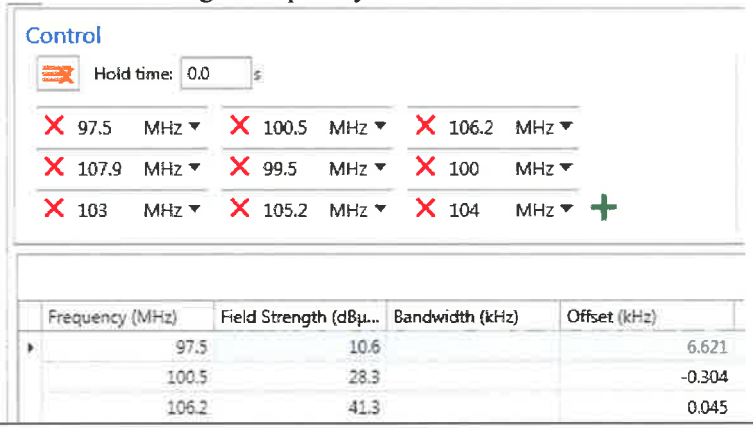
• To have the possibility of directing the reception antennas (changing azimuth, polarization, height) and switching all existing equipment (receivers, antennas) at the monitoring station;	YES Switching equipment: see Skudra Target screenshot  Changing azimuth, polarisation, height: see Skudra Target screenshot	

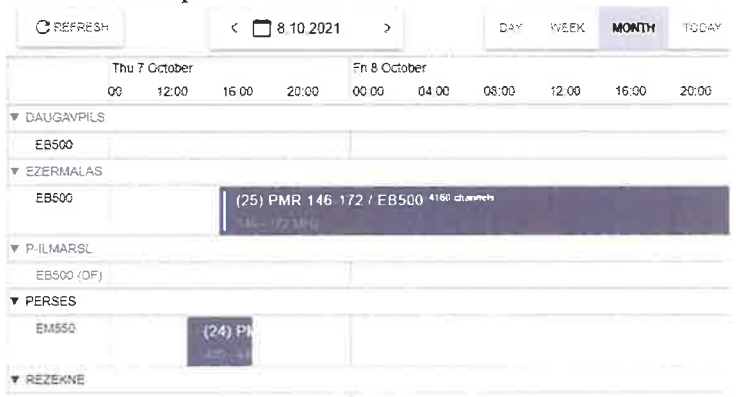
	 Settings Antenna Antenna rotation Azimuth Polar-n Height 60 10 1 m Apply		

• To receive the demodulated audio signal, ensuring hearing on headphones/speakers connected to the work computer and storing digital audio files;	YES See Skudra Target user manual section "4.2 Settings for measuring radio emission parameters" • Selection of parameters to be measured (what the receiver will measure):  It is possible to save and store demodulated audio, record and replay audio.	

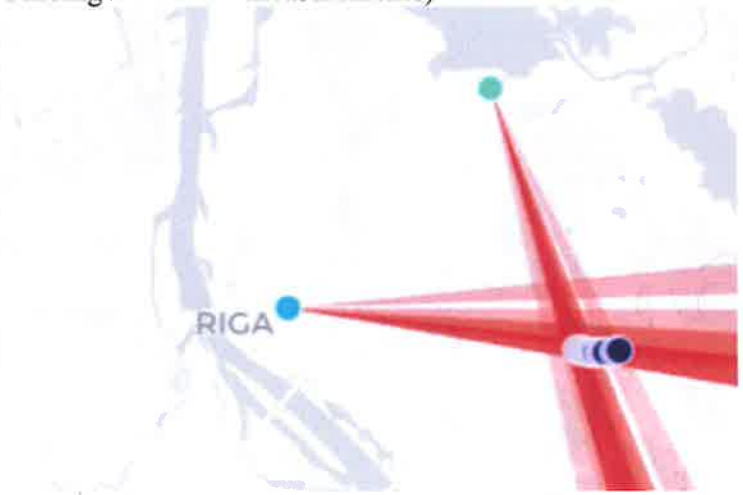
• To command the DF equipment to obtain line of bearing results of the selected transmitter and plot the results on the digital map;	YES The numerical values of the surveying results can be seen in the table, while visually the surveying direction can be seen on the map as a beam: 	
• To be able to define: "start/stop" frequencies, channel bandwidth and duration of the scan process;	YES See Skudra Patrol user manual section “3.4 Range definition section” 	

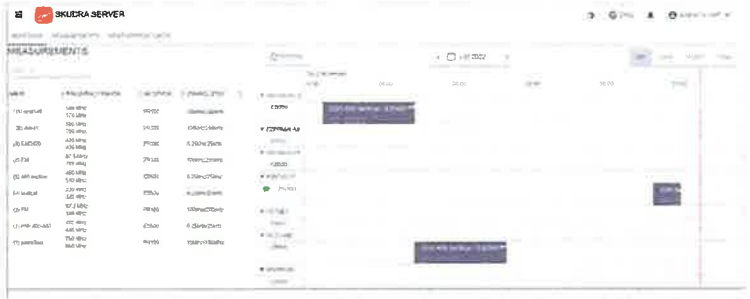
• To allow simultaneous measurement for a single frequency of at least the following parameters: – Frequency; – Electromagnetic field strength level; – Modulation parameters; – Occupied bandwidth; – The direction to the transmitter and the quality of determination; – RDS parameters; – Spectrogram of the signal; – Audio demodulation. •	YES see Skudra Target user manual "4.2 Settings for measuring radio emission parameters" see Skudra Target Measurement section function (depends on used receiver) screenshot : 	

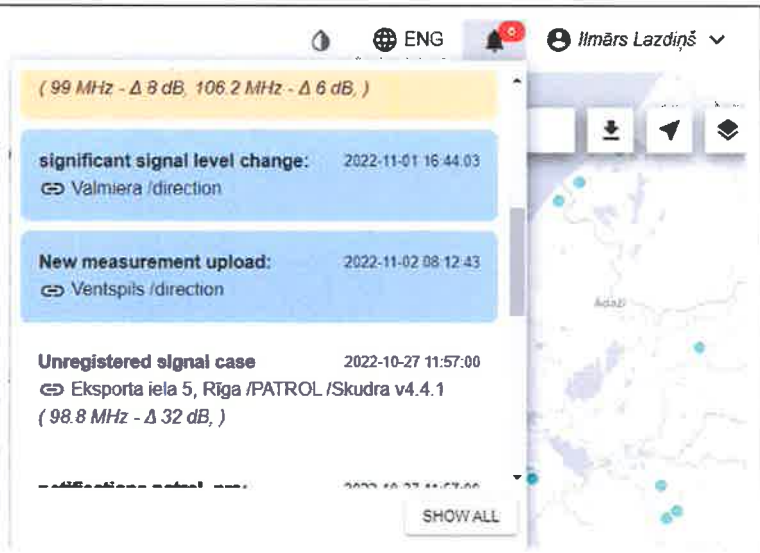
• The process of measuring parameters and displaying their values in numerical format must take place instantly, without the need for additional manipulations, such as, for example, the use of markers. •	YES See Skudra Target receivers control window screenshot: 	
• To allow sequential measurements of multiple frequencies based on a list of frequencies.	YES See Skudra Target frequency selection screenshot 	

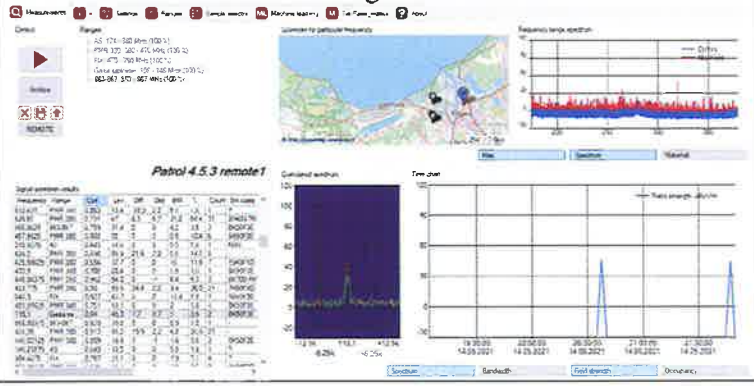
• Allow scheduled measurements and real-time (live) measurements;	YES Skudra Patrol provides cyclic measurements See Skudra Patrol user manual section 5.1, that can be scheduled by Skudra Server See Skudra Patrol user manual section 4.1.1,	
• Have resources of verifying the acceptance of orders and notifying their status;	YES See Skudra Server section "scheduler" screenshot, tasks represents color-coded statuses: grey – saved, not sent. Blue – sent and accepted 	
• To have additional functions such as: markers, max-hold, waterfall, etc.;	YES See Skudra Patrol user manual sections "4.1.11", "4.1.13", "4.1.17"	

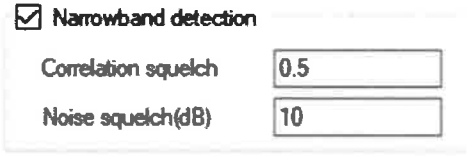
• To allow the mutual tracing of commands to all monitoring and DF stations (fixed and mobile) of the NRMS, in order to monitor (measure) one or more frequencies/frequency bands, as well as take over the obtained data from any of this stations;	YES See Skudra Server section "Scheduler" screenshots   See Skudra Patrol user manual section "4.8 Functionality of Remote control"	

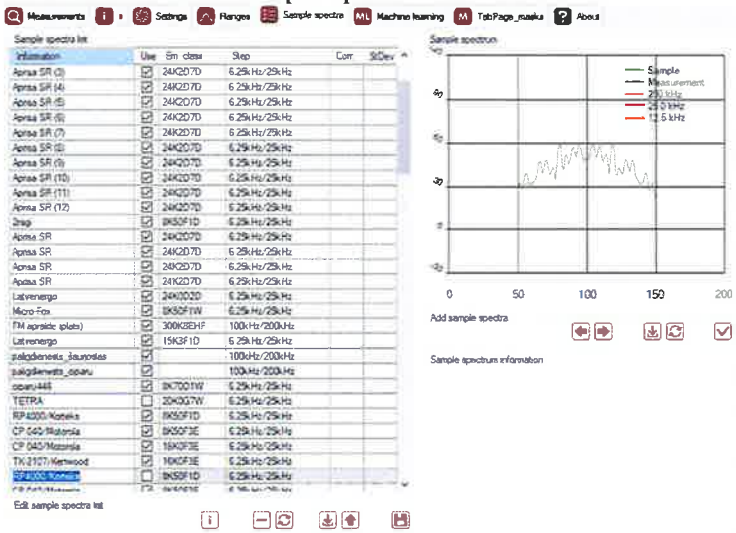
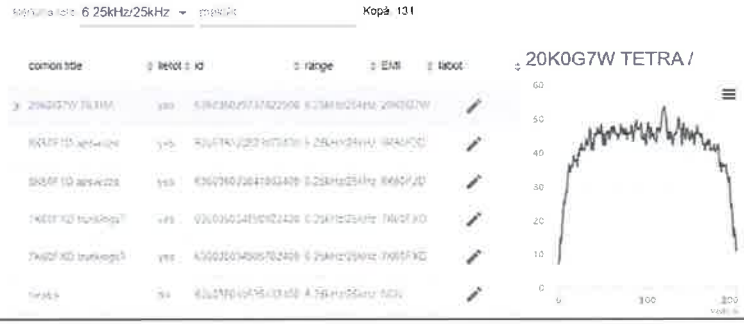
• To allow mutual tracing of commands to all DF stations (fixed and mobile) of the NRMS, in order to locate (obtain the "line of bearing" results) the signal source, with the presentation of the obtained results, including their appearance on the map (the location of the used DF stations, the direction of receiving signal for each station and the location of the signal source);	YES See Skudra Server user manual section "6. DF (Direct Finding / direction measurements)"  See Skudra Patrol user manual section "5.4 Direction finding: Report DF results to Skudra Server"	

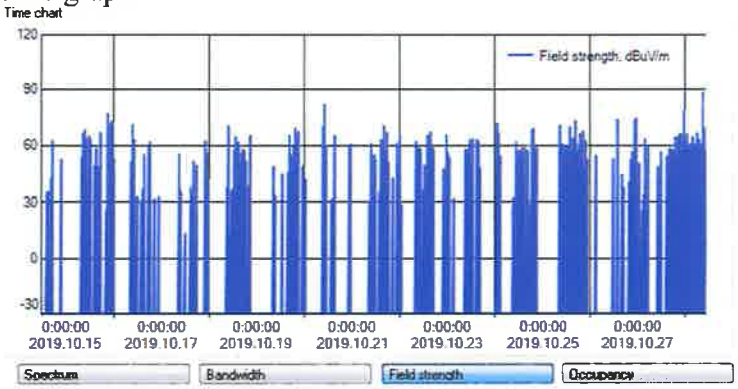
• To have facilities for creating tasks in automatic measurements and monitoring mode with the issuance of predefined alerts and measurement/monitoring results.	YES See Skudra Server section "Scheduler" screenshots   Skudra Server provide predefined event notification. See Skudra Server user notifications:	

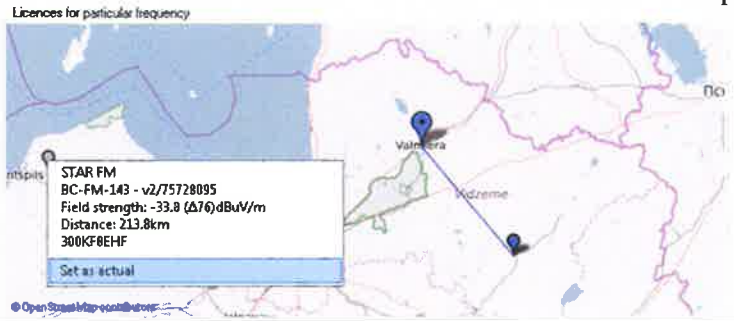

ENG
Ilmārs Lazdiņš
(99 MHz - Δ 8 dB, 106.2 MHz - Δ 6 dB,)
significant signal level change: 2022-11-01 16:44:03
Valmiera /direction
New measurement upload: 2022-11-02 08:12:43
Ventspils /direction
Unregistered signal case 2022-10-27 11:57:00
Eksporta iela 5, Rīga /PATROL /Skudra v4.4.1
(98.8 MHz - Δ 32 dB,)
SHOW ALL

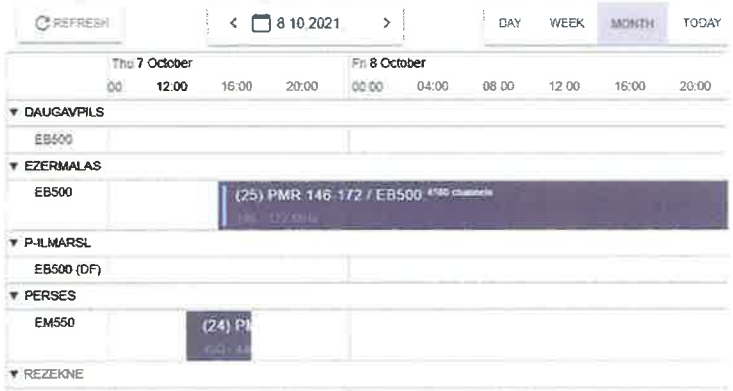
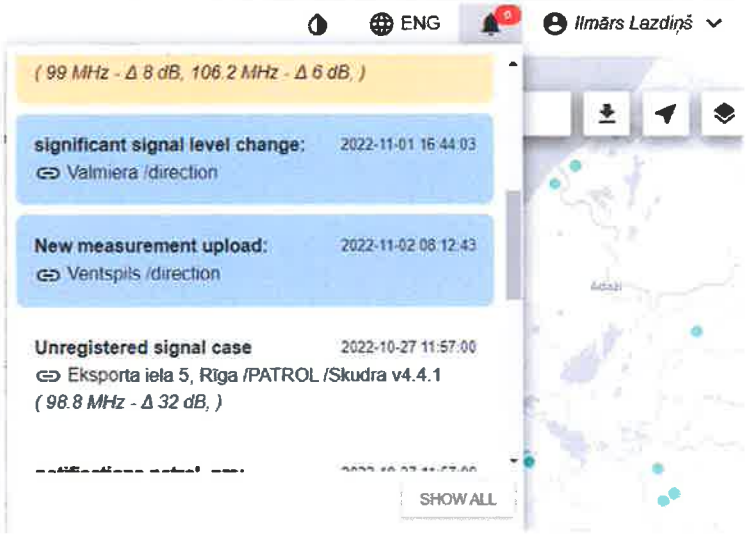
5.5 Scanning functions The spectrum scan feature will allow:		
• Determining the degree of spectrum occupancy. This operation must allow spectrum occupancy to be investigated and the operator must be able to select one or several of the channel characteristics results.	YES See Skudra Patrol monitoring result windows screenshot: 	
• 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.	YES See Skudra Patrol user manual section "5.2 Signal detection", 4.1.9 Explanation of Signal Determination Result Parameters.	
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;	YES See Skudra Patrol user manual section "5.2 Signal detection", "4.3" Measurement Ranges functionality.	
• The following signal detection modes must be available: by spectrum shape mode and "machine learning" mode.	YES See Skudra Patrol user manual "5.2.1 Narrow band detection" for shape mode, "5.2.2 Broadband detection" for machine learning, additionally "5.2.4 Jammer detection"	

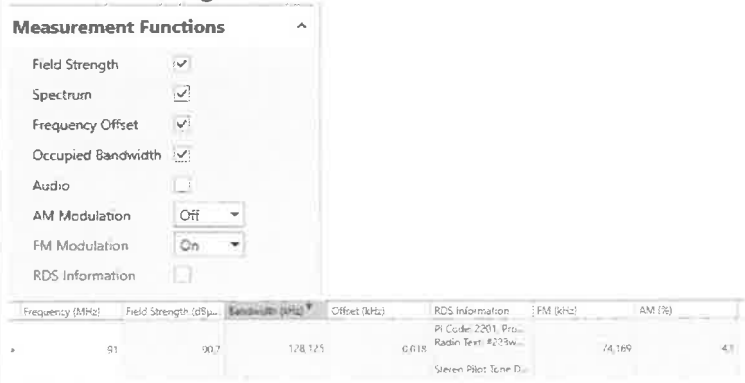
• In the detection mode by spectrum shape, the signal must be considered detected if the spectrum shape in a given channel corresponds to one of the predefined samples. The operator must be able to set the threshold, how close the shape of the signal and that of the sample must be to be considered as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

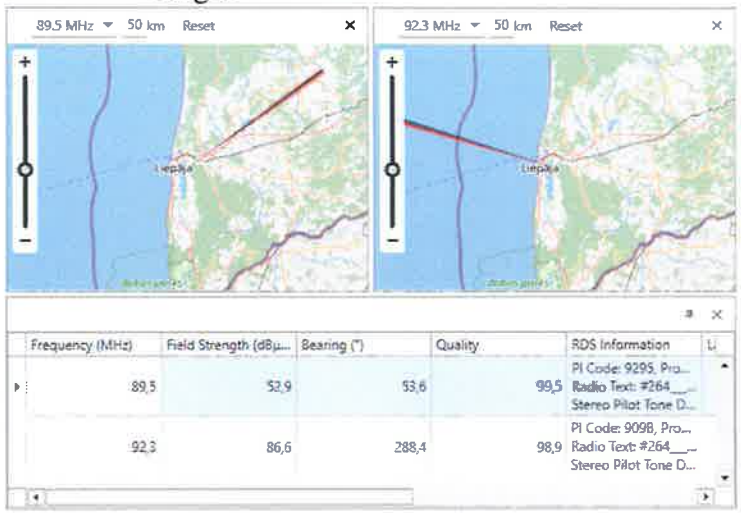
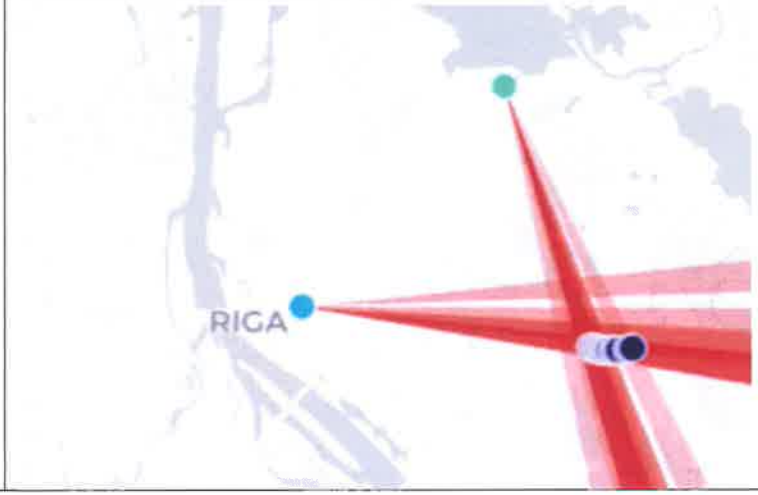
• The monitoring software must include a sample set of generic spectrum shapes that allow most signals to be detected.	YES See Skudra Patrol sample spectra list section:  Skudra Server Sample spectra register 	
• Monitoring software must include "machine learning" functionality to generate samples of spectrum shapes from measurement results.	YES See Skudra Patrol manual section "4.6 Functionality of Machine Learning"	

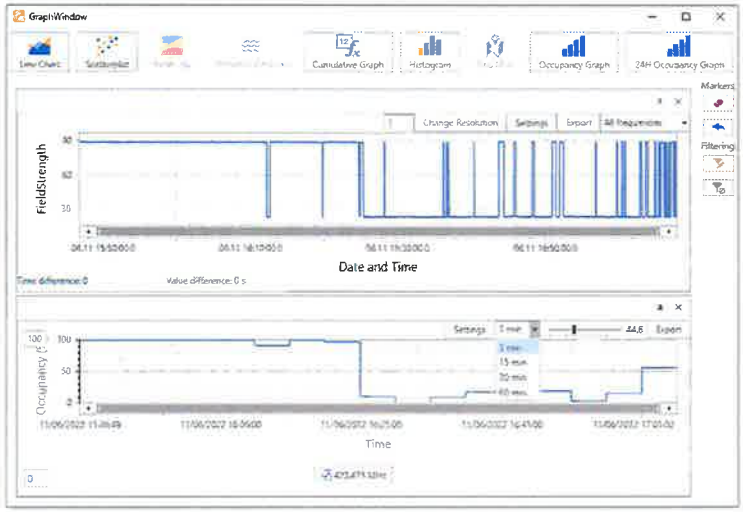
• The detection time and field strength for each signal should be recorded and displayed.	YES See Skudra Patrol manual section "5.5 The storage of signals detected", "4.1.14 Field strength and occupancy time graph" 	
• For each frequency channel in which the signal was detected, the following statistics 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.	YES See Skudra Patrol manual sections "4.1.9 Explanation of Signal Determination Result Parameters", "4.1.11 Cumulated spectrum of signals", "4.1.14 Field strength and occupancy time graph" chart	

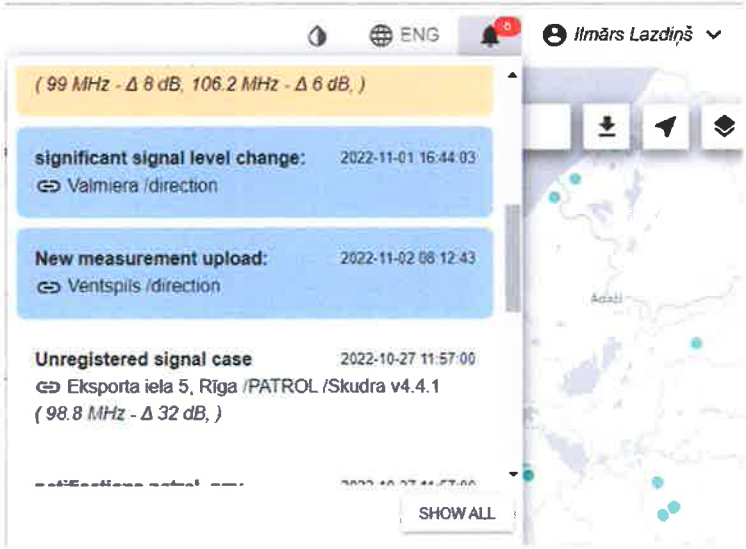
• For each frequency channel where signal was detected, the owner should be shown and if location is available it should be shown on the map. The necessary license information must be extracted from the management database with the possibility of local additions.	YES See Skudra Patrol manual sections "4.1.15 Map: Frequency Assignments", "4.2.3 Configuration and import of licence database", "4.2.5 The List of Specific Frequencies". See Skudra Patrol screenshot of license information on map 	
• Signal detection results must be stored on the dedicated (centralized) server.	YES See Skudra Patrol user manual sections "4.1.4 Upload results to Skudra 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.	YES See Skudra Patrol manual sections "4.8 Functionality of Remote Control", "5.3 Direction finding", "5.6 The establishment of signal parameters"	

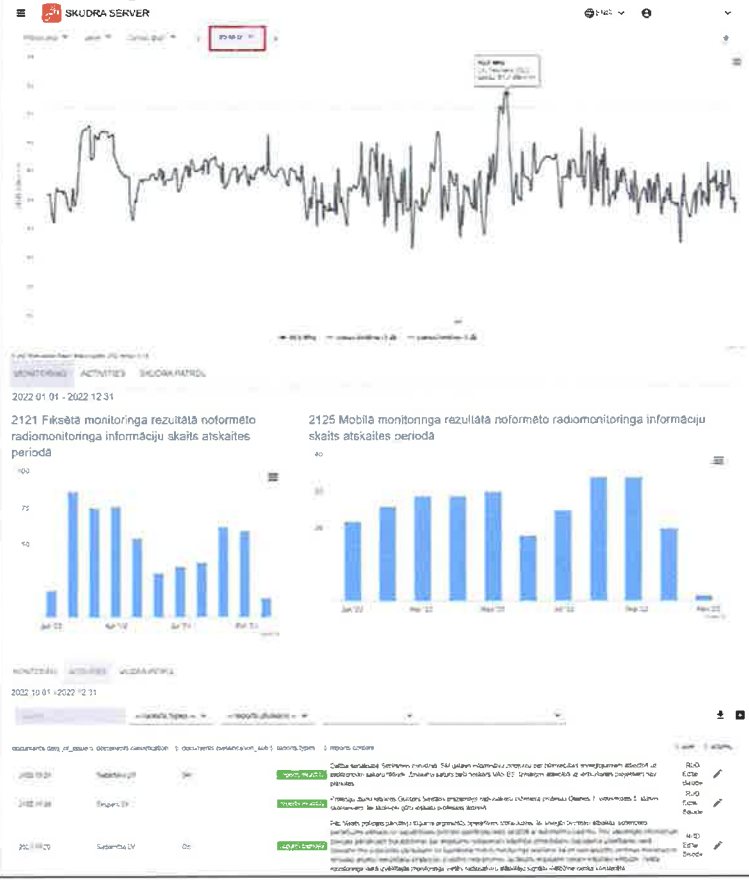
• The application must provide resources to verify acceptance of planned operations and notify when results are available for presentation.	YES See Skudra Server section "scheduler" screenshot, tasks represents color-coded statuses: grey – saved, not sent. Blue – sent and accepted  Skudra Server provide predefined event notification. See Skudra Server user notifications on new measurement:  	

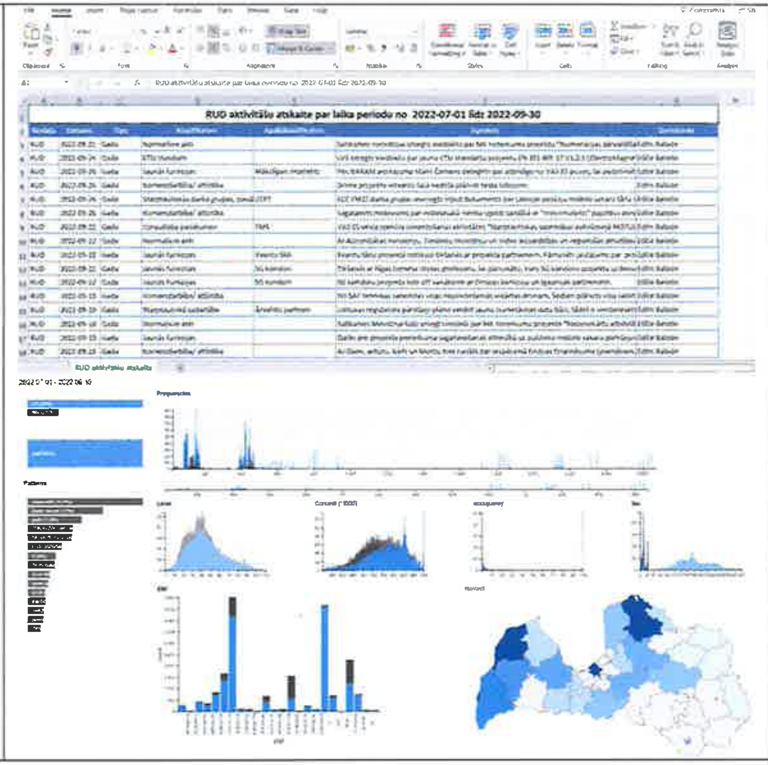
• Scheduling must allow: – Establishing multiple tasks simultaneously. – Setting the start/stop date and time and the duration of each task. – Task priority type. – Operator review of any scheduled operation, before or after transmission to the monitoring and DF station. – Sending various types of alerts by e-mail in case of errors such as interrupting the measurement work, blocking the equipment, etc.	YES See Skudra Server manual section "8 Scheduler". This functionality will be provided using Zabbix :: The Enterprise-Class Open Source Network Monitoring system. Zabbix allow defining different data acquisition of receivers, PC technical parameters and definitions of alerts, priorities, rules, sending sms and emails. https://www.zabbix.com/features	
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).	YES See Skudra Patrol manual section "4.1.13 The Range's spectrum" See Skudra Patrol manual section "4.1.17 Spectrogram (Spectrum Waterfall) graph"	
• 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.	See Skudra Target screenshots: 	

• 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.	See Skudra Target screenshot:  See Skudra Server screenshot:  	

• Spectrum occupancy: – Occupancy as a function of frequency or channel in various time intervals – Electromagnetic field strength as a function of frequency or channel.	YES See Skudra Patrol manual section "4.1.14 Field strength and occupancy time graph" See Skudra Target signal time chart and occupancy chart screenshots 	
• Unauthorized emissions. Tabular presentation of unauthorized transmitters based on a list (spectral masks) of authorized transmitters.	YES See Skudra Patrol manual section "4.1.9.1 Notification of unauthorised emissions"	

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.	YES Skudra Server provide predefined event notification. See Skudra Server user notifications:  Predefined notifications: • New measurement added; • Significant level change for signal, level can be adjusted. • Detection of Unregistered signal; And other on request.	

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.	YES Skudra Server provides functionality to generate different reports, witch can be adjusted to clients needs. See examples: 	


RUD aktivitāšu atskaite par laika periodu no 2022-07-01 līdz 2022-09-30

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.	YES	
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.	YES	
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.	YES	
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.	YES In order to integrate new equipment, there is needed: • Remote access of new equipment. • Full documentation of new equipment. • No legal restrictions from equipment manufacturer. New equipment will provide needed functionality for existing software.	
With the purchase of new licenses in the following installments, the warranty period of these licenses will also extend to previously purchased licenses.	YES	

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.	YES	
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.	YES YES	
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*	YES 2018. – National armed forces obtained SKUDRA licenses. Information on further procurements can be provided up on request. YES 01.06.2022 - Electronic communication Office of Latvia (regulator of radiofrequency in Latvia) decision of the board to include in accounting radiomonitoring software SKUDRA and to use for daily radiomonitoring tasks.	

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: $\mathbf{P_{total} = P1 + P2}$, 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 ($\mathbf{price_{minim}}$) **70** points are awarded; b) for another total price ($\mathbf{price_{(n)}}$) than the one provided in pt. a) the score is awarded as follows: $\mathbf{P1_n = (price_{minim} / price_{(n)}) \times 70}$. **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;	YES We will provide demo version.	

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.

Name: Jānis Bārda
Position: Chairman of the Management Board
Date: 08.11.2022.
Address: Eksporta street 5, Riga, Latvia, LV-1010

Signature 

Name: Laila Līduma
Position: Member of the Management Board
Date: 08.11.2022.
Address: Eksporta street 5, Riga, Latvia, LV-1010

Signature 

Iekšlietu ministrijas Informācijas centrs
Information Centre of the Ministry of the Interior of the Republic of Latvia

Bruņinieku iela 72B, Rīga, LV-1009; Telephone: +371 67208218; Fax: +371 67208219;
e-mail: pasts@ic.iem.gov.lv; www.ic.iem.gov.lv

1 November 2022 Nr. 14-10-1/16858/22-E-14599

CERTIFICATE

The Punishment Register of the Information Centre of the Ministry of the Interior of the Republic of Latvia contains no information on coercive measures and actual administrative violations applied to **VAS "Elektroniskie sakari" ("Electronic Communications Office of Latvia" SJSC)** (registration No.40003021907) in the Republic of Latvia.

Deputy Chief
of the Information Centre **I.Ločmelis**

Rūtena, (+371) 67208516

VAS Elektroniskie sakari
03.11.2022
Reģ. Nr. 2393

LATVIJAS REPUBLIKAS UZŅĒMUMU REĢISTRS
FUNKCIJU IZPILDES DEPARTAMENTS
Informācijas nodaļa
Reģ. Nr. 90000270634, Pērses iela 2, Rīga, LV-1011, tālrunis 67031703
e-pasts: pasts@ur.gov.lv, www.ur.gov.lv

IZZIŅA
Rīgā

11.10.2022. Nr. 7-3-90439

Valsts akciju sabiedrība "Elektroniskie sakari"

Tiesiskā forma: Akciju sabiedrība
Vienotais reģistrācijas numurs: 40003021907
Vienotās *euro* maksājumu telpas maksājuma saņēmēja identifikators:
LV17ZZZ40003021907
Piezīme: 17.02.2014. piešķirts vienotās *euro* maksājumu telpas maksājuma saņēmēja identifikators saskaņā ar likuma „Par Latvijas Republikas Uzņēmumu reģistru" 4.panta 2.[1] apakšpunktu un pārejas noteikumu 21.punktu.
Reģistrēts: 23.08.1991.
Ierakstīts komercreģistrā: 14.10.2004.
Juridiskā adrese: Rīga, Eksporta iela 5, LV-1010
Likvidācijas procesi: nav reģistrētu ziņu
Darbības ierobežojumi: nav reģistrētu ziņu
Maksātnespējas procesi: nav reģistrētu ziņu
Izšķirošās ietekmes: nav reģistrētu ziņu
Īpašie statusi: nav reģistrētu ziņu.

Pamatkapitāls
Parakstītais: 8995637.00 EUR. Izdarīts ieraksts: 12.12.2018.
Apmaksātais: 8995637.00 EUR. Izdarīts ieraksts: 12.12.2018.

Iesniegtie gada pārskati
Pārskata gadi: 1996., 1997., 1998., 1999., 2000., 2001., 2002., 2003., 2004., 2005., 2006., 2007.
Pārskata periodi: 01.01.2008.-31.12.2008., 01.01.2009.-31.12.2009., 01.01.2010.-31.12.2010., 01.01.2011.-31.12.2011., 01.01.2012.-31.12.2012., 01.01.2013.-31.12.2013., 01.01.2014.-31.12.2014., 01.01.2015.-31.12.2015., 01.01.2016.-31.12.2016., 01.01.2017.-31.12.2017., 01.01.2018.-31.12.2018., 01.01.2019.-31.12.2019., 01.01.2020.-31.12.2020., 01.01.2021.-31.12.2021.

Personas:
Valde
Laila Līduma (070171-12570)
Amats: Valdes loceklis ar tiesībām pārstāvēt kapitālsabiedrību kopīgi ar visiem valdes locekļiem
Izdarīts ieraksts par iecelšanu: 20.08.2021.

Jānis Bārda (230877-11632)
Amats: Valdes priekšsēdētājs ar tiesībām pārstāvēt kapitālsabiedrību kopīgi ar visiem valdes locekļiem
Izdarīts ieraksts par iecelšanu: 05.10.2021.

Padome
Elita Baklāne-Ansberga (180477-11826)
Amats: Padomes loceklis
Izdarīts ieraksts par iecelšanu: 23.10.2020.
Tīna Kukka (310575-11568)
Amats: Padomes loceklis
Izdarīts ieraksts par iecelšanu: 23.10.2020.
Ilze Oša (230876-10620)
Amats: Padomes priekšsēdētājs
Izdarīts ieraksts par iecelšanu: 23.10.2020.
Izdarīts ieraksts par personas datu izmaiņām: 16.11.2020.
Ieva Ilvesa (130977-12007)
Amats: Padomes loceklis
Izdarīts ieraksts par iecelšanu: 10.02.2021.

Informācija par patiesajiem labuma guvējiem:
Juridiskās personas patieso labuma guvēju noskaidrot nav iespējams.
Datums no 01.07.2019.

Nodrošinājuma līdzekļi: nav reģistrētu ziņu

Dokuments parakstīts elektroniski ar drošu elektronisko parakstu un satur laika zīmogu.

Informācijas nodaļas speciāliste A.Stacēviča

Stacēviča 67031858

Informācijai
Aktuālās ziņas par jebkuru Uzņēmumu reģistrā reģistrētu tiesību subjektu bez maksas un bez autorizācijas ir iespējams apskatīt Uzņēmumu reģistra informācijas tīmekļvietnē https://info.ur.gov.lv/.
Piekļuve vēsturiskās informācijas apskatei, kā arī publiskās daļas dokumentu apskate vai lejupielāde bez maksas iespējama pēc autentificēšanās tīmekļvietnē.

Translation from Latvian

/Coat of Arms/

REGISTER OF ENTERPRISES OF THE REPUBLIC OF LATVIA

FUNCTION EXECUTION DEPARTMENT

Information Division

Reg. No. 90000270634, Pērses iela 2, Riga, LV-1011, telephone (+371) 67031703
e-mail: pasts@ur.gov.lv, www.ur.gov.lv

CERTIFICATE

Riga

11.10.2022 No. 7-3-90439

State joint-stock company "Elektroniskie sakari"

Legal form: Joint Stock Company
Unified registration number: 40003021907
The Single *Euro* Payments Area payment recipient identifier: LV17ZZZ40003021907
Note: On 17.02.2014 the Single *Euro* Payments Area payment recipient identifier was assigned, in accordance with Section 4, subparagraph 2.[1] and paragraph 21 of the Transitional Provisions of the Law on the Register of Enterprises of the Republic of Latvia.
Registered: 23.08.1991
Entered in the Commercial Register: 14.10.2004
Legal address: Eksporta iela 5, Riga, LV-1010
Liquidation proceedings: no registered information
Operating limitations: no registered information
Insolvency procedures: no registered information
Decisive influences: no registered information
Particular statuses: no registered information.

Share capital
Subscribed: EUR 8,995,637.00 Entry made on: 12.12.2018
Paid-up: EUR 8,995,637.00 Entry made on: 12.12.2018

Annual reports filed
Reporting years: 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007
Reporting periods: 01.01.2008-31.12.2008, 01.01.2009-31.12.2009, 01.01.2010-31.12.2010, 01.01.2011-31.12.2011, 01.01.2012-31.12.2012, 01.01.2013-31.12.2013, 01.01.2014-31.12.2014, 01.01.2015-31.12.2015, 01.01.2016-31.12.2016, 01.01.2017-31.12.2017, 01.01.2018-31.12.2018, 01.01.2019-31.12.2019, 01.01.2020-31.12.2020, 01.01.2021-31.12.2021

Persons:
The Board
Laila Līduma (070171-12570)
Title: Board Member with the authority to represent the capital company jointly with all Board Members
Entry regarding appointment made on: 20.08.2021
Jānis Bārda (230877-11632)
Title: Chairman of the Board with the right to represent the capital company together with all the Board Members

Entry regarding appointment made on: 05.10.2021

The Council
Elita Baklāne-Ansberga (180477-11826)
Title: Council Member
Entry regarding appointment made on: 23.10.2020
Tīna Kukka (310575-11568)
Title: Council Member
Entry regarding appointment made on: 23.10.2020
Ilze Oša (230876-10620)
Title: Chairman of the Council
Entry regarding appointment made on: 23.10.2020
Entry regarding personal data changes made on: 16.11.2020
Ieva Ilvesa (130977-12007)
Title: Council Member
Entry regarding appointment made on: 10.02.2021

Information about beneficial owners:
It is not possible to determine the true beneficiary of a legal entity.
Date from: 01.07.2019

Means of security: no registered information

The document has been electronically signed with a secure electronic signature and contains a time stamp.

Information Department Specialist A. Stacēviča

Stacēviča 67031858

For information
Updated information regarding any legal subject registered in the Register of Enterprises is available free of charge and without authorisation on the Register of Enterprises information website https://info.ur.gov.lv/.
Access to view historical information, as well as to view and download public documents is free of charge after authentication on the website.

On 4 November 2022, I, translator and project director of Limited liability company "Skrivanek Baltic", 87C Lāčplēša Street, Riga, Līga Darģe personal identity number 020491-11633, certify that the translation of this document from Latvian into English, certified with my signature, is correct orthographically and in its essence.

TRANSLATION CORRECT.

Līga Darģe

THIS DOCUMENT HAS BEEN ELECTRONICALLY SIGNED WITH A SECURE ELECTRONIC SIGNATURE AND CONTAINS A TIME STAMP

Pielikums
valsts akciju sabiedrības „Elektroniskie sakari" akcionāru sapulces 2019. gada 7. oktobra protokolam Nr.4.

APSTIPRINĀTS
ar valsts akciju sabiedrības „Elektroniskie sakari" akcionāru sapulces 2019. gada 7. oktobra lēmumu Nr. 2 (protokols Nr.4)

VALSTS AKCIJU SABIEDRĪBAS

„ELEKTRONISKIE SAKARI"
STATŪTI

I. Vispārīgie noteikumi

1. Sabiedrības firma: valsts akciju sabiedrība „Elektroniskie sakari" (turpmāk – sabiedrība).

2. Sabiedrības komercdarbības veidi (NACE klasifikators):
2.1. Citi telekomunikācijas pakalpojumi (61.9);
2.2. Datu apstrāde, uzturēšana un ar to saistītās darbības (63.11);
2.3. Tehniskā pārbaude un analīze (71.20);
2.4. Pētījumu un eksperimentālo izstrāžu veikšana dabaszinātnēs un inženierzinātnēs (72.1);
2.5. Citur neklasificēti profesionālie, zinātniskie un tehniskie pakalpojumi (74.9.);
2.6. Sava vai nomāta nekustamā īpašuma izīrēšana un pārvaldīšana (68.20).

3. Paziņojumus par akcionāru sapulces sasaukšanu un ar tiem saistītos dokumentus sabiedrības pārvaldes un kontroles institūcijām un sabiedrības locekļiem nosūta pa pastu vai elektroniski uz adresēm, kuras ir paziņotas sabiedrībai, vai nodod personīgi.

II. Sabiedrības kapitāls un vērtspapīri

4. Sabiedrības pamatkapitāls ir 8 995 637,00 *euro*, ko veido 8 995 637 akcijas.

5. Visām sabiedrības akcijām ir vienādas tiesības uz dividendes saņemšanu.

6. Visām sabiedrības akcijām, izņemot personāla akcijas, ir vienādas tiesības uz likvidācijas kvotas saņemšanu un balsstiesībām akcionāru sapulcē.

7. Visas sabiedrības akcijas ir vārda akcijas.

8. Visas sabiedrības akcijas ir dematerializētas akcijas.

9. Katras sabiedrības akcijas nominālvērtība ir viens *euro*.

III. Padome

10. Padomes sastāvā ir četri locekļi.

11. Padomes locekli ievēlē amatā uz pieciem gadiem.

12. Padome pieņem lēmumus ar klātesošo padomes locekļu vienkāršu balsu vairākumu.

13. Padome savu darbu organizē atbilstoši tās apstiprinātai kārtībai.

IV. Valde

14. Valdes sastāvā ir trīs locekļi.

15. Valdes locekli ievēlē amatā uz pieciem gadiem.

16. Valde pieņem lēmumus ar klātesošo valdes locekļu vienkāršu balsu vairākumu.

13. Valdes locekļi var pilnvarot no valdes locekļu vidus vienu vai vairākus valdes locekļus slēgt noteiktus darījumus vai noteikta veida darījumus.

14. Papildus likumā noteiktajam valdei nepieciešama iepriekšējā padomes piekrišana tādu darījumu, iepirkumu vai saistību uzņemšanai, kas pārsniedz sabiedrības 50 % no pamatkapitāla vērtības.

15. Valde savu darbu organizē atbilstoši tās apstiprinātai kārtībai.

Statūti stājās spēkā 2020 gada 1. janvārī.

Akciju turētāja pārstāvis Edvīns Balševics

Rīgā
2019. gada 7. oktobrī

Šajā dokumentā caurauklotas
kopā...2 (DIVAS)
numurētas lapas

07.0.2018.

Olga Paipala
Vides aizsardzības un reģionālās attīstības ministrijas
Juridiskā departamenta direktora vietniece
Juridiskās nodaļas vadītāja

Translation from Latvian into English

Annex
to the Minutes No. 4 of the meeting of shareholders of the State Joint-Stock Company "Elektroniskie sakari" dated 7. October 2019.

APPROVED
by the Decision No. 2 of the meeting of shareholders of the State Joint-Stock Company "Elektroniskie sakari" of 7 October 2019 (Minutes No. 4)

ARTICLES OF ASSOCIATION OF THE STATE JOINT-STOCK COMPANY "ELEKTRONISKIE SAKARI"

I. General Provisions

1. Company's firm: State Joint-Stock Company "Elektroniskie sakari" (hereinafter referred to as - the Company).

2. Company's types of commercial activity (NACE classifier):
2.1. Other telecommunications activities (61.9);
2.2. Data processing, hosting and related activities (63.11);
2.3. Technical testing and analysis (71.20);
2.4. Research and experimental development on natural sciences and engineering (72.1);
2.5. Other professional, scientific and technical activities (74.9);
2.6. Renting and operating of own or leased real estate (68.20).

3. Notifications on convocation of a meeting of shareholders and documents related thereto shall be sent to the company's management and control bodies and shareholders by post or electronically to the addresses notified to the company or handed over in person.

II. Company's capital and securities

4. Company's share capital shall be 8,995,637.00 *euro,* consisting of 8,995,637 shares.

5. All the company's shares have equal rights to receive dividends.

6. All the company's shares, except for personnel's shares, have equal rights to receive liquidation quota and vote at the meeting of shareholders.

7. All the company's shares shall be registered shares.

8. All the company's shares shall be non-certificated shares.

9. Value of each company's share shall be one *euro.*

III. Council

10. The Council shall consist of three members.

11. Member of the Council shall be elected for a five-year term.

12. The Council shall make decisions by a simple majority of votes of the Members of the Council present.

13. The Council shall organise its work according to the procedures approved thereby.

IV. Board

14. The Board shall consist of three members.

15. Board Member shall be elected for a five-year term.

16. The Board shall make decisions by a simple majority of votes of the Board Members.

13. Board Members may authorise one or several Board Members to conclude certain transactions or transactions of certain kind.

14. Additionally to the provisions of the law, the Board shall need a prior consent of the Council to conclude such transactions, commit procurements or obligations exceeding 50% of value of the company's share capital.

15. The Board shall organise its work according to the procedures approved thereby.

The Articles of Association shall enter into effect on 1 January 2020.

Representative of the shareholder /*signature*/ Edvīns Balševics

Riga
7 October 2019

This document contains
2 (two)
thread bound and numbered sheets
07.10.2019

/*Stamp:* Olga Paipala, Ministry of Environmental Protection and Regional Development, Deputy Director of the Legal Department/
/signature/

Agency Certification

Riga, 8 November 2022

THE TRANSLATION IS CORRECT.

Translated by the translation agency's SIA "Linearis" translator Āris Incenbergs, personal identity number 060898-11755.

Translator _____

/ Āris Incenbergs /

Procurator _____

/ Lauris Zemturis /

Annex
to the Minutes No. 4 of the meeting of shareholders of the State Joint-Stock Company "Elektroniskie sakari" dated 7. October 2019.

APPROVED
by the Decision No. 2 of the meeting of shareholders of the State Joint-Stock Company "Elektroniskie sakari" of 7 October 2019 (Minutes No. 4)

ARTICLES OF ASSOCIATION OF THE STATE JOINT-STOCK COMPANY "ELEKTRONISKIE SAKARI"

I. General Provisions

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2.3. Technical testing and analysis (71.20);
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2.5. Other professional, scientific and technical activities (74.9);
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6. All the company's shares, except for personnel's shares, have equal rights to receive liquidation quota and vote at the meeting of shareholders.

7. All the company's shares shall be registered shares.

8. All the company's shares shall be non-certificated shares.

9. Value of each company's share shall be one *euro*.

Valsts ieņēmumu dienests

Talejas iela 1, Rīga, LV-1978, tālr. 67122689, e-pasts vid@vid.gov.lv, www.vid.gov.lv

Izziņa

Rīgā

2022.gada 4. novembrī

Reģistrācijas numurs: **40003021907**
Nosaukums: **ELEKTRONISKIE SAKARI AS**

2022.gada 2. novembrī nodokļu maksātājam nav VID administrēto nodokļu (nodevu) parāda.

PĀRBAUDIET IZZIŅU

https://eds.vid.gov.lv/ref/abfd18a7-b803-4a1d-8686-12af02795445

• Pieslēdzieties EDS • Izvēlieties nodokļu maksātāju • Dodieties uz sadaļu "Izziņas" • Ievadiet kodu

abfd18a7-b803-4a1d-8686-12af02795445

Translation from Latvian

/Coat of Arms/
State Revenue Service

Talejas iela 1, Riga, LV-1978, tel. +371 67122689, e-mail vid@vid.gov.lv, www.vid@vid.gov.lv

CERTIFICATE

Riga

4 November 2022

Registration number: **40003021907**
Name: **JSC ELEKTRONISKIE SAKARI**

On 2 November 2022 the taxpayer does not owe any taxes (fees) administered by SRS.

CHECK THE NOTICE
Https://eds.vid.gov.lv/ref/abfd18a7-b803-4a1d-8686-12af02795445

• Sign into EDS • Choose a taxpayer • Go to the "Notices" section • Enter code **abfd18a7-b803-4a1d-8686-12af02795445**

On 7 November 2022, I, translator and project director of Limited liability company "Skrivanek Baltic", 87C Lāčplēša Street, Riga, Līga Darģe personal identity number 020491-11633, certify that the translation of this document from Latvian into English, certified with my signature, is correct orthographically and in its essence.

TRANSLATION CORRECT.

Līga Darģe

THIS DOCUMENT HAS BEEN ELECTRONICALLY SIGNED WITH A SECURE ELECTRONIC SIGNATURE AND CONTAINS A TIME STAMP

BUREAU VERITAS
Certification

EN ISO/IEC 17021-1
S2-424

Certification

Awarded to

ELEKTRONISKIE SAKARI VAS

EKSPORTA IELA 5, RĪGA, LV-1010, LATVIA

Bureau Veritas Certification certify that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standard detailed below

STANDARD

ISO 9001:2015

SCOPE OF CERTIFICATION

RADIO SPECTRUM AND NUMBERING MANAGEMENT IN THE ELECTRONIC COMMUNICATIONS SECTOR. ACCEPTANCE OF TECHNICAL PROJECTS FOR THE INSTALLATION OF ELECTRONIC COMMUNICATIONS NETWORK ANTENNAS, RADIO EQUIPMENT, BROADCAST TRANSMITTERS AND MOBILE COMMUNICATION BASE STATIONS.

Original cycle start date:	**29-05-2017**
Expiry date of previous cycle:	**28-05-2020**
Certification/Recertification audit date:	**27-04-2020**
Certification/Recertification cycle start date:	**29-05-2020**
Subject to the continued satisfactory operation of the organisation's Management System, this certificate expires on:	**28-05-2023**

Certificate Number: **LV006673** *Version:* **1** *Revision date:* **29-04-2020**

Certification body address: Bureau Veritas Latvia SIA, Duntes street 17a, Riga, LV-1005, Latvia

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation.

To check this certificate validity please call +371 67323246

BUREAU VERITAS
Certification

EN ISO/IEC 17021-1
S2-424

Certification

Awarded to

ELEKTRONISKIE SAKARI VAS

EKSPORTA IELA 5, RĪGA, LV-1010, LATVIA

Bureau Veritas Certification certify that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standard detailed below

STANDARD

ISO/IEC 27001:2013

SCOPE OF CERTIFICATION

RADIO SPECTRUM AND NUMBERING MANAGEMENT IN THE ELECTRONIC COMMUNICATIONS SECTOR. ACCEPTANCE OF TECHNICAL PROJECTS FOR THE INSTALLATION OF ELECTRONIC COMMUNICATIONS NETWORK ANTENNAS, RADIO EQUIPMENT, BROADCAST TRANSMITTERS AND MOBILE COMMUNICATION BASE STATIONS.

IN ACCORDANCE WITH STATEMENT OF APPLICABILITY DATED: 06.04.2021.

Original cycle start date:	**10-06-2021**
Expiry date of previous cycle:	**NA**
Certification/Recertification audit date:	**27-05-2021**
Certification/Recertification cycle start date:	**10-06-2021**
Subject to the continued satisfactory operation of the organisation's Management System, this certificate expires on:	**09-06-2024**

Certificate Number: **LV007320** *Version:* **1** *Revision date:* **10-06-2021**

Certification body address: Bureau Veritas Latvia SIA, Duntes street 17a, Riga, LV-1005, Latvia

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation.

To check this certificate validity please call +371 67323246

USER MANUAL

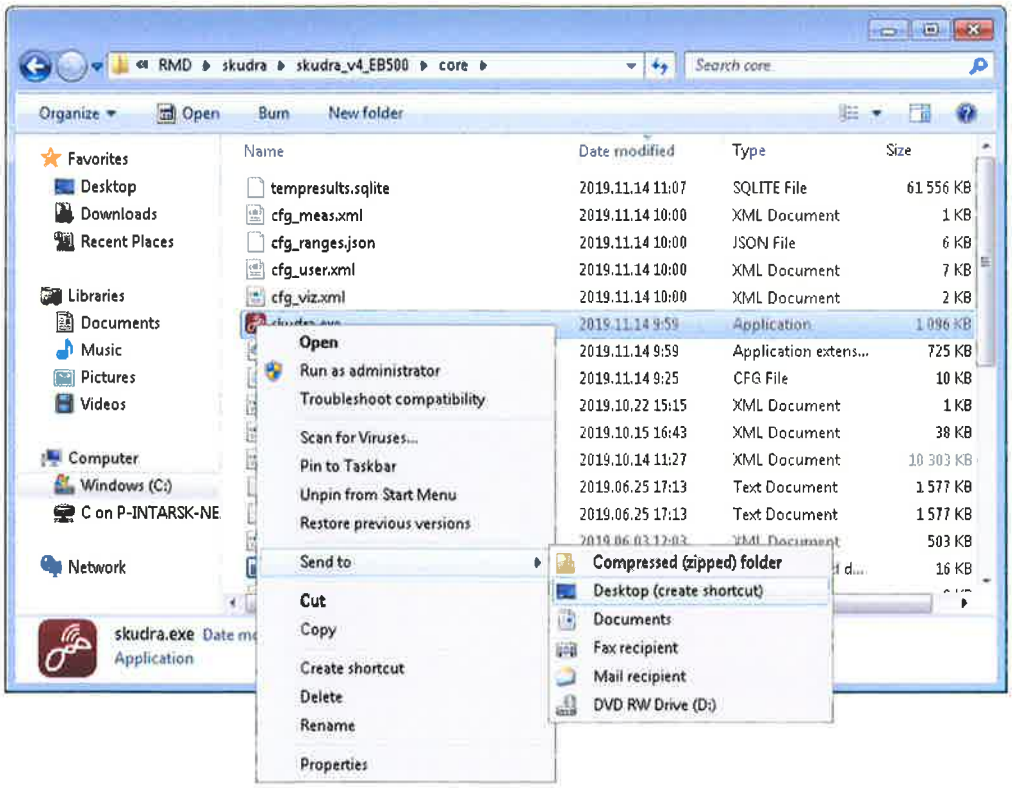
v.4.5.4 03.11.2022

Content

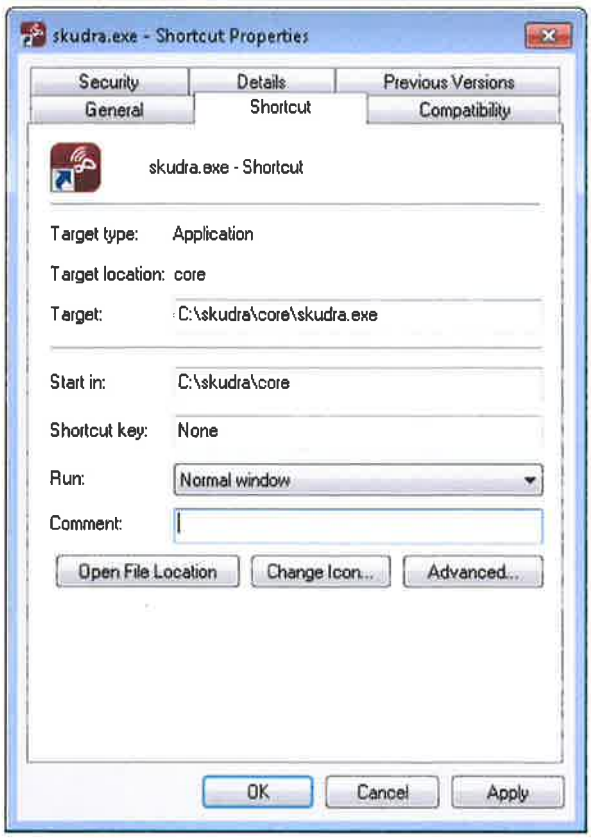
1 Initial Setup

1.1 Setting up the software

No installation is necessary for the software Skudra - just copy the software folder from the USB stick to the desired folder in the computer. For user convenience a shortcut may be created.



It is important to designate the correct value of start in. By default start in should be correct, but in the event of copying the shortcut from another computer it may occur that the start in value should be corrected.



1.1.1 Computer configuration requirements

Technical requirements for the running the software:

- OS: Microsoft Windows 7, 10, 11 with Microsoft.NET Framework 4.7.2 or later;
- CPU: Intel Core i5;
- RAM: 4GB;
- HDD: 100GB;
- Screen resolution: 1280 x 720 px;

1.1.2 Supported receivers

R&S EB200; R&S ESMB; R&S EB500; R&S ESMD; R&S DDF255; R&S PR100; R&S EM100; R&S EB510; Narda SignalShark; R&S DDF107; R&S DD205; R&S EM550; R&S UMS100.

1.1.3 UMS100 support

R&S UMS100 support is provided through SkudraUMS100 windows service installed on UMS100 embedded computer. Installation files are provided with copy of Skudra Patrol. SkudraUMS100 requires Microsoft.NET Framework 2.0 to be installed on UMS100 embedded computer.

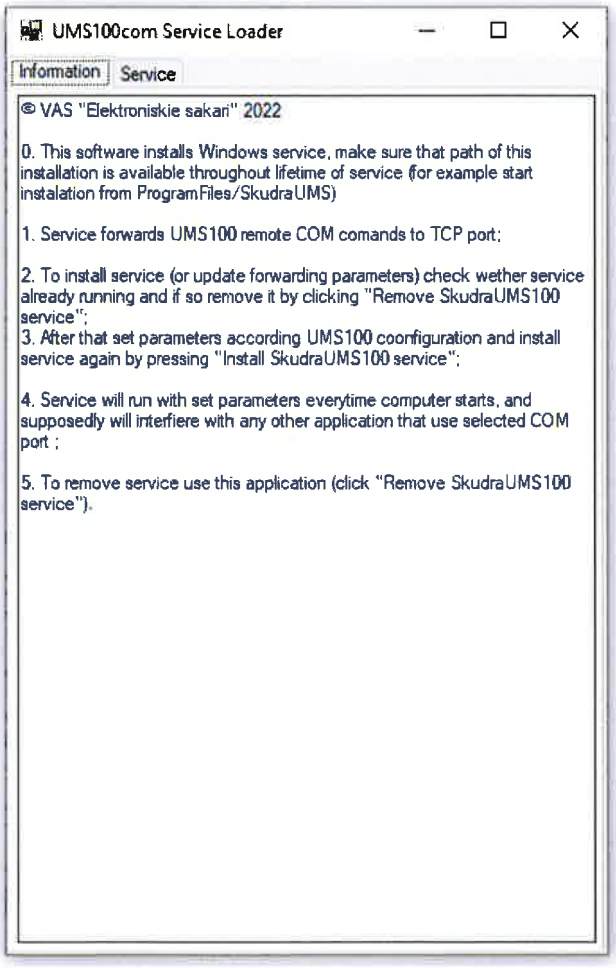
SkudraUMS100 service forwards commands sent to and received from embedded UMS100 receiver to external TCP connection, that is accessible on UMS100 IP address

and port set in during installation of service. Thus, when configurating Skudra Patrol, external IP address of R&S UMS100 and port set during the installation of service has to set as receiver IP (port) in settings panel.

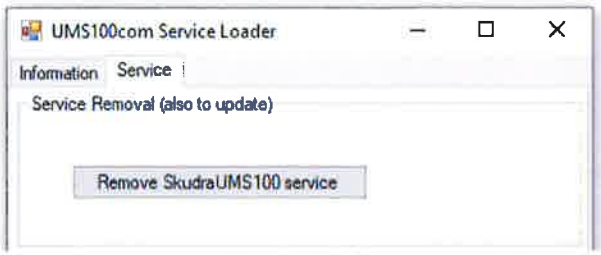
As Skudra Patrol requires OS and Microsoft.NET framework far newer than that achievable on UMS100 system, only way to run Skudra Patrol with UMS100 is using Skudra Patrol on remote computer with SkudraUMS100 service installed on UMS100.

1.1.3.1 Installation of SkudraUMS100 service

- Installation of SkudraUMS100 service has to be done on R&S embedded computer;
- As later possible configuration or removal of service is possible only with same application that installs service, it is advisable to run installation (*SkudraUMS100comLoader.exe*) from folder that will be accessible throughout the lifetime of service;
- Installation of SkudraUMS100 service is started with running the file *SkudraUMS100comLoader.exe*. After that following screen appears:

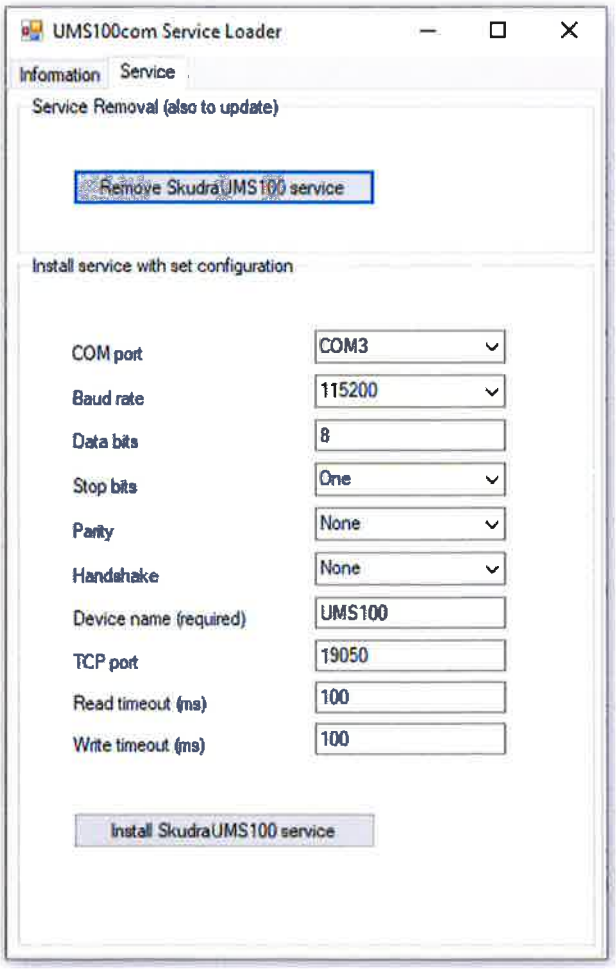


- Functionality to install service is provided in tab “Service”;

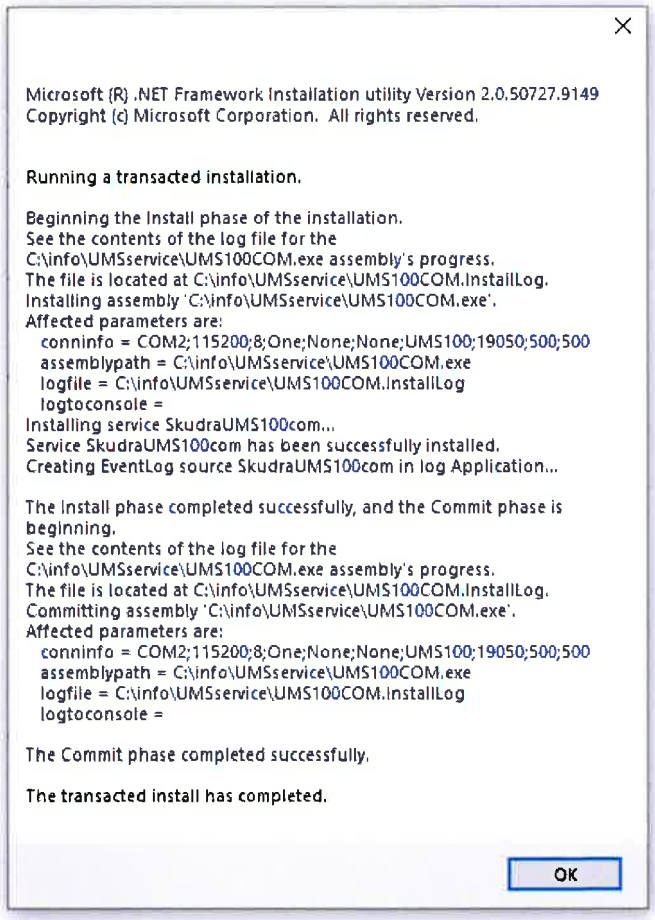


- To install SkudraUMS100 service, it is first necessary to press "Remove SkudraUMS100 service". Doing that performs check whether service is installed and if installed uninstalls service;

- After ensuring that service is not installed, Install SkudraUMS100 service is enabled:



- By pressing "Install Skudra UMS100 service" service will install with defined settings. After successful installation following message box will be displayed:



- After service is installed it will start every time as the system starts and block use of set Serial (COM) port by any other application. To unblock serial port to be used by another application, Skudra Service has to be uninstalled or stopped (temporarily) using Windows services functionality.

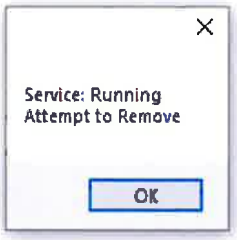
1.1.3.2 Settings of SkudraUMS100 service

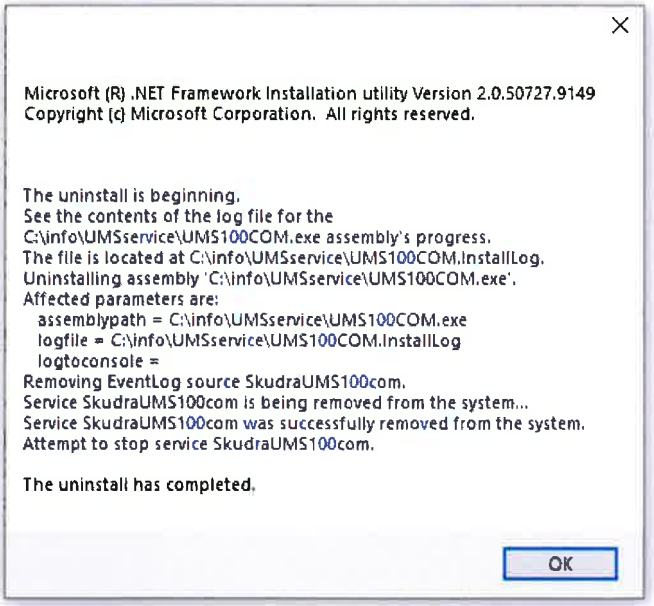
- Serial (COM) port related settings is dependant of actual internal configuration of UMS100, however settings shown in this manual may be considered as default;
- As used serial (COM) port may not be visible in UMS100 device manager, it can be found using Serial port communications software (like PuTTy) by checking which port responds to connection requests;
- After restart of receiver Baud rate is set to 19200 (and such must be used when communicating through PuTTY), however SkudraUMS100 service sets Baud rate to selected in settings. Value of 115200 is recommended, as it provides faster data connection;

- For Skudra Patrol to recognize SkudraUMS100 service as UMS100 receiver, it is required to set Device name to "UMS100";
- TCP port has to be set to free port. Generally Skudra softwares uses ports in range 19005 to 19100, therefore it may be practical to use port in this range, as use of them already may be allowed by network administrator. However it is possible to use any free port of UMS100 computer, provided that network is configured to allow communication on selected port;
- Read and Write timeouts defines time how long service waits before request from Skudra Patrol is considered unsuccessful. Setting High values (in range of 1000 ms) is only necessary if network between Skudra Patrol and UMS100 frequently experiences comparable delays. High timeout values comes with drawback of longer communication retry times. However setting small (in range of tens of ms) response timeout maybe too short for receiver to perform sweep and return results.

1.1.3.3 Removal and update of SkudraUMS100 service

- Removal of SkudraUMS100 service can be done by installation (SkudraUMS100comLoader.exe);
- To stop and remove SkudraUMS100 service from UMS100 user has to press "Remove SkudraUMS100 service". After following message boxes will be displayed:





- After SkudraUMS100 service is uninstalled, it can be updated (installed again with different settings). See 1.1.3.1

1.1.4 Supported direction finders

R&S DDF255, R&S DD205; R&S EB500; R&S ESMD; R&S PR200

1.1.5 Licence protection

The software is protected from unlicensed use by a USB dongle. To start and use the software Skudra, the dongle accompanying the software licence agreement must be plugged into a USB port.

No manual driver installation is necessary for the dongle. The driver is installed by the *Windows* operating system when the dongle is first plugged in.

If the software is started without the dongle a warning message appears.

One dongle licenses three instances of Skudra running simultaneously.

1.2 Network configuration

The software Skudra uses the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) to communicate with the receiver and Skudra Server Database.

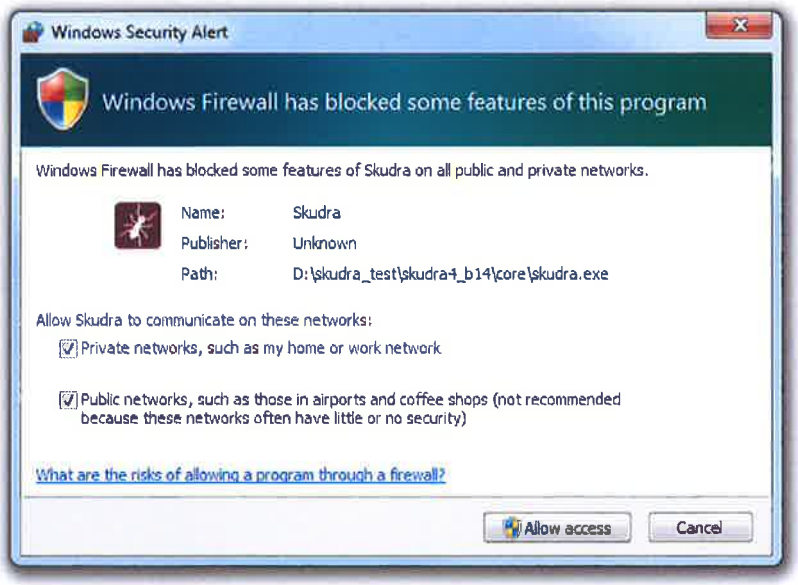
Thus Skudra should be allowed appropriate access to:

- TCP connection with the receiver IP address (port 5555);
- Incoming UDP datagrams from the receiver's IP address. UDP datagrams are expected at ports 19005 - 19100. Often this functionality is firewall-blocked by default, and must be manually allowed. In case UDP packets are blocked, the connected receiver model may be determined, but monitoring spectrum is not acquired;
- In order to save monitoring results, as well as upload and save spectrum samples and spectrum usage statistics in the Skudra Server Database, a TCP connection is necessary (port 80 or 443).

Connecting via VPN and tunnelling, etc. is supported, but the delay involved may slow down the speed of scanning.

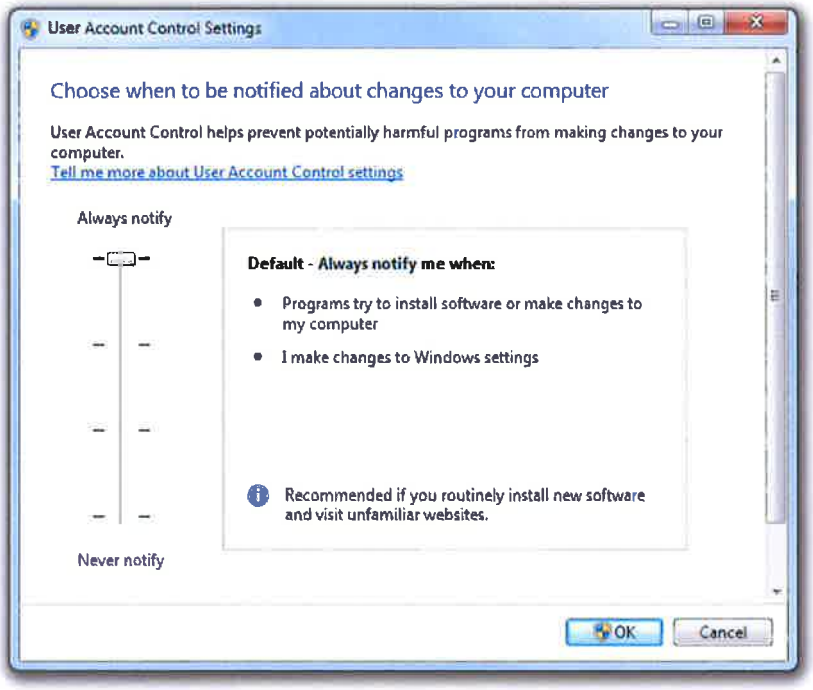
1.2.1 Firewall settings

Initial use of Skudra software, depending on the computer configuration, may require unblocking Skudra access to arriving receiver data.

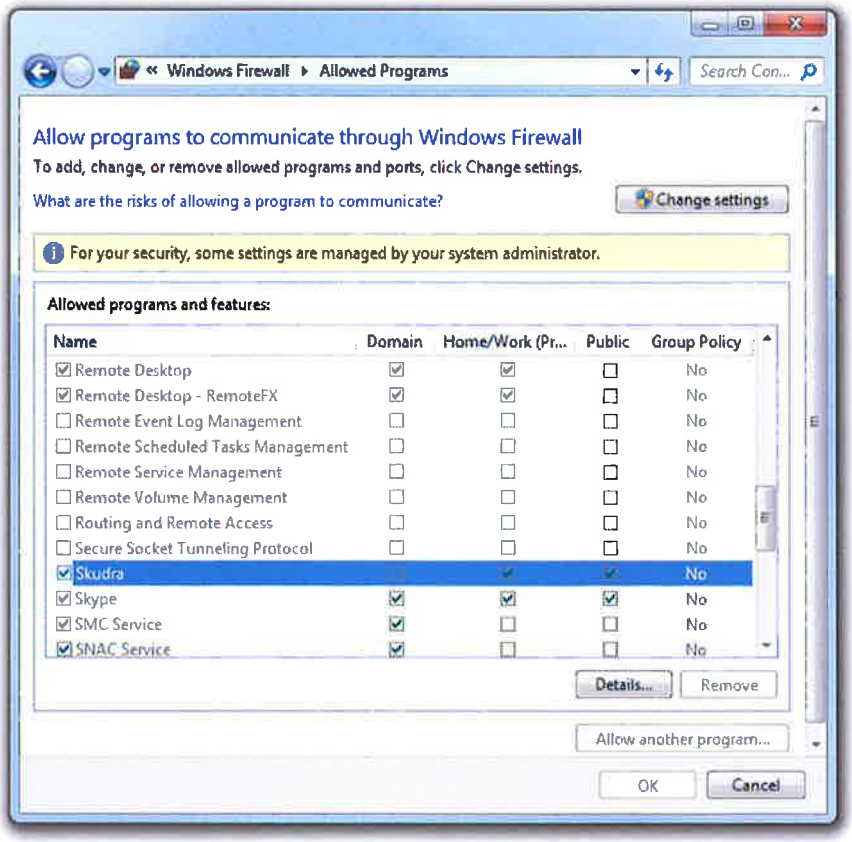


To allow access, it is necessary to define in which networks access to receiver data is licensed - work/home, public (sometimes, domain). The choice must be made according to the network connection indicator.

If there is no pop-up message concerning blocking of the software, you may need to check if *Windows* is set up to alert on the change of settings:

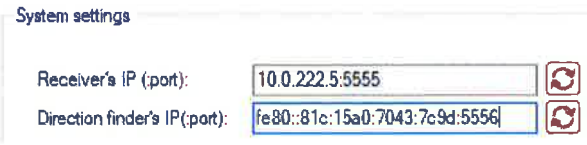


An alternative method is adding Skudra to the programs allowed to communicate through the *Windows* firewall or to alter the Skudra entry according to the used network.



1.2.2 IPv6 support

Skudra Patrol supports IPv6 addressing. IPv6 address can be provided in formats [2001:db8:85a3:8d3:1319:8a2e:370:7348]:443 or 2001:db8:85a3:8d3:1319:8a2e:370:7348:443. However, for address IPv6 to work it is necessary that receiver supports IPv6 also.



1.3 Software update

Most often software updates are done by substituting the files in the *core* folder of Skudra with the updated ones. In special cases, when noted in the information accompanying the update, it may be necessary to change all the content of the core folder as explained in the next section.

After such updates the software will keep the setup intact and it will be possible to open earlier saved result files.

If old result files are not needed any more, their support may terminated to make the software operation more effective.

1.3.1 Software update in special cases

If the description of the software update states that all of the *core* folder files should be changed, in order not to lose the software settings, prior to the change the following *core* files should be saved in a temporary folder of the user's choice:

- cfg_applications.xml
- cfg_licence_db.xml
- cfg_licence_spec.xml
- cfg_meas.xml
- cfg_paraugspektri.xml
- cfg_ranges.json
- cfg_user.xml
- cfg_viz.xml
- karte (folder)

The file "cfg_paraugspektri.xml" contains sample spectra. If the user has never appended the sample spectra, using "cfg_paraugspektri.xml" from the update should be considered, as this already contains sample spectra that enable optimal signal determination in the software developer's measurement environment. Similarly the

folder *karte* (map) update should be considered, because it contains the current map of Latvia, the update of which by software tools is time consuming.

Continuing the update, all content of the *core* folder should be deleted. If the old files remain, the software may not work properly. Further, all *core* files from the update should be copied to the computer's Skudra *core* folder and the earlier saved configuration files in the temporary folder should also be copied back to the computer's Skudra *core* folder.

! This special update procedure should also be used updating from a version earlier than 4.0.9 to 4.1.0 and higher.

1.3.2 Insignificant software updates

Doing insignificant software updates, if the accompanying information does not require otherwise, it suffices to substitute the computer Skudra *core* files with the ones in the update.

Most often updated are the files "skudra.exe", "skudra.exe.dp64.dll" and "language.cfg". Prior to substituting these the software should be closed.

2 Short Tutorial

2.1 Commencing measurements

To begin measurements, start the software either from the shortcut (1) or directly from the folder "\core\skudra.exe".

The software Skudra will start with last session's settings.

If no changes are needed in the measurement settings, monitoring can be commenced immediately by clicking the measurement start button (A.1). If changes are necessary, they should be applied in the settings section (0).

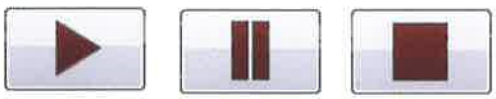
To start the software for the first time it is necessary to define at least the receiver's IP address and port (5555) in the appropriate window (0).

Parameters most often changed in day-to-day operations:

- Geographical coordinates of the monitoring site (C.10 and C.11);
- Monitoring range (D.1);
- Licence database file download (C.16 and C.17);
- Skudra Server authorisation (C.23 un C.25)

2.2 Measurement process control

An ongoing measurement can be paused by clicking the button "PAUSE" (A.1) or completely stopped by clicking the button "STOP" (A.2).



Settings can not be changed during an ongoing measurement.

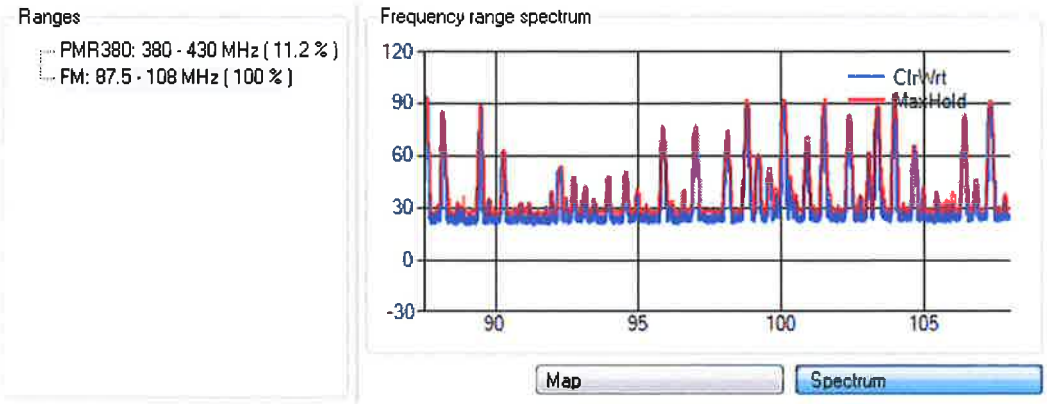
2.3 Measurement result analysis

The software constantly visualizes the measurement process regardless if the measurement is underway, paused or stopped completely, thus the user can observe ongoing events as they develop.

During measurement, bands checked in the settings section are scanned. Bands are scanned consecutively and cyclically. The progress of each range scan is displayed in parentheses after the range.

By clicking the name of the range, the spectrum of the respective range is visualized. It should be taken in account that, to see the spectrum ,the button "Spectrum" should be clicked.

The bands spectrum graph can be zoomed in by drawing the frame over the part of interest. The displayed spectrum central frequency can be changed (to sequently review the spectrum) by clicking the graph with the left mouse button. Zooming out to see the complete spectrum is done by clicking the graph with the right-hand mouse button.



Signal detection results from all scanned ranges are presented in the list of results. The results are aggregated by frequency channel and monitoring range. Each entry can have multiple parameters, which may be revealed or hidden by clicking the right-hand mouse button on the column title.

Signal detection results

Frequency	Range	Corr.	Lev.	Diff.	Dist.	BW	%	Count	Em.class	Licence	Lic.Nr.	Application	Notes
87.6	FM	0.917	94.6	-5.6	2.3	95	100	749	300KF8...	Latvijas Valst...	BC-FM-148 - ...	TV analoque...	
88.2	FM	0.921	85.7	-2.3	2	122.5	100	749	300KF8...	SUPER FM I...	BC-FM-269 - ...	TV analoque...	
89.5	FM	0.919	89.1	-11.2	2.3	112.5	100	749	300KF8...	Latvijas Valst...	BC-FM-309 - ...	TV analoque...	
90.3	FM	0.923	63.6	2.4	23.1	130	100	749	300KF8...	SUPER FM I...	BC-FM-336 - ...	TV analoque...	
92	FM	0.835	40	-2.5	46.3	92.5	37.7	282	300KF8...	STAR FM	BC-FM-202 - ...	TV analoque...	
92.3	FM	0.895	53.9	9.4	31.4	155	100	749	300KF8...	SUPER FM I...	BC-FM-238 - ...	TV analoque...	
92.8	FM	0.883	48.5	4.1	42	140	100	749	300KF8...	RADIO VIDZ...	BC-FM-249 - ...	TV analoque...	
93.2	FM	0.759	42.9	-3.2	33.6	182.5	85.4	639	300KF8...	QBS	BC-FM-377 - ...	TV analoque...	
94	FM	0.869	48.8	-2.9	33.6	145	100	749	300KF8...	Radio TEV	BC-FM-273 - ...	TV analoque...	
94.6	FM	0.887	51.1	-0.7	33.6	150	100	749	300KF8...	RADIO VIDZ...	BC-FM-218 - ...	TV analoque...	

Explanation of signal detection result values:

Frequency - The frequency channel (MHz), where the signal was found. Depending on the range set, the channel step may be 100 kHz or 6.25 kHz;

Range - The name of the user-determined measurement range where the signals were detected;

Corr. - Average correlation value (see section ¤) of all signal events in the frequency channel;

Lev. - Field strength dBµV/m (see section ¤);

Diff. - The difference between the theoretically calculated and the measured field strength. Positive values are assigned to field strength that exceeds theoretically calculated, but negative - strength that is less than theoretically calculated. Zero is displayed when the measurement is equal to the theoretical

value or theoretical calculations show there should not be any signals at the monitoring site;

Dist. - Distance in kilometers from the monitoring site to the possible licence coordinates. Zero is displayed if by theoretical calculations the transmitter should not be received;

BW - the emission's bandwidth in kHz (see section ¤);

% - Frequency occupancy (%) as the number of instances of signals determined over the number of scans, expressed in percent;

Count - Number of instances of signals determined;

Em. class - The class of emission most often determined, found by comparing the received signal with the sample spectra;

Licence - most probable licence (it's holder);

Lic.Nr - The number of the most probable licence;

Application - Radiofrequency application according to EFIS;

Notes - User added comment. Text input in this field will be linked to the saved entry in the Skudra file as well as the Skudra database.

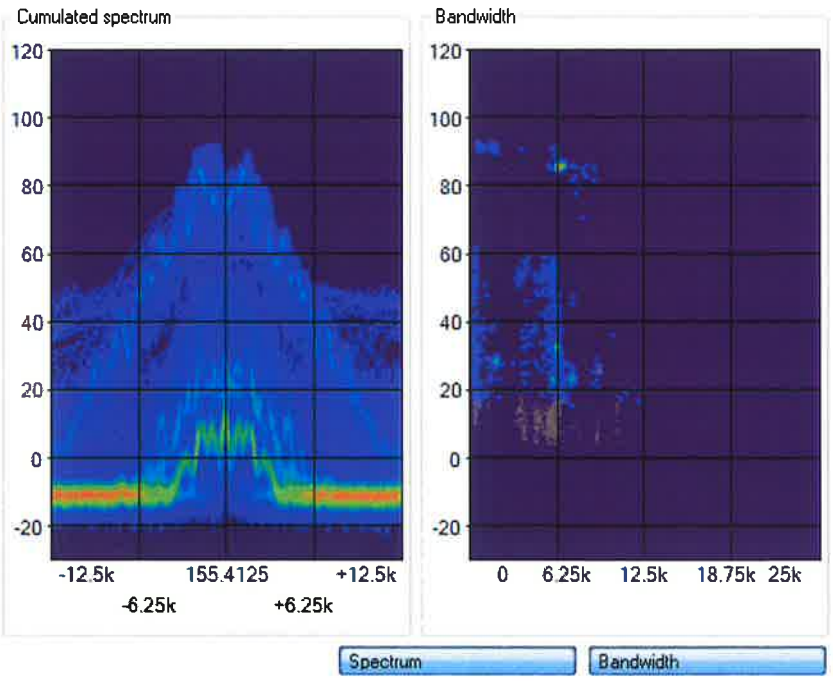
By highlighting an entry in the signal determination result list, it is possible to show the corresponding licence on the map, the cumulated spectrum of the frequency channel, bandwidth breakdown and the time-level or occupancy graph of signals determined in the frequency channel.

Click the button "map" to display the map.

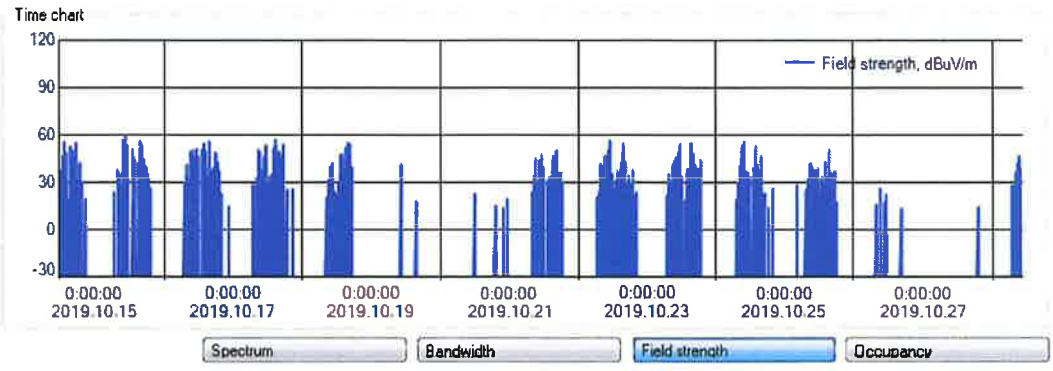
The map shows licences corresponding the frequency channel. The large blue marker shows the monitoring site. A small blue marker shows the most probable licence at the monitoring site, other licences are shown by grey markers. Clicking on the marker, a menu opens with licence owner and number, theoretically calculated level and it's difference with the measurement result, distance to the monitoring site,

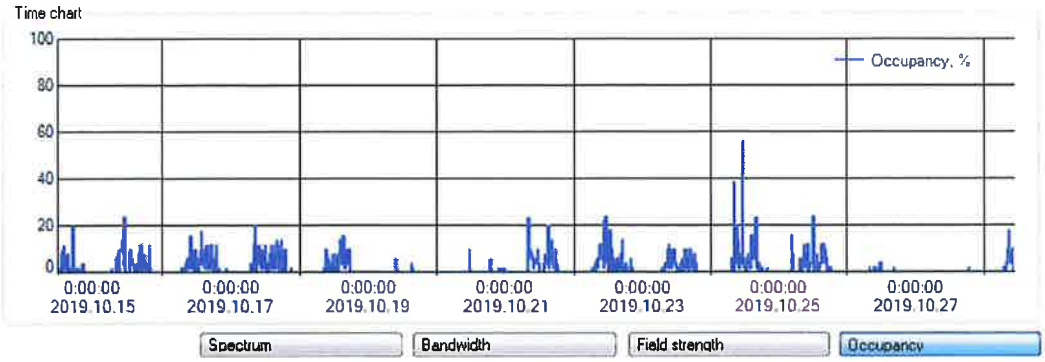
emission class and the option to mark the licence as most probable. On the monitoring site marker it is possible to mark the most probable licence (owner) without linking coordinates.

To visualize the observed signal's cumulated spectrum and bandwidth breakdown in the frequency channel, the buttons "Spectrum" and "Bandwidth" should be pressed accordingly. The graphs show most often observed frequency - level pairs (or correspondingly, bandwidth - level pairs) with a hue that is closer to red. Less often observed values are shown with a hue closer to blue.



To view the detected signal field strength/time or occupancy/time graphs of the frequency channel the buttons "Field strength" or "Occupancy" should be correspondingly clicked. The graphs are shown alternatively - opening one, the second is closed. The occupancy graph shows the number of signal detections in 15 minute intervals.





Both the field strength and occupancy graphs may be zoomed into by drawing the frame over the spot of interest and zoomed out by right-click of the mouse on the graph.

2.4 Editing Measurement Results

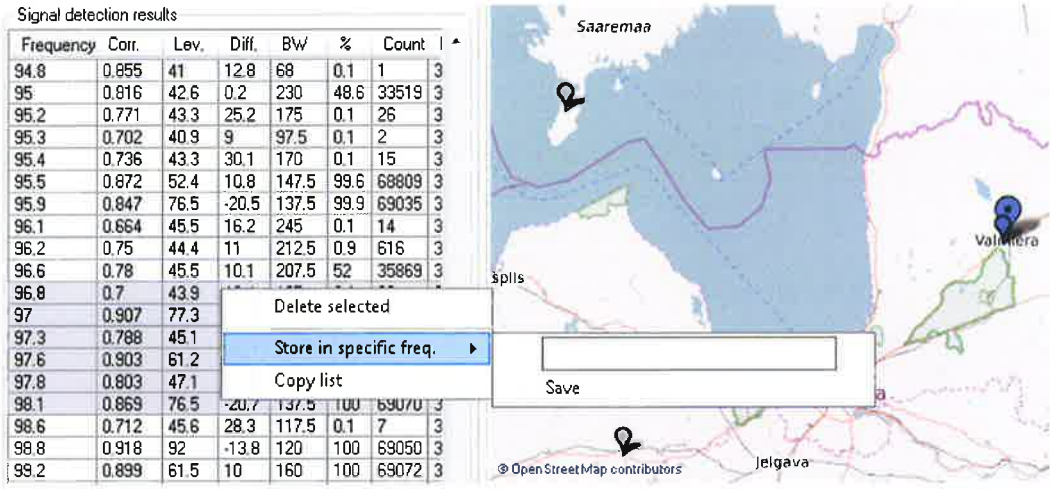
Results may be edited during measurements, after measurements have stopped, or opening an earlier saved result file.

The following editing actions are possible:

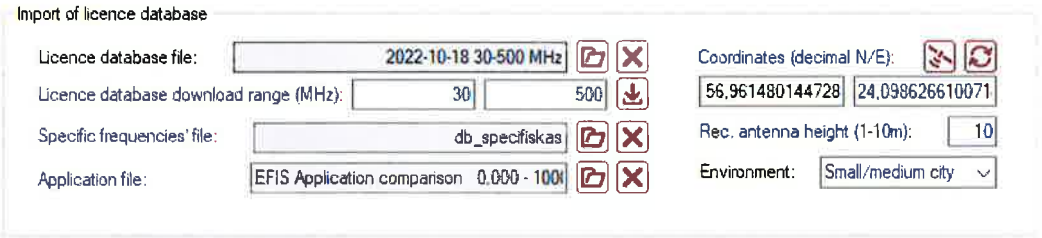
- Delete entries (frequency channels);
- Change licences designated as most probable;
- Recalculate most probable licences for all the signal determination result list, using modified monitoring site coordinates, updated licence database and other frequency licence input and range settings.

No other edits are foreseen, e.g., bandwidth or level time graph.

Signal detection result list entries may be deleted highlighting the entry and choosing *"Delete selected"* (delete highlighted) from the mouse right-click menu. Alternatively *"delete"* may be pressed on the keyboard. Entries may be deleted one by one or several at a time by highlighting them pressing and holding the keys *"Shift"* or *"Ctrl"*.



Licences found as most probable, can be changed only one by one. Licences included in the licence database or the list of specific frequencies can be chosen on the map, and on the marker menu clicking "*set as actual*". In cases when the licence will not be listed in the database, the corresponding frequency/user pair can be saved to the specific frequency file, opening the mouse context menu by right-click, choosing *"Store in specific freq."* (to the specific frequency list), inputting the user information and clicking *"Save"* .



Complete recalculation of the most probable licence, radio communication system, difference between theoretical and measured level of the signal determination list can be done by clicking the button "Recalculate results" in the "Stored measurement settings" section (B.4).

The results will be updated according to the current settings: "Coordinates, "Rec. antenna height", "Environment", "Licence database file", "Specific frequencies' file" and it's changes, "Application file", as well as the newly set "Min. field strength" and "Guaranteed distance".

2.5 Actions with the Receiver during monitoring

While the software Skudra is carrying out measurements, the receiver may be disconnected from the software. In this case the software will stand by until the receiver is reconnected or the measurement is manually stopped.

On disconnecting the receiver from the software it is safe to change any receiver settings (except the IP address and port). Upon reconnecting the receiver with the software, all settings necessary for the functioning of the software will restore their correct value.

Correction of software settings necessary for the operation of the software is not done constantly, but in specific moments (e.g., upon loosing connection). Therefore, while the receiver allows it, parameter change during the operation of the software may give unforeseen results. The following settings have direct impact on the measurement results and software operation: IP configuration, IF spectrum display, duration of measurement, IF Span, IF spectrum accumulation mode, IF spectrum width - SPAN, RF attenuation, IF mode (Lowdist/Normal/LowNoise) and for individual receivers spectrum point width (Sharp/Narrow/Normal).

2.6 Stopping measurements, saving results and storing them in the database

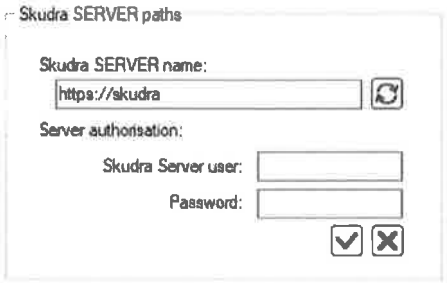
Measurement may be stopped by clicking the "STOP" button (A.2).

After interrupting the measurement, buttons will be shown to erase the active results from the software memory, saving and sending them to the database.

By clicking the save button (A.4), the results will be saved in the result folder indicated in the settings section (C.5). The result file will be named automatically. The name will consist of the start date of monitoring, name of the measurement session, start and stop frequencies, a serial number based on the previous criteria and a version serial number in the sequence hereby listed.

Upon clicking the upload to database button (A.5), the results will be uploaded to Skudra Server. If successful, a link to the saved result will be shown in the measurement sections lower left corner, but in the case of failure a pop-up error message will be displayed.

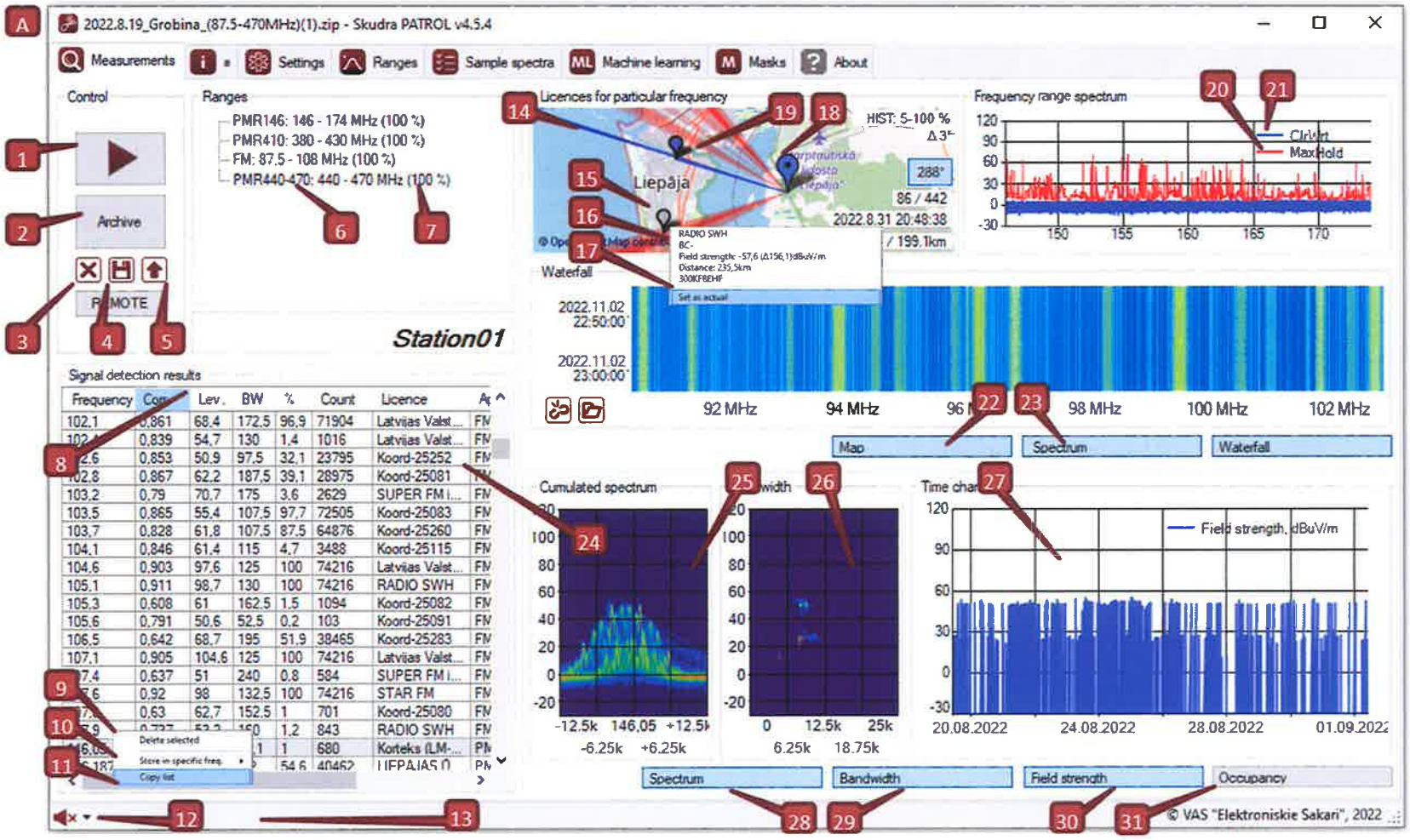
User authorization is required for any interaction with Skudra Server. Authorization is done by entering the user's name and password and clicking (C.25). Upon successful authorization the software Skudra will save an access key to Skudra Server, which will be valid for a time, defined by Skudra Server. Repeated authorization is neccessary only after the key expires.



The saved key may be deleted clicking the button with the cross in the group "Skudra SERVER paths" (C.24).

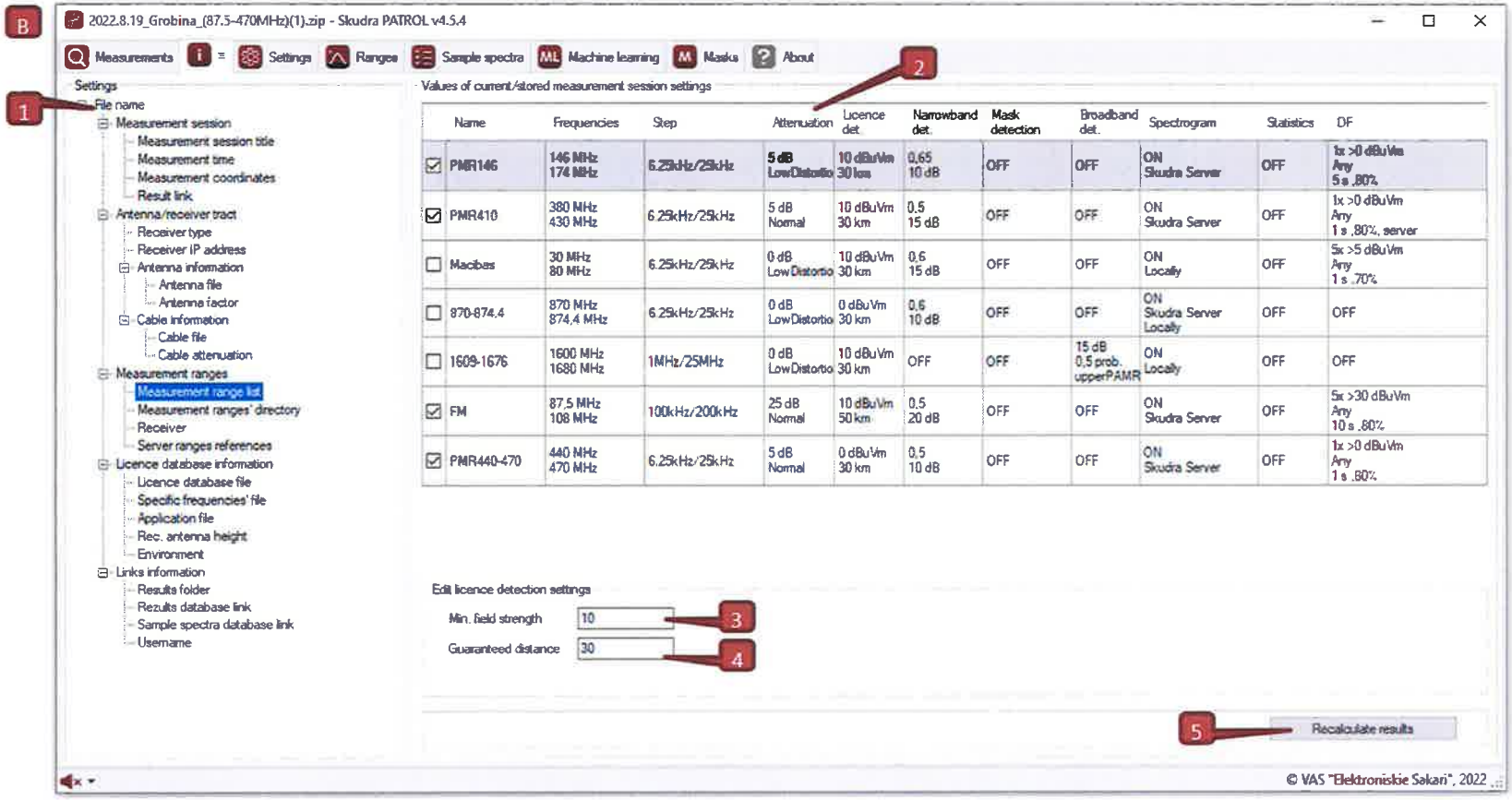
3 Description of the Software User Interface

3.1 Measurement section



A.1. Combined functionality measurement start and measurement pause button;
A.2. Combined functionality measurement interrupting and saved measurement opening button;
A.3. Button to close current (indicated) measurement results;
A.4. Button to save current (indicated) measurement results;
A.5. Button to upload the current (indicated) measurement results to the database (*Skudra Server*);
A.6. Bands in which monitoring will be done;
A.7. Measurement cycle range scan progress;
A.8. Signal detection results column title, that may comprise Frequency, Range name, Correlation, Level, theoretical level Difference, Distance to transmitter, emission occupied Bandwidth, how often the signal is detected (%), Number of emissions detected, Owner of the licence, Number of the licence, Radio communication application and user Notes;
A.9. Menu to delete the highlighted entry from the list of signal detection results;
A.10. Menu to add the highlighted entry to the list of specific frequencies;
A.11. Menu to copy the list of signal detection results to the clipboard;
A.12. Menu to adjust the receiver's volume while Paused;
A.13. Area to display information on the working of the software;
A.14. Map showing licences corresponding to the frequency;
A.15. Marker showing licences assumed less posible;
A.16. Menu showing information corresponding to the marker;
A.17. Menu to change the highlighted licence as most probably corrresponding to the signal;
A.18. Blue marker showing most probable licences;
A.19. Light blue marker showing the monitoring sitei;
A.20. Selected range's spectrum maximum value curve (*MaxHold*);
A.21. Selected range's spectrum instantanious value curve (*ClrWrt*);
A.22. Button to display and hide the map of licences corresponding to the frequency;
A.23. Button to display and hide the range spectrum graph;
A.24. List of signal detection results;
A.25. Cumulated signal spectrum for an entry chosen from the list of signal detection results;
A.26. Bandwidth/level two dimensional breakdown for an entry chosen from the list of signal detection results;
A.27. Frequency time/level occupancy graph for an entry chosen from the list of signal detection results;
A.28. Button to display and hide the cumulated spectrum;
A.29. Button to display and hide the signal bandwidth/level two dimensional diagram;
A.30. Button to display the level/time graph;
A.31. Button to display the occupancy/time graph.

3.2 Stored measurements settings



B.1. Treeview to select stored or ongoing mesasurement session settings to be view in field on right;

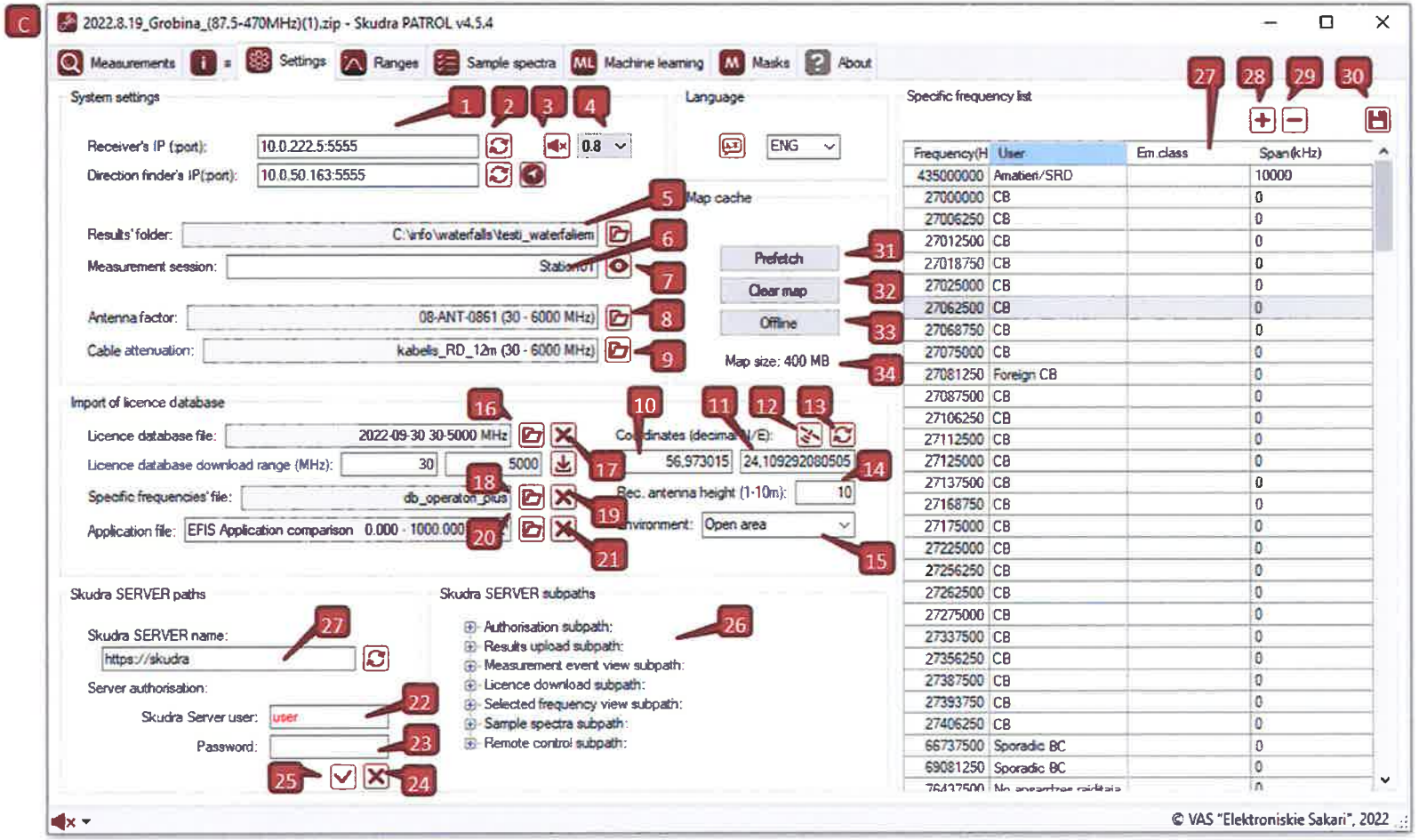
B.2. Display of measurement ranges list (choise selected in treeview on the left) of current or stored measurement session;

B.3. Licence detection's minumum field strength input field to be used for Recalculation of results;

B.4. Licence detection's guaranteed distance input field to be used for Recalculation of results

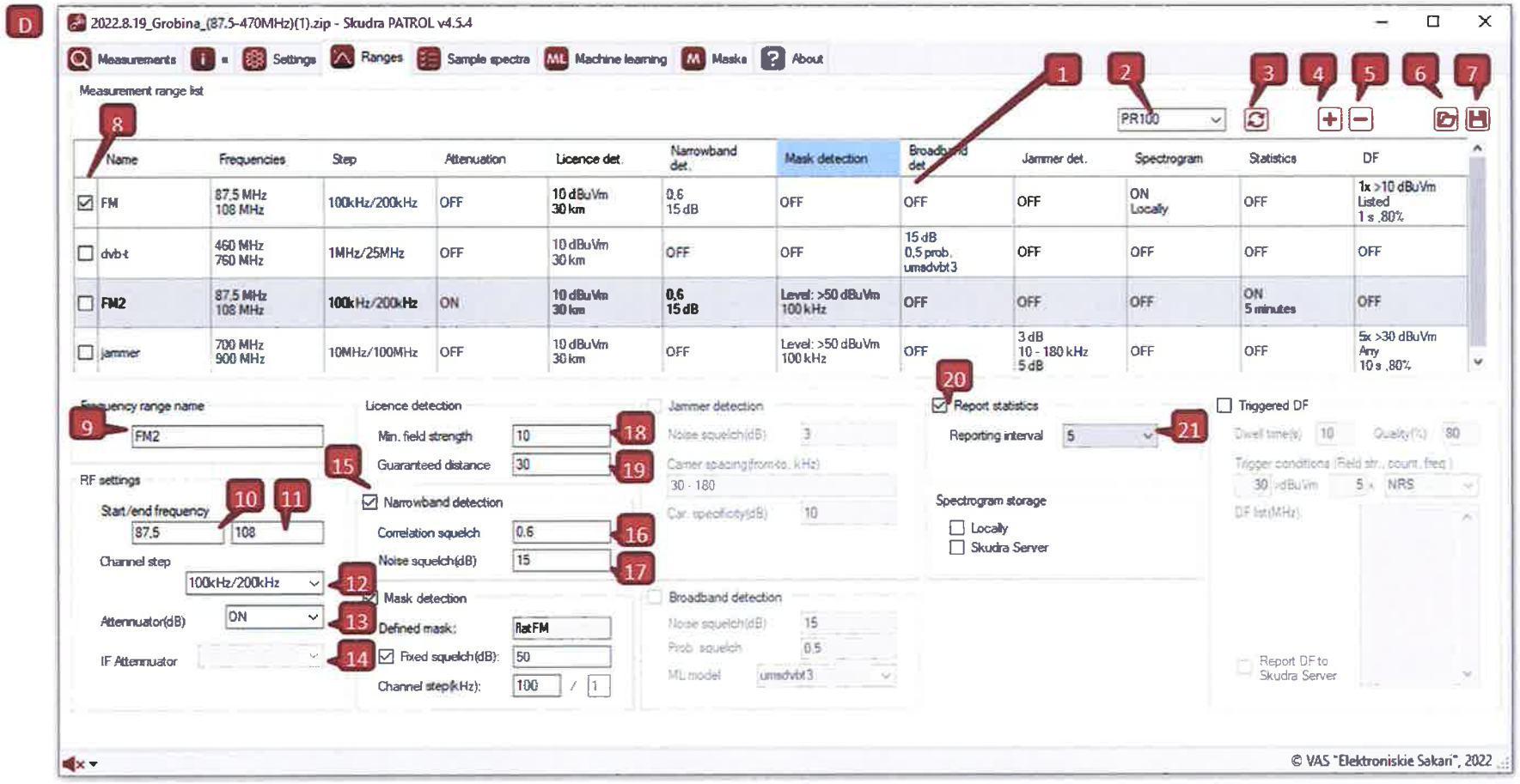
B.5. Button for recalculation of the signal detection result list for an updated theoretically possible detectable transmitter list at the monitoring site

3.3 Settings section



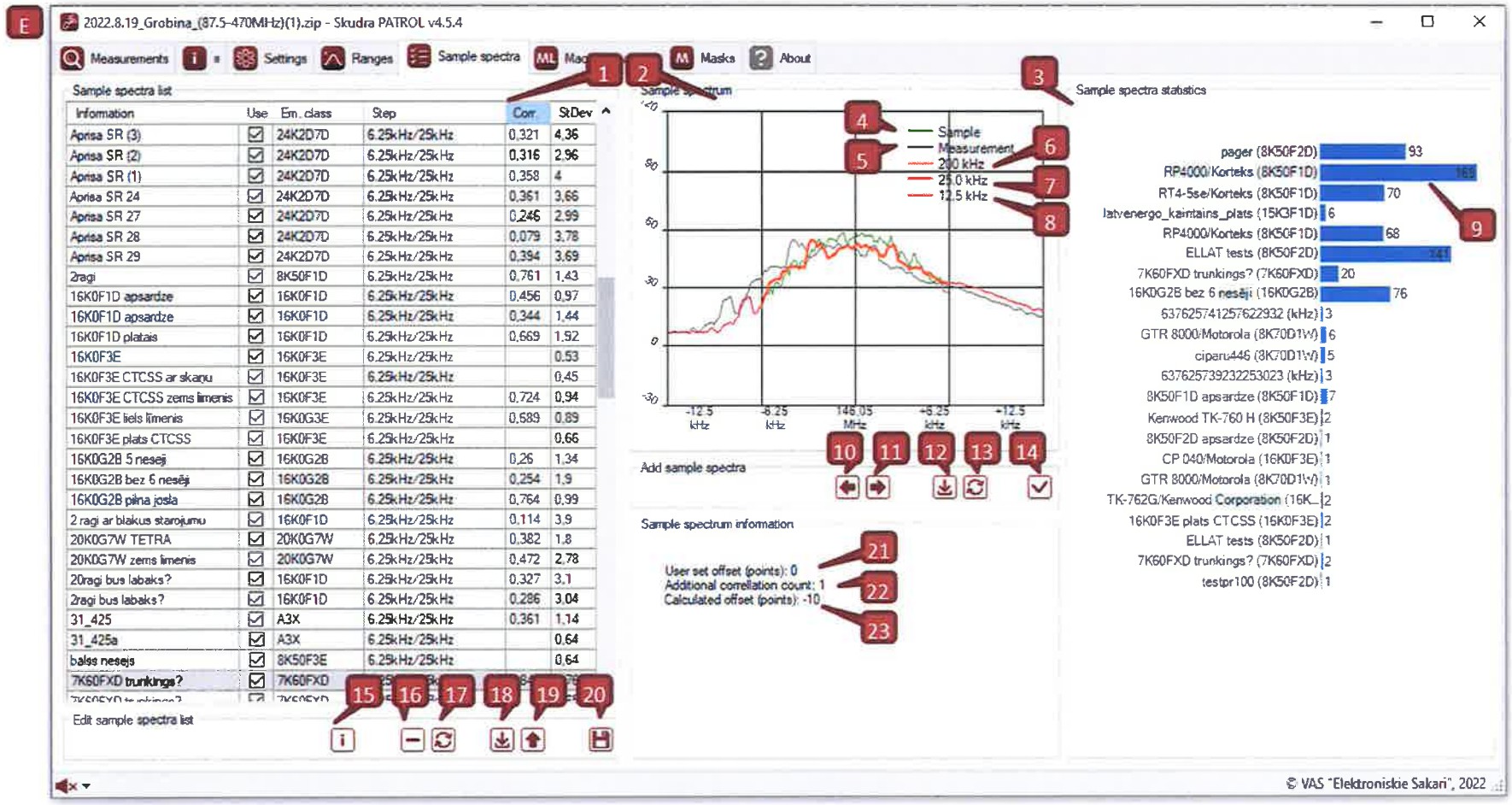
C.1. Receiver IP address and port setup window;
C.2. Button to check the receiver IP address and model;
C.3. Button to mute the receiver sound;
C.4. Default volume setting menu;
C.5. Button to choose the folder for saving the results and chosen folder display window;
C.6. Window to input the measurement session (monitoring site) name;
C.7. Button to display the session name in the software measurement section under the measurement range list
C.8. Antenna factor choice button and chosen file (and accessable frequency range) display window;
C.9. Cable attenuation file selection button and the selected file and accessable frequency range display window;
C.10. Monitoring site geographical latitude in decimal notation used to calculate the licence and link the results to the map;
C.11. Monitoring site geographical longitude in decimal notation used to calculate the licence and link the results to the map;
C.12. Automatic monitoring site coordinate input from computer data (available only in *Windows-10*);
C.13. Button to recalculate the theoretical reception of licences after changing monitoring site coordinates;
C.14. Receiving antenna height input window for theoretically detectable licence calculation;
C.15. Menu for selection of the monitoring environment for theoretically detectable licence calculation;
C.16. Button to import the licence database file to the software;
C.17. Button for deleting the licence database file from the software;
C.18. Button to import the specific frequency file to the software;
C.19. Button for deleting the specific frequency file from the software;
C.20. Button to import the radio communication application classification file to the software;
C.21. Button for deleting the radiofrequency application file from the software;
C.22. Input field to enter the Skudra Server user name;
C.23. Skudra Server user password input field;
C.24. Button to delete the stored access token to Skudra Server and user name;
C.25. Button to request an authorization token to Skudra Server using an earlier set user name and password and storing the acquired token to the software;
C.26. Skudra Server subpaths ;
C.27. List of specific frequencies;
C.28. Button to add an entry to the list of specific frequencies;
C.29. Button to delete a highlighted entry from the list of specific frequencies;
C.30. Button to save the list of specific frequencies to file;
C.31. Button to open OSM map fetching mode;
C.32. Button to delete all fetched OSM maps from software;
C.33. Combined function button to use OSM maps online or offline;
C.34. Information on offline OSM map consumed software memory volume.

3.4 Range definition section



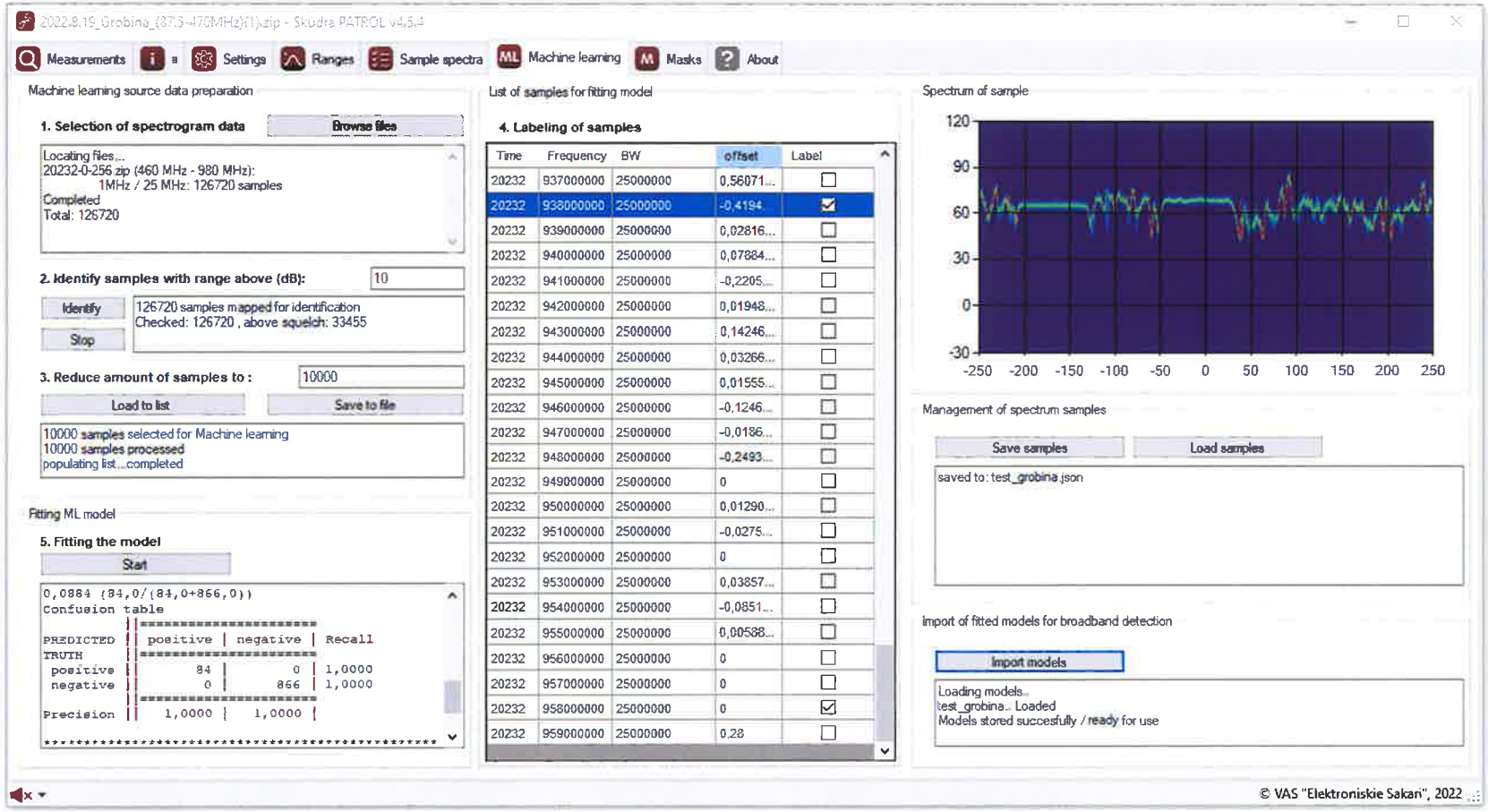
D.1. Measurement range editing list;
D.2. Menu of monitoring receiver selection with the appropriate technical functionality from the monitoring range editing list;
D.3. Button to set range list according to connected receiver;
D.4. Button to add a new range to the monitoring range editing list;
D.5. Button to delete a range from the monitoring range editing list;
D.6. Button to load an earlier saved monitoring range list to the software;
D.7. Button to save a monitoring range list to file;
D.8. Checkbox to select ranges to be used in measurement
D.9. Input field to set range name
D.10. Input field to set range start frequency (MHz);
D.11. Input field to set range end frequency (MHz);
D.12. Menu to set signal detection channel step;
D.13. Menu to set RF attenuation (dB) (receiver dependant);
D.14. Menu to set IF attenuation value(receiver dependant);
D.15. Checkbox to enable detection of signals;
D.16. Input field to set correlation squelch for signal detection;
D.17. Input field to set noise squelch for signal detection;
D.18. Input field to set minumum field strength (dBμV/m), for assignment frequency to be considered receivable;
D.19. Input field to set distance (km) in that every assignment is considered receivable;
D.20. Checkbox to enable reporting frequency usage statistics;
D.21. Menu to set reporting interval of statistics.

3.5 Sample spectra section

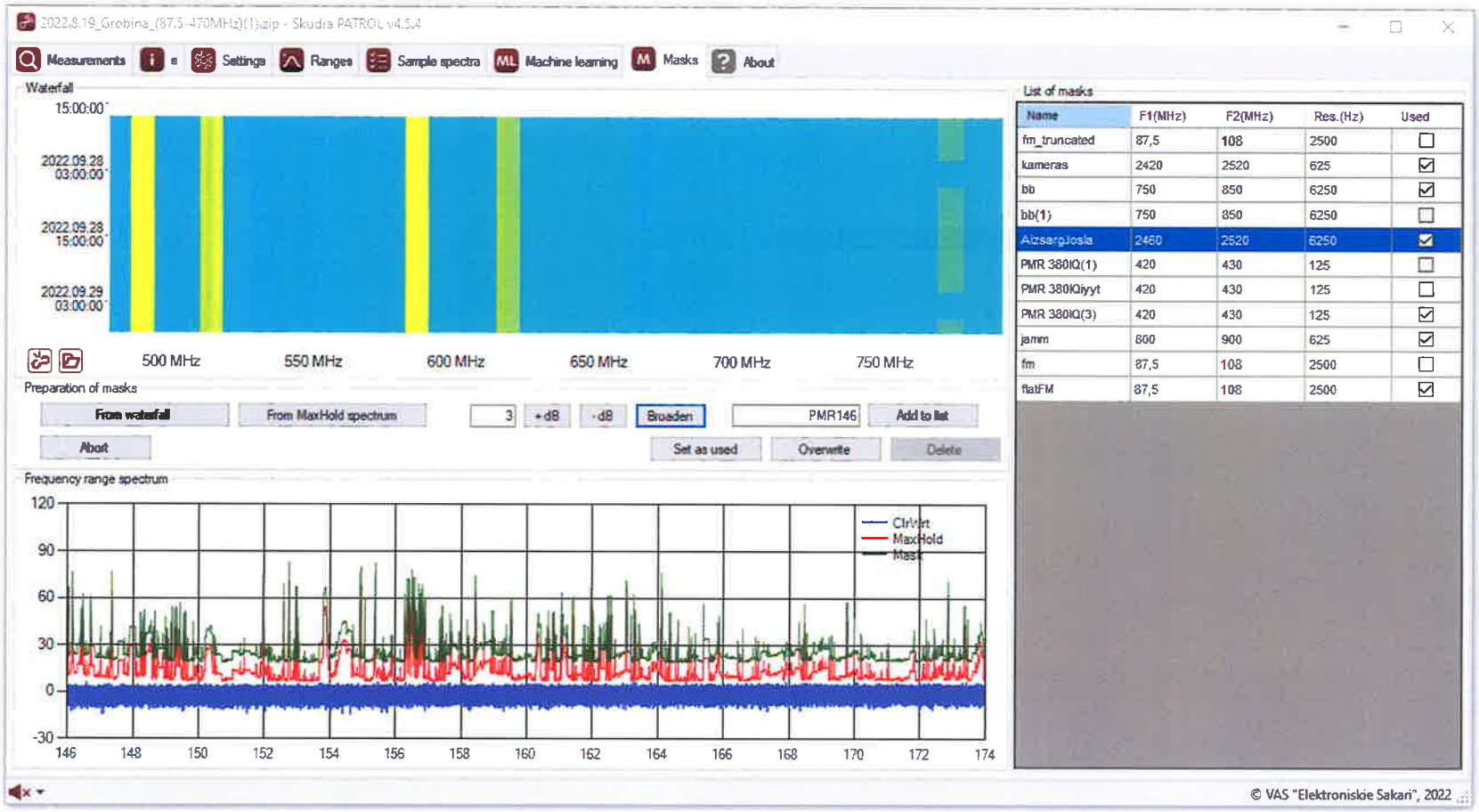


E.1. Sample spectra list;
E.2. Sample spectra display and defining graph;
E.3. Sample spectra usage statistics graph;
E.4. Sample spectrum highlighted in the list;
E.5. The highlighted entry's (in the signal detection list) cumulated spectrum quasi mode value;
E.6. A potential sample curve of values of 200 kHz wide spectrum;
E.7. A potential sample curve of values of 25 kHz wide spectrum;
E.8. A potential sample curve of values of 12.5 kHz wide spectrum;
E.9. Sample spectra which have been determined as closest to the highlighted entry in the signal determination result list and how often they have been observed;
E.10. Button for manual fine tuning of the middle frequency of the highlighted potential sample spectrum to a lower value;
E.11. Button for manual fine tuning of the middle frequency of the highlighted potential sample spectrum to a higher value;
E.12. Button to obtain quasi-mode spectrum and potential sample spectrum from the highlighted entry in the signal detection result list;
E.13. Button to cancel the manual changes to potential sample spectra;
E.14. Button to add the highlighted potential sample spectrum to the sample spectra list;
E.15. Button to visualize the statistics of all frequencies where the signal was determined to be close to the selected sample spectrum including number of occurances;
E.16. Button to delete the highlighted sample from the software's list of sample spectra;
E.17. Button to erase all unsaved changes to the list of sample spectra;
E.18. Button to add remotely stored (Skudra Server) sample spectra to the local sample spectra list;
E.19. Button to upload the highlighted entry in the list of sample spectra to Skudra Server;
E.20. Button to save changes to the list of the local sample spectra;
E.21. Information on the deviation of the user added frequency offset points of the potential sample spectrum from the sample spectrum middle frequency;
E.22. Information on the additional number of neccessary correlations to the potential sample spectrum (each with an additional frequency deviation of one point);
E.23. Information on the number of offset points of the automatically determined potential sample spectra central frequency.

3.6 Machine learning section



3.7 Masks section

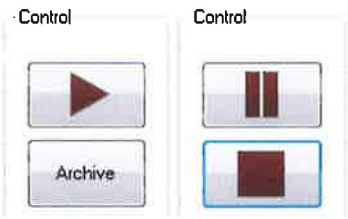


4 Description of Complete Functionality

4.1 Measurement control and visualization

4.1.1 Starting, stopping and interrupting measurements

- To start measurements click the typical multimedia design button "*Play*" (A.1), to stop - "*Stop*"(A.2);

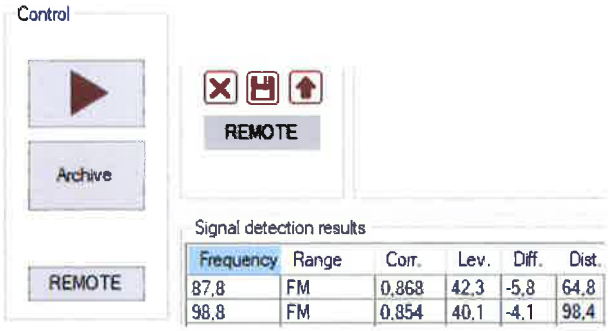


- It is possible to pause the measurement by clicking the button "*Pause*" (A.1), and restart by clicking the button "*Play*". During the paused measurement the receiver may be used for aural monitoring, and other purposes, including disconnecting from the software. After clicking the button "*Play*" monitoring will resume and the results will not be fragmented.
- If prior to commencing measurements the software contains unsaved measurement data or unsaved open measurement results, the software will offer to save the existing results, not save/discard changes or cancel opening of the result file.

- If any active (set as used) measurement range has DF triggering enabled (4.3.5), "DF ON" / "DF OFF" button is visible in "Control" group.
- When starting measurement session button is in "DF ON" state, indicating that direction finding is in progress. Direction finding can be interrupted by setting (clicking) button to "DF OFF" state, and continued by setting (clicking) to "DF ON" state. During the interruption direction finder can be used for any other task. However,

by interrupting DF process, all DF requests enqueued (5.3), yet not DFied will be lost. DF requests completed are not influenced;

- It is possible to run Skudra Patrol in remote control mode (4.8), when measurement ranges are configured, measurements started and stopped, and results saved automatically by Skudra Server. This mode is enabled and disabled by toggling "REMOTE" button;



- Remote control mode can be enabled only if no measurements are active and Signal detection results are cleared.

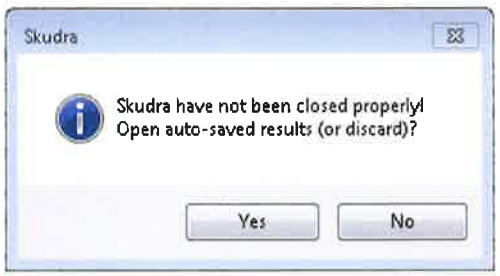
4.1.2 Saving and opening the results

- Upon stopping the measurements the result may be saved in a file by clicking the button "Save" (A.4);
- The result will be saved together with the setting information in a "*zip*" file which is automatically named by a sequence of the monitoring start date, measurement session name, start and stop frequencies, a serial number based on the previous criteria and a version serial number in the sequence hereby listed. The result file will be saved in the folder specified in the settings section (C.5);
- The result file may be opened clicking the button "Archive" (A.2) and selecting the appropriate file. Opening the file, full functionality is restored as it was after stopping the measurement;
- If prior to opening a result file the software already contains unsaved measurement results or unsaved changes of open measurement results, prior

to opening the new file the software will offer to save the existing results, not save/discard changes or cancel opening of the result file.

4.1.3 Automatic saving of results

- During measurement and introducing changes to either earlier saved or unsaved results, results are automatically saved in an internal software file. The goal for this automatic saving is to prevent loss of the results in case of incorrect closure of the software, e.g., unforeseen shutdown of the computer;
- In cases of it's incorrect closure, the software will inform the user and offer to save the automatically saved results;



- If the software was closed correctly, it is not possible to restore unsaved results.

4.1.4 Upload results to Skudra Server

- After stopping measurements, the signal detection results may be uploaded to Skudra Server by clicking the button "*upload*" (A.5) in the measurement section;

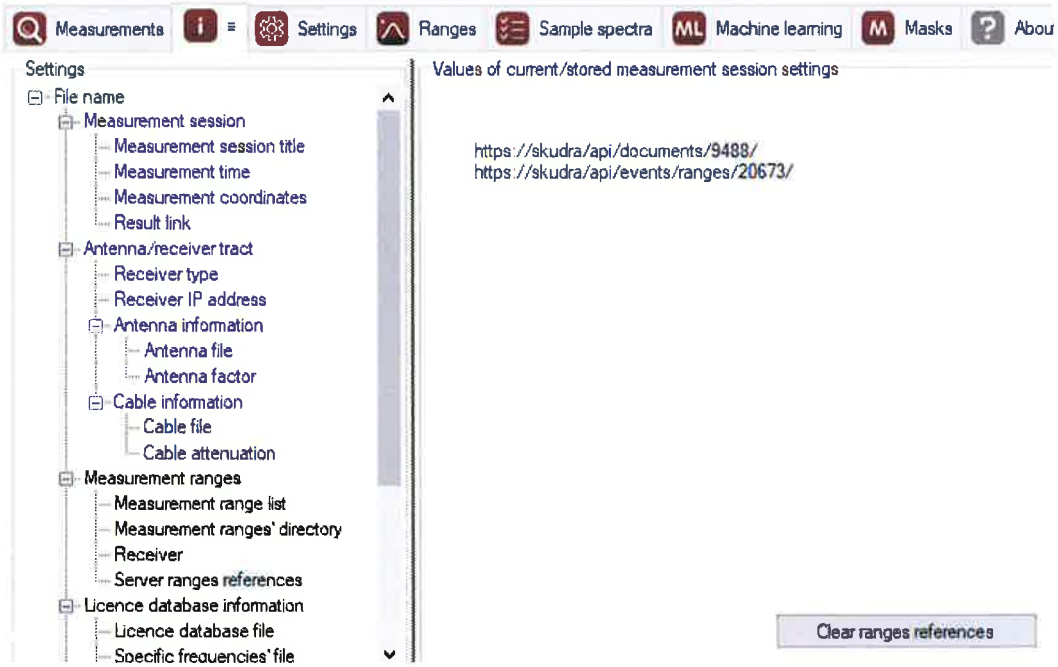
- To enable uploading the results, the software must have access to the Skudra Server access key (see section ¤);
- The following information is sent to Skudra Server: monitoring coordinates, time of monitoring, measurement range limits, the contents of the signal

search result list (all columns), the cumulated spectra of each entry, bandwith breakdown, signal level change with time, DF results (if available);

- The upload progress during uploading the results is shown in the bottom left corner of the software window;

- When upload is complete a link to the saved result is displayed in the bottom left corner of the software window. It is possible to copy the link to the uploaded result to the clipboard by right-clicking the link and choosing "copy".

- If measurement has been set-up, with options that performs periodic updates to Skudra (DF reporting to Skudra server, statistics, waterfall spectrogram storage to server) and corresponding measurement has been deleted from Skudra server, measurement upload to server will result in error "*Storing to Skudra Server not complete The remote server returned an error: (500) Internal Server Error. DoesNotExist at /api/events/ranges/...*". To avoid that Skudra server measurement reference at Skudra Patrol has to be cleared at "Stored measurement settings" panel's (3.2) "Server ranges reference" selection by clicking "Clear ranges refences".



4.1.5 Closing measurements results and the software

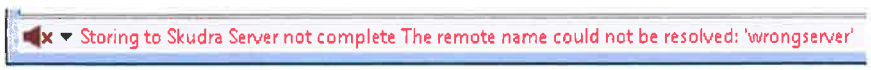
- The results displayed by the software may be closed clicking the button "X" (A.3) in the group of control buttons;

- The software may be closed by clicking the button "X" in the software window's upper right corner;
- If there remains unsaved measurement data or unsaved open measurement results when closing the data file or the software, the software will offer to save the existing results, not save/discard changes or cancel closing of the result file or software.

- If there is no warning displayed, there have been no unsaved results in the software.

4.1.6 Informative messages

- Most error messages and other information that will occur while running the software will appear in the area for informative messages (A.13) at the lower left of the software window;



- These messages may be copied to the clipboard or cleared by clicking the right mouse button and choosing "copy" or "clear" respectively.

4.1.7 Measurement ranges

- By clicking the measurement start button (A.1) measurements are started in the ranges (A.6) that are displayed in the group "Ranges". Measurement ranges and parameters should be defined in the measurement range list in the settings section (D.1);

- At each range the appropriate scanning progress of the measurement cycle is shown (A.7);
- During measurements or while reviewing earlier measurement results, by clicking the left mouse button over the range, the appropriate range's spectrum will be displayed.

4.1.8 Signal detection result list

- The signal search result list (A.24) shows entries of all frequency channels where signals were observed;

Signal detection results

Frequency	Range	Corr.	Lev.	Dist.	BW	Count	Em.class	Licence	Application	Notes
87.6	FM	0.912	93.6	2.3	82.5	5	300KF8...	Lat		
88.2	FM	0.92	84.8	2	122.5	5	300KF8...	SU		
89.5	FM	0.912	89.2	2.3	120	5	300KF8...	Lat		
90.3	FM	0.913	62.9	23.1	117.5	5	300KF8...	SU		
92	FM	0.854	39.7	46.3	72.5	2	300KF8...	ST		
92.3	FM	0.898	53.4	31.4	147.5	5	300KF8...	SU		
92.8	FM	0.901	46.9	42	130	5	300KF8...	RA		
93.2	FM	0.775	42.2	33.6	170	5	300KF8...	QB		
94	FM	0.883	48	33.6	147.5	5	300KF8...	Ra		
94.6	FM	0.899	49	33.6	145	5	300KF8...	RA		
95	FM	0.807	40.8	36.2	112.5	2	300KF8...	ST		
95.5	FM	0.868	51.3	32.6	152.5	5	300KF8...	Ra		
95.9	FM	0.931	75.3	2.3	107.5	5	300KF8...	SO		
97	FM	0.898	76.2	2.3	137.5	5	300KF8...	RA		
97.6	FM	0.897	59.3	32.6	150	5	300KF8...	RA		
98.1	FM	0.836	71.9	2.3	150	5	300KF8...	Ra		
98.8	FM	0.929	91.6	2.3	112.5	5	300KF8...	RA		
99.2	FM	0.908	60.1	31.4	160	5	300KF8...	SU		
99.6	FM	0.879	52	36.3	160	5	300KF8...	Ra		
99.8	FM	0.797	40.5	82.1	115	1	300KF8...	RA		
100.1	FM	0.924	92.6	2.4	115	5	300KF8...	Varos & Co	FM sound an...	
100.3	FM	0.674	48	51.3	155	3	300KF8...	Latvijas Valsts...	FM sound an...	

Frequency
Range
Corr.
Lev.
Diff.
Dist.
BW
%
Count
Em.class
Licence
Lic.Nr.
Application
Notes

- Detecting a signal in a frequency channel where previously no signal was detected (no entry in the list), a new entry appears top of the list. If the signal is detected repeatedly, content of the entry is appended;
- The result list may be arranged in an ascending or descending order for every shown value by clicking the left mouse button on the columns title (A.8);

- The result list's columns may be displayed or hidden by clicking the columns title (A.8) with the right mouse button and choosing the appropriate columns out of the context menu appearing;
- Highlighting an entry to the result list, the appropriate cumulated spectrum (A.25), bandwidth breakdown (A.26), licences corresponding to the frequency including map coordinates (A.14) and the time or occupancy graph (A.27) is displayed. Highlighting several entries, information will be displayed for the last highlighted entry.
- Introduced changes to the signal determination list can be saved to new result file or uploaded to the database. Already saved result files and database entries will not be edited.
- The size of the signal search result list may be changed by dragging the lists top and right-hand borders. Column size (respecting the system design minimum) may changed by dragging the column title borderlines.

4.1.9 Explanation of Signal Determination Result Parameters

Frequency - The frequency channel (MHz), where the signal was found. Depending on the range setting (D.1), the channel step may be 100 kHz or 6.25 kHz;

Range - The name of the user determined measurement range where the signals were found;

Corr. - Average value of detection quality of all registered signal events in the frequency channel. However, different signal detection types have different meaning for this parameter:

- For narrow band detection - maximum Pearson correlation coefficient squared (determination coefficient) among correlations of all sample spectra;
- For broadband detection - Selected ML model output from 0 to 1;
- For jammer detection - Maximum of Carrier specificity in dB, in specified spacing range;
- For mask detection - maximum mask overshoot value in dB;

Lev. - Maximum electromagnetic field strength dbμv/m exceeding 2% of events of signal detection. The field strength is calculated by adding the antenna factor (C.8) and cable attenuation (C.9) to the signal level. The signal level of each detection is calculated as the maximal value of spectrum in the signal bandwidth. The 100 kHz channel step FFT resolution is 2.5 kHz, 6.25 kHz - 125 Hz, *Blackman* windowing.;

Diff. - The difference between the theoretically calculated and the measured field strength. Positive values are assigned to field strength that exceeds theoretically calculated, but negative - field strength that is less than theoretically calculated. Zero is displayed when the measurement is equal to the theoretical value or theoretical calculations show there should not be any signals at the monitoring site;

Dist. - Distance in kilometers from the monitoring site to the possible licence coordinates. Zero is displayed if by theoretical calculations the transmitter should not be received;

BW - the emission's maximum bandwidth in kHz exceeded in 5% of signal detections at a signal to noise ratio at least 30 dB. If the signal to noise ratio has never exceeded 30 dB, the bandwidth is calculated as maximum of unique bandwidth level combination pairs exceeding 5% of signal observations. The signal bandwidth in each detection event is determined by the 1% ß (99% power in bandwidth) method, and by the mid-level between the maximum level and noise level if the signal to noise ratio does not exceed 30 dB;

Count - Number of instances of signals detected;

Em. class - For narrowband detection the class of emission of the sample spectrum that most often correlates most with the signal in the specific frequency channel. For broadband, jammer and mask detection field is always filled with "broadband", "jammer" and "mask" respectively;

Licence - The holder of the most probable licence of the signal received at the montoring site. The addressees or users that are not linked to coordinates are shown in parantheses;

Lic. Nr. - The number of most probable licence of the signal received at the monitoring site;

Application - Radiofrequency application relevant to frequency in the EFIS classifier according to the downloadable file from www.efis.dk which has been set in the settings section as radiofrequency application file (C.20);

Notes - User added comment. Text input in this field will be linked to the entry in the signal determination result file.

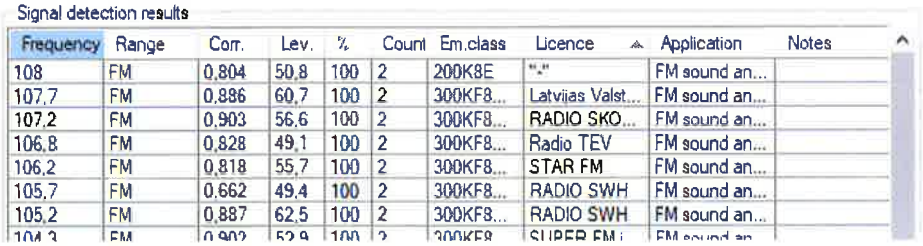
Signal detection results

Frequency	Range	Corr.	Lev.	Diff.	Dist.	BW	Coun	Em.class	Licence	Lic.Nr.	Application	Notes
99.6	FM	0.879	52	7.9	36.3	160	5	300KF8...	Radio TEV	BC-FM-271 -...	TV analogue...	
99.8	FM	0.797	40.5	6.3	82.1	115	1	300KF8...	RADIO VIDZ...	BC-FM-208 -...	TV analogue...	
100.1	FM	0.924	92.6	-1.2	2.4	115	5	300KF8...	Vārds & Co	BC-FM-169 -...	FM sound an...	
100.3	FM	0.674	48	0.4	51.3	155	3	300KF8...	Latvijas Valst...	BC-FM-371 -...	FM sound an...	
100.9	FM	0.914	70.7	12.4	17.1	135	5	300KF8...	RADIO ENT...	BC-FM-242 -...	FM sound an...	
101.5	FM	0.906	91.6	-20.4	2.3	117.5	5	300KF8...	Latvijas Valst...	BC-FM-103 -...	FM sound an...	
102.4	FM	0.912	81.5	-9.5	2	140	5	300KF8...	SUPER FM I...	BC-FM-266 -...	FM sound an...	
103.1	FM	0.898	61.8	14.1	30.6	95	5	300KF8...	1.business ra...	BC-FM-316 -...	FM sound an...	
103.4	FM	0.93	88.2	-0.3	2.5	115	5	300KF8...	1.business ra...	BC-FM-315 -...	FM sound an...	
104	FM	0.911	93.8	-18.4	2.3	100	5	300KF8...	Latvijas Valst...	BC-FM-126 -...	FM sound an...	
104.7	FM	0.916	66.1	18.8	32.5	135	5	300KF8...	1.business ra...	BC-FM-317 -...	FM sound an...	
106.5	FM	0.915	84.4	-22	2.3	102.5	5	300KF8...	RADIO SWH	BC-FM-067 -...	FM sound an...	
106.9	FM	0.838	44.1	0.3	42	120	5	300KF8...	Radio TEV	BC-FM-325 -...	FM sound an...	
107.4	FM	0.901	92.1	-5.2	2.4	115	5	300KF8...	STAR FM	BC-FM-073 -...	FM sound an...	

4.1.9.1 Notification of unauthorised emissions

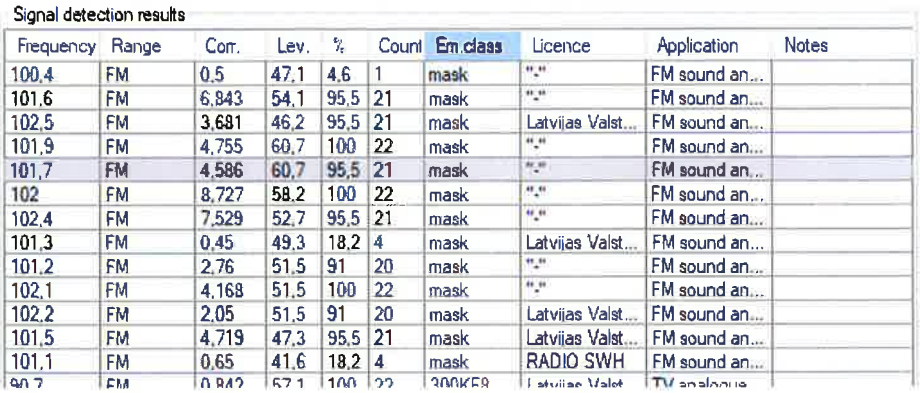
Signal detection result(4.1.8) list contains information, whether detected signal is authorised according to frequency assignment database (4.5,) filtered by set licence detection parameters (4.3.2), and whether emissions on particular frequency overshoot set spectrum mask(4.3.3).

- In all detection modes, if, for particular frequency channel, frequency assignment in particular monitoring site is considered invalid or there is no assignment for frequency at all, Licence field for related record in signal detection results list contains key "-" - no assignment;


Signal detection results

Frequency	Range	Corr.	Lev.	%	Count	Em.class	Licence	Application	Notes
108	FM	0,804	50,8	100	2	200K8E	"-"	FM sound an...	
107,7	FM	0,886	60,7	100	2	300KF8...	Latvijas Valst...	FM sound an...	
107,2	FM	0,903	56,6	100	2	300KF8...	RADIO SKO...	FM sound an...	
106,8	FM	0,828	49,1	100	2	300KF8...	Radio TEV	FM sound an...	
106,2	FM	0,818	55,7	100	2	300KF8...	STAR FM	FM sound an...	
105,7	FM	0,662	49,4	100	2	300KF8...	RADIO SWH	FM sound an...	
105,2	FM	0,887	62,5	100	2	300KF8...	RADIO SWH	FM sound an...	
104,3	FM	0,902	52,9	100	2	300KF8	SUPER FM i	FM sound an	

- In mask detection mode, Emission class field contains keyword "mask" - emission has overshoot mask. Mask overshoot detection is independent of unauthorised signal detection, thus signal can be both - unauthorized and overshoot spectrum mask, just one or none.


Signal detection results

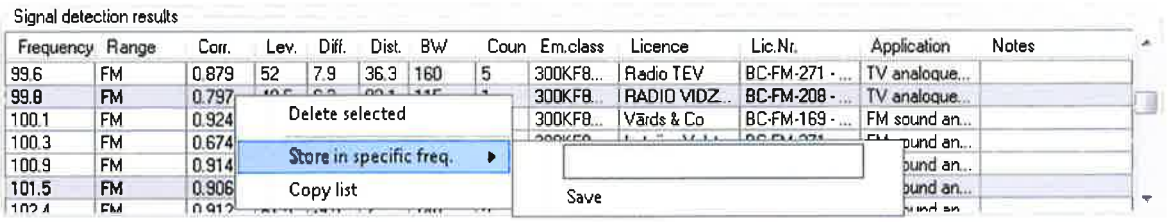
Frequency	Range	Corr.	Lev.	%	Count	Em.class	Licence	Application	Notes
100,4	FM	0,5	47,1	4,6	1	mask	"-"	FM sound an...	
101,6	FM	6,843	54,1	95,5	21	mask	"-"	FM sound an...	
102,5	FM	3,681	46,2	95,5	21	mask	Latvijas Valst...	FM sound an...	
101,9	FM	4,755	60,7	100	22	mask	"-"	FM sound an...	
101,7	FM	4,586	60,7	95,5	21	mask	"-"	FM sound an...	
102	FM	8,727	58,2	100	22	mask	"-"	FM sound an...	
102,4	FM	7,529	52,7	95,5	21	mask	"-"	FM sound an...	
101,3	FM	0,45	49,3	18,2	4	mask	Latvijas Valst...	FM sound an...	
101,2	FM	2,76	51,5	91	20	mask	"-"	FM sound an...	
102,1	FM	4,168	51,5	100	22	mask	"-"	FM sound an...	
102,2	FM	2,05	51,5	91	20	mask	Latvijas Valst...	FM sound an...	
101,5	FM	4,719	47,3	95,5	21	mask	Latvijas Valst...	FM sound an...	
101,1	FM	0,65	41,6	18,2	4	mask	RADIO SWH	FM sound an...	
90,7	FM	0,842	57,1	100	22	300KF8	Latvijas Valst	TV analogue	

Licence (unauthorised emission) and mask detection (overshoot) events are sent to Skudra Server, if at least one of measurement options are enabled: Report statistics (4.1.19), Report DF to Skudra Server (5.4), Remote control with automatic upload to Skudra Server (4.8), or if results are manually uploaded to Skudra Server.

4.1.10 Signal Search Result List Context Menu

Right-clicking the mouse on an entry in the signal search result list opens a menu providing the following functionality:

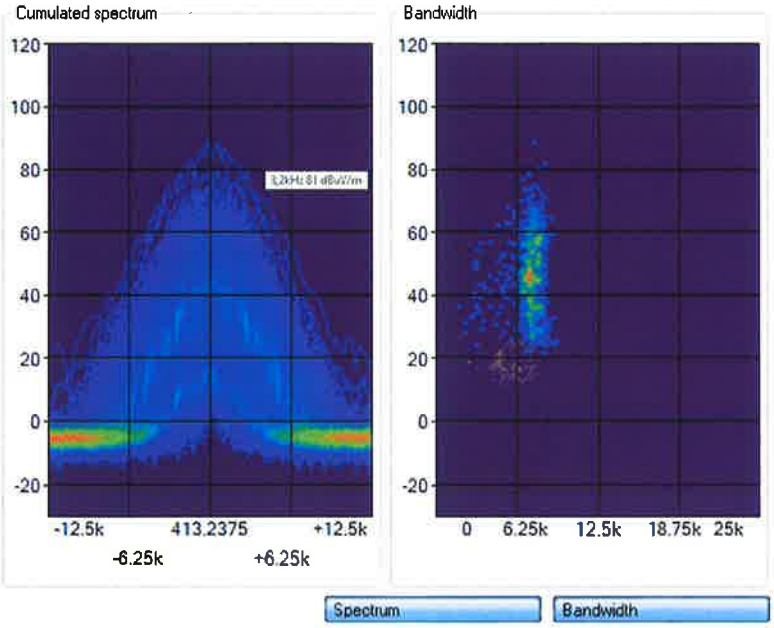
- "Delete" - the highlighted entry and all associated information about the signals observed on the frequency is erased. The task may be carried out by clicking the key "*delete*";
- If multiple entries are highlighted, all will be deleted;
- "To specific list" - the highlighted entry's frequency may be added to the list of specific frequencies (setting section, list of specific frequencies (C.27). The frequency user should be entered and confirmed by clicking the button "Save";



- "Copy list" - All entries of the signal search result list are copied to the clipboard in "csv" format to be pasted in any word or spreadsheet proccessor.

4.1.11 Cumulated spectrum of signals

- The cumulated spectrum of signals corresponding to the highlighted entry in the signal detection result list is displayed to the right of list (A.25). If multiple entries are highlighted, the last cumulated spectrum will be displayed;
- The cumulated spectrum graph may be displayed or hidden by clicking the button (A.28) on the panel below the cumulated spectrum or the time graph, if the cumulated spectrum is hidden;
- In the cumulated spectrum, all observed signal spectra in the frequency channel are shown. Spectra containing no signal, only noise, are not included. All signal spectra are overlayed. The number of appearances of the relevant frequency-level pair is colour-coded from red (maximum, though often less than 100%) to green, to blue (once);
- The cumulated spectrum characterizes how often the signal is detected - whether on the frequency operates one or several transmitters, what the base station/repeater spectrum looks like.



- The cumulated spectra at the channel step of 100 kHz are displayed in a band of 500 kHz, but at the step of 6.25 kHz in a 25 kHz range;
- The cumulated spectra graph can be resized by dragging the graph's top border. The cumulated spectra contains 200x300 values. When resizing, the aspect ratio 2:3 is kept unchanged;
- Marker of cumulative spectrum value, currently mouse hovering on, is displayed in mouse tooltip.

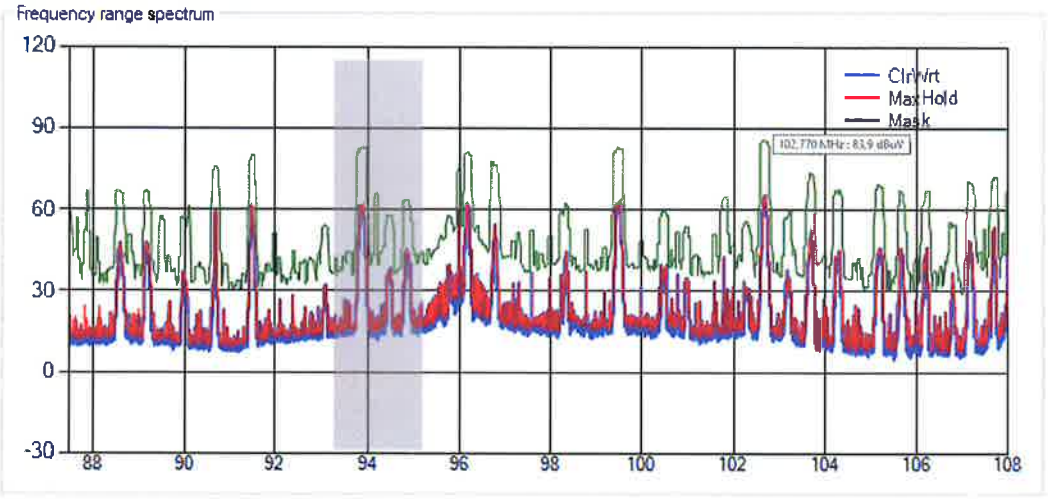
4.1.12 Bandwidth breakdown graph

- Right of the signal search list is the two dimensional display of the signal level/strength (A.26) relevant to the highlighted entry in the list. When multiple entries are marked, the cumulated spectrum of the last highlighted entry is displayed;
- The Bandwidth breakdown graph may be displayed or hidden by clicking the button "Bandwidth" (A.29) in the panel under the bandwidth breakdown graph or the time graph if the bandwidth breakdown is hidden;
- All combination pairs of signal bandwidth/level detected in a single frequency channel of a measurement range are displayed in the bandwidth breakdown graph. Bandwidth measurements with signal to noise ratios no less than 30 dB (measurements are done with the 1% ß method - 99% power in the bandwidth) are displayed colour-coded from red (maximum) to green, to blue (a single event). Combination pairs with a signal to noise ratio less than 30 dB (by spectrum width in the middle between maximum and noise level) are displayed grey. The frequency of equal results are not cumulated for the latter;

- The bandwidth breakdown graph helps to determine the field strength of a specific bandwidth signal - what is the field strength of a repeater, what is the field strength of a base station;
- The bandwidth breakdown at the channel step of 100 kHz are displayed in a band up to 500 kHz, but at the step of 6.25 kHz - up to 25 kHz;
- The bandwidth breakdown graph can be resized by dragging the graph's top border. The cumulated spectra contains 200x300 or 250x300 values. When resizing, the aspect ratio is kept unchanged.

4.1.13 The range's spectrum

- The range's spectrum graph is displayed on the right-hand side of the measurement panel. The graph shows spectrum of the range highlighted in the measurement panel's list (A.6);
- The instant values of spectrum are displayed in blue (A.21) and peak values in red (A.20). Instant and peak values are displayed immediately on arrival from the receiver but no often than approximately once per second;
- If spectrum mask detection for particular range is enabled, spectrum mask is displayed in green;

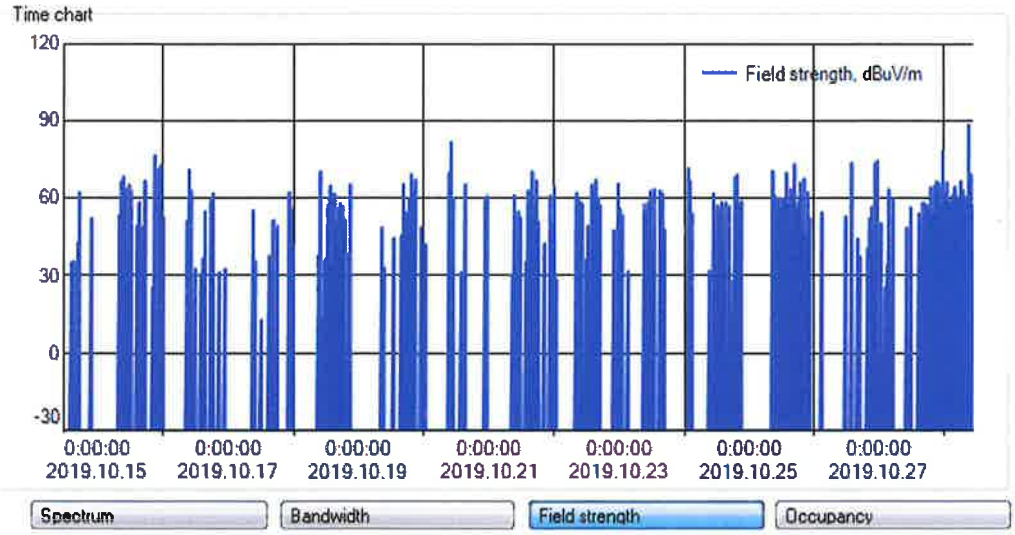


- The bands spectrum graph may be zoomed in on the abscissa by mouse click on the necessary limits. The maximum range may be restored by right-click of the mouse. By left-click of the mouse the central frequency may be set without changing the zoom, thus gradually reviewing all the spectrum under magnification;
- Peak values (MaxHold trace) can be cleared by selecting "Clear" in tooltip menu on graph's legend;

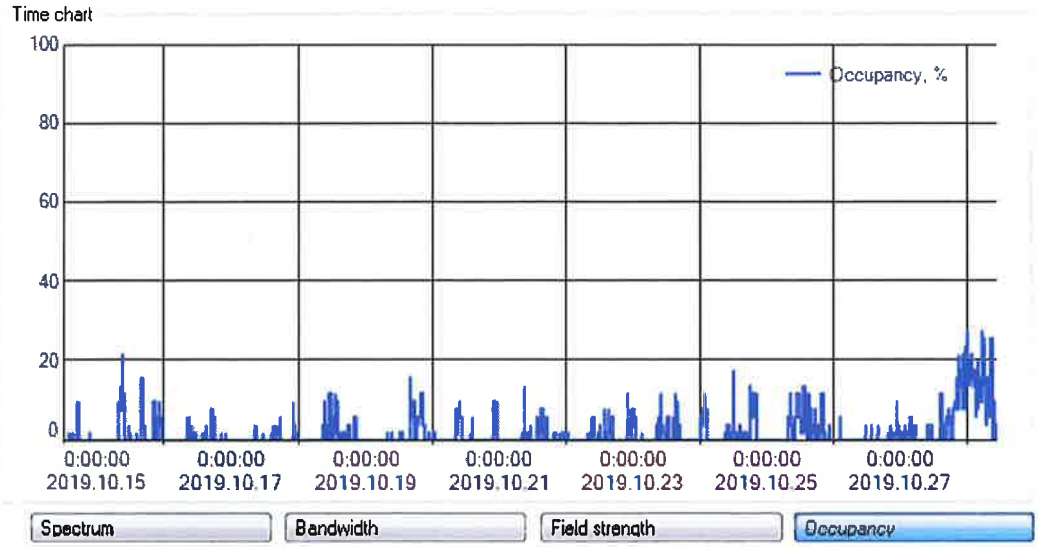
- The bands spectrum graph may be displayed or hidden clicking the button "Spectrum" (A.22) under the spectrum graph or the frequency's licence map if the band's spectrum graph is hidden;
- The bands spectrum graph may be resized by hiding or displaying the frequency's licence map, or dragging the bottom border under the button "Spectrum" (A.22);
- Marker of spectrum trace value, currently mouse hovering on, is displayed in mouse tooltip.

4.1.14 Field strength and occupancy time graph

- The field strength or frequency occupancy time graph is displayed in the measurement section's lower right corner. The displayed graph may be chosen by clicking the button "Field strength" (A.30) or "Occupancy" (A.1);
- The graph displays data of the highlighted entry in the signal determination list;
- The frequencies signal level is displayed as the ordinate, and the time is displayed as the abscissa. In the case no signal was observed during search, the ordinate displayed is minimal. If the process of measurement has been stopped or interrupted, the time graph will show a gap;



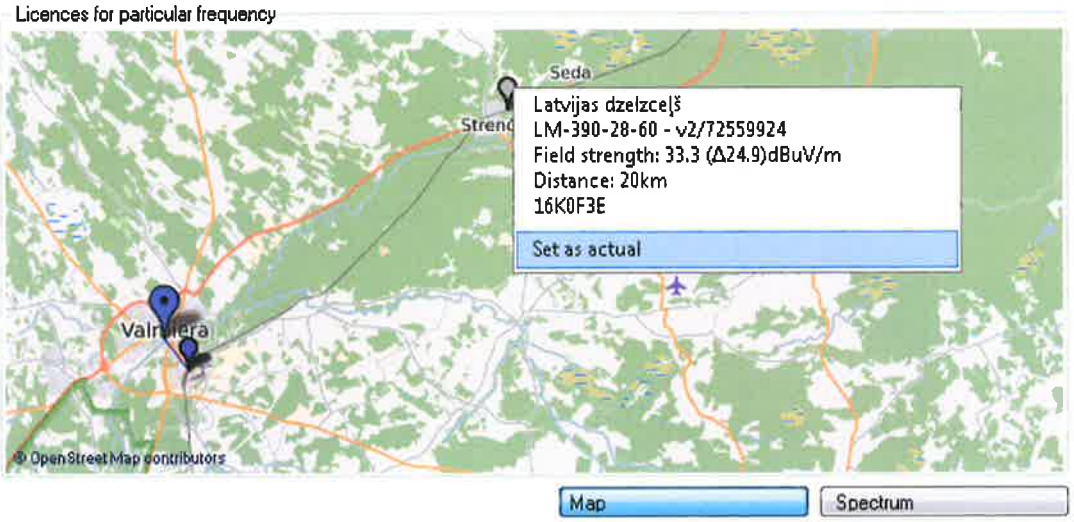
- If the occupancy graph option is chosen it is generated from the percentage how often the signal appears in 15 minute intervals according to Recommendation ITU-R SM.1880;



- Both the field strength graph and occupancy graph may be zoomed in on the abscissa by left-mouse drag the necessary time limits. To zoom out right-click the mouse over the graph.
- The graph may be resized displaying or hiding the cumulated spectrum and occupancy graphs, as well dragging the graphs top border.

4.1.15 Map: Frequency Assignments

- Map in measurement panel is used for two functionalities: display of frequency assignments and display of direction finding results;
- The frequency assignment map (A.14) displays all available licence information on the highlighted frequency in the signal detection list;
- The licence assignment coordinates and monitoring site are displayed on the map with markers. A large blue marker shows the monitoring site's coordinates. A small blue marker designates the coordinates of the most probable assignment. Other coordinates of the same frequency assignment are marked by small grey markers



- The assignment map's coordinate context menu shows the frequency's licence owner, licence number, theoretically calculated field strength, the difference between calculated and measured field strength, distance from the monitoring site to the assignments coordinates and emission class according to licence as well as the option to mark the assignment as the most probably received;

- In the monitoring site's marker's context menu it possible to define an unknown spectrum (*NRS*) user as the most possible signal source, as well the option to mark as most possible an assignment without coordinates or an undefined user from the list of specific frequencies;
- The signal detection result list is also updated according to the change of assignment of the received signal;
- The map uses OSM maps offline or online (C.33), according to the map settings in the settings section;

- The map may be resized displaying or hiding the range's spectrum graph, as well as dragging the map's lower border.

4.1.16 Map: Direction finding results

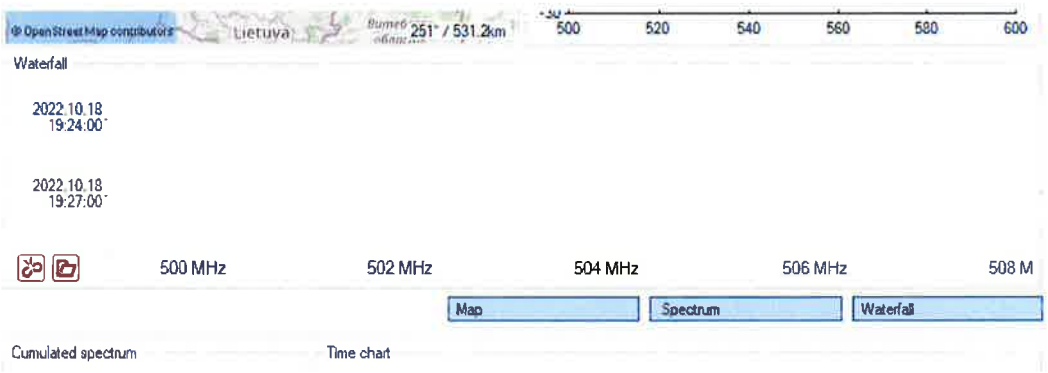
Map in measurement panel is used for two functionalities: display of frequency assignments and display of direction finding results;

- Direction finding results are displayed as histogram for currently selected record in signal detection result list (4.1.8). Direction finding results and corresponding functionality is only visible if the selected record has direction finding attempts associated;
- Histogram is displayed by red beams, with various opacity ranging from minimum for single occurrences of particular bearing to full opacity for bearing measured most often;
- Opacity behaviour of histogram display can be altered by HIST text box in top-right corner of map in format "minimum visible recurrence - recurrence for maximum opacity". By setting minimum above 0, it is possible to dismiss rare directions, by setting maximum bellow 100 it is possible to reduce impact of most frequent bearing;
- Width of each individual bearing can be set by Δ textbox in top-right corner of map;
- Blue beam denotes last direction measured, it can be enabled or disabled by pressing button at bottom-right corner of map ("286°"), number represents last direction measured;

- First text box at bottom-right corner of map contains successful direction finding attempts versus all attempts;
- Second text box at bottom-right corner of map contains date and time of last direction measured;
- Third text box at bottom-right corner of map contains direction and distance from monitoring site location to mouse cursor. That can be used to readout bearing values from map.

4.1.17 Spectrogram (Spectrum Waterfall) graph

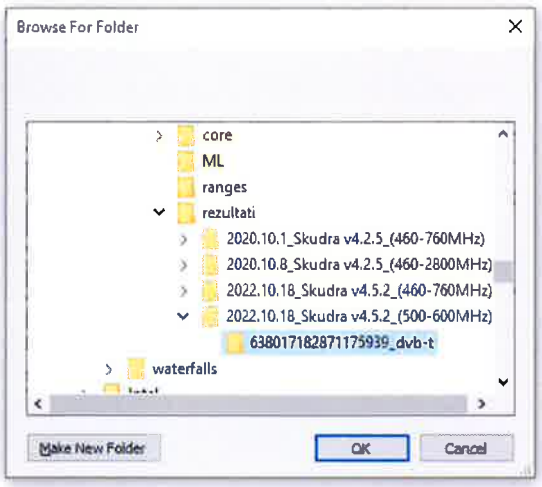
- To display actual spectrogram data, corresponding measurements have to be opted in Ranges section or measurements that includes spectrograms have to be stored before (See Ranges section for more information);
- Data displayed in Waterfall graph is generated every 256 scan cycles and after the measurement is stopped. After the same events it is possible to update spectrum waterfall;
- Zoom levels are generated sequentially after necessary scan data is acquired. Second zoom level is generated after first 512 scans, third after 1024 scans and so on. That way it is ensured that access speed to measured spectrogram is similar to that of viewing map;
- Waterfall section is displayed above Time chart and Cumulated spectrum plot if Waterfall button is toggled on:



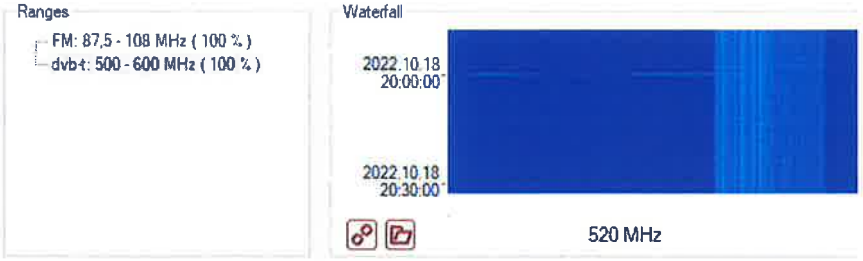
- User has to select spectrogram data to displayed in waterfall graph. There are two options provided for that. To show previously stored spectrogram user has to press “open folder” button. To show currently acquired spectrogram linked to selected frequency range user have to toggle on “chain” button:

- In process of selecting stored spectrogram for display user is provided with browse folder dialog. During measurement spectrograms are stored in results folder set in Settings section. Spectrograms for each measurement session is

saved in subfolder with the name identical to one automatically given to zip file when saving measurement result. Further each measurement range in measurement session have subfolder named after range ID and range name. This folder has to be selected to display waterfall;



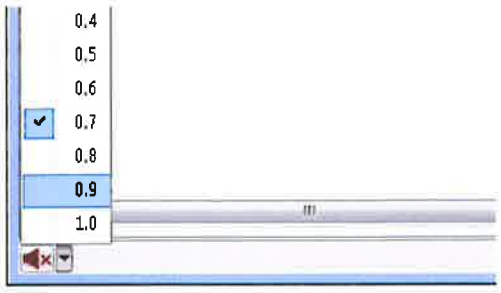
- If user has opted to show currently acquired spectrogram, spectrogram of currently selected range in Ranges group box (in Measurement section) will be displayed after clicking on corresponding range;



- To display spectrogram of currently selected range regardless of further selection of measurement ranges, user can toggle off "chain" button;
- Zooming in and out of spectrogram is done by mouse scroll. However, zooming is only available after corresponding zoom levels are generated as mentioned at the start of paragraph;
- Navigation on waterfall graph is possible with mouse drag, keyboard arrow keys, "Home" and "End" keys;
- F5 key forces to reload waterfall data. Similar effect can be achieved by zooming and panning waterfall graph.

4.1.18 Aural monitoring

- When measurements are paused, aural monitoring is possible. To enable it, the frequency detected during monitoring may be sent to the receiver together with the relevant receiver settings of the particular frequency. To do this, the entry in signal detection results list should be double-clicked or pressed on the "*ENTER*" key;



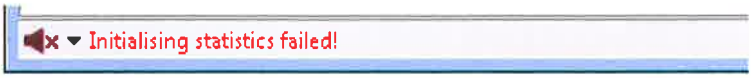
- The volume of the receiver speaker may be controlled by the context menu of the button (A.12) at the lower left of the software window. The default volume may be set prior to measurements in the settings section (C.3 and C.4).

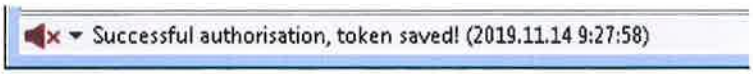
4.1.19 Reporting frequency usage statistics to Skudra Server

- Functionality of reporting frequency usage statistics is designed for periodic (in user set time intervals) storing of frequencies and count of detected signals into Skudra Server. Goal of such recording is to provide Skudra Server with immediate information about changes in spectrum usage;
- Frequency usage statistics are recorded in Skudra Server for selected ranges that have marked option "Report statistics" (D.20) in Measurement range list (D.1);
- Each measurement range has statistics recorded separately, and for each range it is possible to set individual reporting intervals (D.21);
- To perform reporting of statistics a valid Skudra server authorisation token is necessary;
- In order to get Skudra Server authorisation token it is necessary to set appropriate link in field "Skudra Server name" (C.26). Next it is necessary to fill fields "Skudra Server user" (C.22) and "Password" (C.23), and confirm request of token by clicking "accept" (C.25). (See section 4.2.6);
- In case of commencing measurements set to include statistics reporting without a valid authorisation token, software will display authorisation window requesting to renew authorisation token by providing Skudra Server username and password;

- By providing valid Skudra Server username and password and clicking "OK" new authorisation token will be obtained and stored in Skudra Patrol and measurements will be started. Providing invalid Skudra Server username and password user will be asked to enter credentials repeatedly. Choosing option "Cancel" will display dialog to confirm cancelation, confirmation of which will cause measurement session not to start;

- According to result of authorisation Skudra Patrol information roll will show message either "Initialising statistics failed!" or "Successful authorisation, token saved";

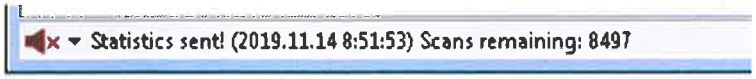




- If during the measurements authorisation token cease to be valid or expires, acquisition of new token is prompted, similarly as when commencing measurements, by authorisation window;
- Reporting statistics to Skudra Server without valid token is not possible. However, if authorisation token expires during the measurements, calculated statistics will be temporarily stored in Skudra Patrol until valid authorisation

token is acquired and then reported to Skudra Server. The same is true if connection to Skudra Server has been lost;

- Reporting statistics stored temporarily in Skudra Patrol may take a while, therefore progress report will be indicated in Skudra Patrol information area (A.13);



- Choosing to cancel reporting statistics by clicking "Cancel" in authorisation window or closing Skudra Patrol software during reporting of temporarily stored statistics will cause loss of statistics that had not been reported by then;
- Calculation of frequency usage statistics from uploaded Skudra Patrol measurement results is foreseen in functionality of Skudra Server.

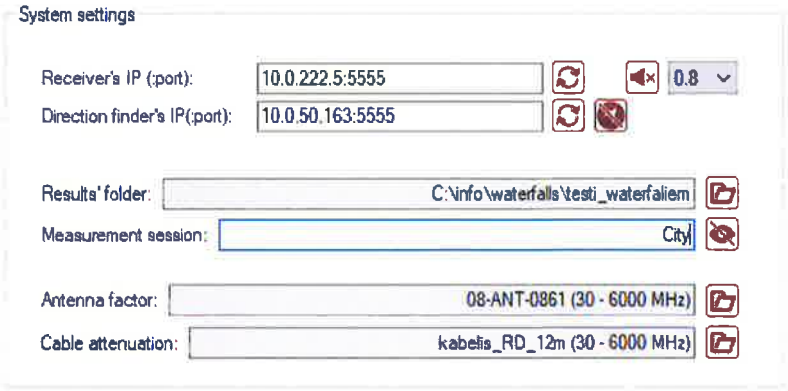
4.2 The Functionality of Settings

4.2.1 Saving settings

- Measurements are done with settings displayed at the start of measurements. During measurements settings can not be changed.
- Settings (with exceptions mentioned in the next clauses) are saved commencing measurements and closing the software;
- Frequency licences stored by the software, calculated taking into account the monitoring site's parameters, are stored immediately upon loading;
- Changes to the specific frequency file are saved immediately upon updating them from the signal determination result list (A.10) as well as clicking the save button (C.30) in the list of specific frequencies group (C.27);
- Changes to the range setting edit list (D.1) will be saved same as other settings upon commencing measurements and closing the software. The save button (D.7) is provided to save the range settings in a separate file;
- The Skudra Server user password is not saved. The token acquired during authorisation will be saved with other settings upon commencing measurements and closing the software.

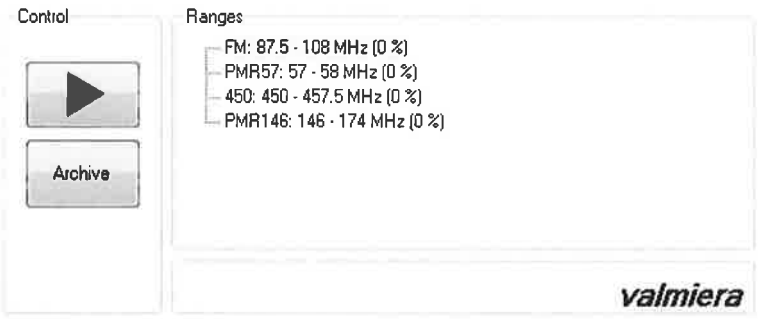
4.2.2 System Settings

- The monitoring receiver's IP address and port should be entered in the format *IPv4address:Port or IPv6address:Port(0)*. The port of currently supported receivers is either "5555" or "5300". If the receiver's IP address is not known, refer to the receiver's user manual;



- To check the connection to the IP address and determine the receiver's model click the "*refresh*" button (C.1). In case the IP address will correspond to a receiver supported by the software, the receiver model will be displayed, else, if the IP address will belong to a different equipment - "*receiver is not supported*", but if the connection with the IP address will fail - "*connection failed*";
- The Direction finders IP address and port should be entered in the format *IPv4address:Port or IPv6address:Port*. Use of direction finder is not mandatory, it is required only direction finding is enables for measurement ranges (4.3.5);
- To check the connection to the IP address and determine the direction finder's model click the "*refresh*" button. In case the IP address will correspond to a direction finder supported by the software, the DF antenna model will be displayed, else, if the IP address will belong to a different equipment - "*DF antenna is not supported*", but if the connection with the IP address will fail - "*connection failed*";
- "Compass" button to the right of Direction finder's controls, enables use of compass and gnss reiceiver connected to direction finder. If compass button is set to enabled, direction finding results will be corrected with compass value, otherwise no correction or fixed correction set in DF equipment will be applied. Also, with compass enabled realtime gnss coordinates (if available) will be reported to Skudra server (5.4), otherwise static coordinates set in settings panel (4.3.2) will be reported;
- The "*Mute*" button (C.3) and volume menu (C.4) correspondingly serves to mute the speaker and change volume. These buttons replicate the functions of the button (A.12) in the lower left of the software window;
- The folder where results of measurements should be saved is indicated in the window "*result's folder*". If the folder turns out to be inaccessible a pop-up warning will appear. The results folder can be changed by clicking the "*open*" button at the folder window and choosing the desired folder;

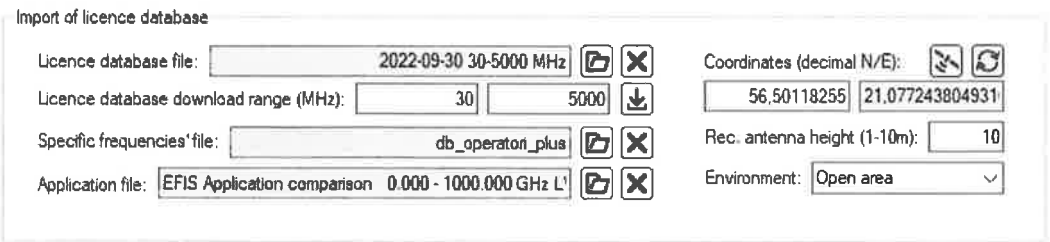
- The measurement should distinctively named in the input field "*Measurement session*". The name given will be used in the result file name, thus the symbols used are limited to the characters supported by the computer's file system;
- The button "eye" (C.7) is intended to display the contents of the window "Measurement session" in the software's measurement section under the measurement range list.



- The input field "*Antenna factor*" (C.8) and "*cable attenuation*" (C.9) accordingly show the antenna factor and cable attenuation files loaded into the software, and their covered frequency range;
- The antenna factor and cable attenuation files may be replaced clicking the button "*open*" next to the file window and choosing the necessary file. As soon as a new valid factor file is chosen it is saved to the software's memory and it doesn't have to be repeatedly read;

4.2.3 Configuration and import of licence database

The group of frequency licence loading comprises all functionality necessary to determine the theoretical field strength of the stations detectable at the monitoring site and their assignment's parameters, as well as to determine the radiofrequency application corresponding to the frequency channels. By the theoretical field strength it is determined whether it is possible to receive the emissions from assignments transmitter at the monitoring site;



- Licence database information can imported through licence file of documented format (6.1.2), by clicking "folder open" button next to the "Licence database file" and selecting corresponding file. However it easier to download database information directly;

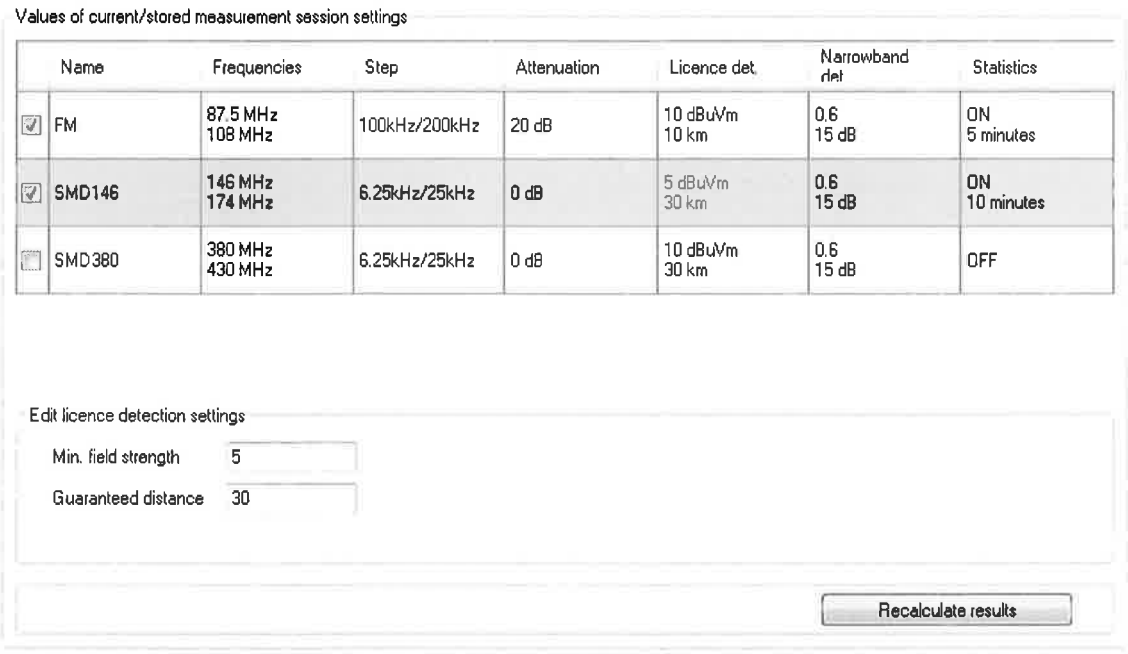
- Authorised (4.2.6) user can download licence database information directly from Skudra Server in frequency range set in "Licence database download range" input field by clicking download button next to it;

- As download of licence database information can take some time, it is done in background and progress is reported in "Licence database file" input field;
- The theoretical field strength value of the assignment at the monitoring site is calculated by the Hata-Davidson method, using the monitoring site's coordinates (C.10 un C.11), receiving antenna height (C.14), the monitoring environment characteristics (C.15). Licence selection is explained is detail in 4.5;
- In computers running *WINDOWS 10* or higher it is possible to get the monitoring site coordinates (C.10 un C.11) from the information stored in computer's operating system by clicking the button "*satellite*" (C.12);
- Changing the monitoring site's characteristics (i.e., everything except the licence database information) the site's characteristics will be changed temporally indicated by highlighting the parameter in red. To recalculate the theoretical field strength the button "refresh" (C.13) should be clicked or the licence database file should be reloaded by clicking the button "*open*" (C.16) or "download". If recalculation is not done, the changed settings will be lost next time the software restarts;
- In the window "*specific frequency file*" a file is indicated that contains information on assignments not linked to any particular frequency or do not require an individual licence. The specific frequency file may be changed clicking the button "*open*" (C.18) and choosing the necessary file. After changing this file it is not necessary to recalculate the transmitters detectable at the monitoring site;
- Contents of the specific frequency file loaded to the software are displayed in the group "specific frequency list" (4.2.5);
- The file containing information on the radiofrequency applications appropriate to the frequency bands is displayed in the window "*Application file*". The corresponding "*csv*" file of the necessary country may be downloaded from the web site www.efis.dk. The radiofrequency application file may be changed clicking the button "*open*" (C.20) and choosing the appropriate file;
- The licence database file, specific frequency file and application file information may be deleted from the software by clicking the buttons "*delete*" (C.17, C.18 and C.19) to the right from the appropriate file text

fields. After deletion of the file information, the recalculation of detectable transmitters at the monitoring site is not necessary.

4.2.4 Frequency use licence recalculation (update of results)

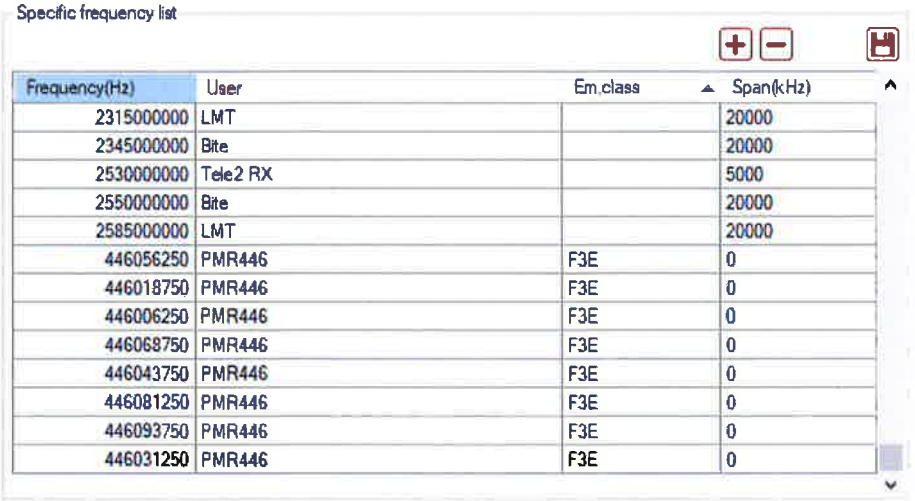
- During measurements, information about most probable licences, the theoretical signal field strength corresponding to licences, monitoring site coordinates, and other information shown in the group *"Configuration and import of licence database" (see section 4.2.3**Error! Reference source not found.**)*, as well as values in the range settings list (D.1) column "Licence detection" are linked to the signal detection results.
- In order to recalculate earlier results (e.g. with an updated licence database file) the button *"refresh results"* (B.5) should be clicked; To update the measurement results according to the newly loaded frequency licence settings, the measurement results should be saved and opened as an archive file;
- If different licence detection thresholds are necessary, appropriate change have to be made in input fields (B.3 and B.4) shown after selecting "Measurement range list" in "Settings" treeview (B.1). Changes will be indicated to the archived measurement range settings table (B.2) in red.



- After implementing the neccessary changes to the column *"Licence det."*, and clicking button *"Recalculate results"* (B.5) - the results will be recalculated according to the updated licence information and settings. A pop-up message *"Detection results recalculated"* will appear;

4.2.5 The List of Specific Frequencies

- In the group "*Specific frequency list*" (C.27), it is possible to view and edit the contents of the of specific frequency list, i.e., frequencies of assignments, the licences of which are not linked to specific frequencies, or which do not require an individual licence;
- The list of specific frequencies may also be appended from the list of detected signals (A.24) by selecting the result's context menu "*to the specific frequency list*" (A.10);



Frequency(Hz)	User	Em.class	Span(kHz)
2315000000	LMT		20000
2345000000	Bite		20000
2530000000	Tele2 RX		5000
2550000000	Bite		20000
2585000000	LMT		20000
446056250	PMR446	F3E	0
446018750	PMR446	F3E	0
446006250	PMR446	F3E	0
446068750	PMR446	F3E	0
446043750	PMR446	F3E	0
446081250	PMR446	F3E	0
446093750	PMR446	F3E	0
446031250	PMR446	F3E	0

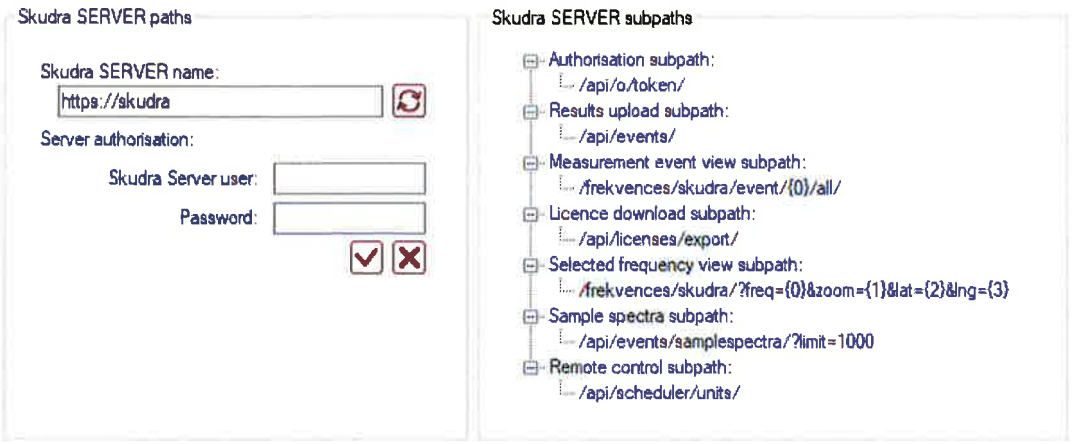
- The list of specific frequencies comprises three columns:
  - Frequency - the frequency of the channel (Hz),
  - User - the user operating the corresponding entry's frequency, the equipment, the radio communication service or other information,
  - Em. class - the class of emission corresponding to the frequency entry and user. Filling this column is not mandatory and it's contents are purely informative;
  - Span(kHz) - frequency span of assignment. Any frequency in set span is considered related to set user;
- The list of specific frequencies may be sorted by column, clicking the header;

- Changes to the list of specific frequencies may be done by direct editing of the entries. To save the changes and use them in measurements the button "*Save*" (C.30) should be clicked;
- The list of specific frequences may be appended or a highlighted entry deleted correspondingly clicking the buttons "+" (C.28) and "-" (C.29). In order to apply the changes to measurements, they must be saved by clicking the button "*save*" (C.30);
- Clicking button "save" saves changes made to "specific frequency list" to the file that is loaded at "Specific frequencies' file" (4.2.3), therefore, to save previous edition of specific frequencies file, its copy have to be made manually.

4.2.6 Interaction with Skudra Server

To upload results, exchange sample spectra, download licence information, store waterfall spectrograms, report statistics, report DF results or register for remote control it is necessary to acquire an access key to Skudra Server;

- The Skudra Server access token may be acquired filling the windows "Skudra Server user" (C.22) and "password" (C.23) and confirming the key request by clicking the button "confirm" (C.25);

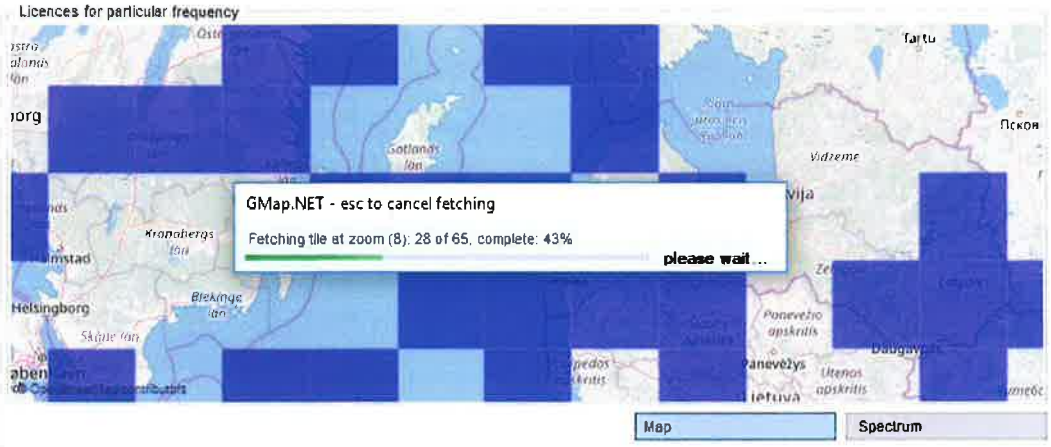


- The Skudra Server access token is stored in the software's memory and is reusable in the period set by Skudra Server. The key may be deleted by clicking the button "*delete*" (C.24);
- To be able to get the Skudra Server access token, valid Skudra SERVER name (path) must be available;
- There is possibility that due to changes in Skudra server configuration some of Skudra SERVER subpaths have been changed, they must be updated by clicking refresh button next to Skudra SERVER name input field;

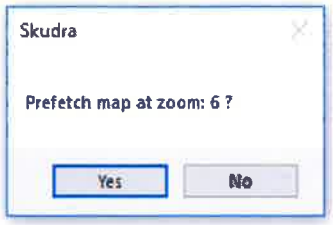
4.2.7 Map storage

- OSM maps are used to display the licence information;

- Maps may be used offline, when the map saved by the software is used, or online when the map is acquired from OSM servers. Changing from offline mode to online mode and vice-versa is done clicking the button "Offline/Online" (C.33);
- Tiles of the map viewed online are saved in the software's memory;



- In order to fetch the offline maps, click the button "*Prefetch*" (C.31). After clicking the appropriate button map fetching will begin within the borders of the current map displayed in the measurement section map "licences for particular frequency" (A.14),;
- A confirmation for each zoomed-in layer download will be asked, and download progress will be displayed;



- If the next zoomed-in layer's download is not confirmed, the map's download will stop. Each downloaded layer is saved before commencing the next download.

4.3 Measurement Ranges functionality

- The range settings define the bands that will be scanned during measurements, as well as their parameters;
- Summary of set measurement ranges is displayed in Measurement range list. List is not editable directly (except use check box), but selection of particular range in list provides editorial controls. It is possible to edit several ranges together by selecting more that one range;

Measurement range list

	Name	Frequencies	Step	Attenuation	Licence det.	Narrowband det.	Mask detection
☑	FM	87,5 MHz 108 MHz	100kHz/200kHz	0 dB Normal	10 dBuVm 30 km	0,6 15 dB	flatFM 100 kHz
☐	dvb-t	460 MHz 760 MHz	1MHz/25MHz	0 dB Normal	10 dBuVm 30 km	OFF	OFF
☑	SMD	146 MHz 174 MHz	6.25kHz/25kHz	30 dB Normal	10 dBuVm 30 km	0,6 15 dB	OFF
☑	GPS	1400 MHz 1500 MHz	10MHz/100MHz	30 dB LowDistortion	10 dBuVm 30 km	OFF	OFF

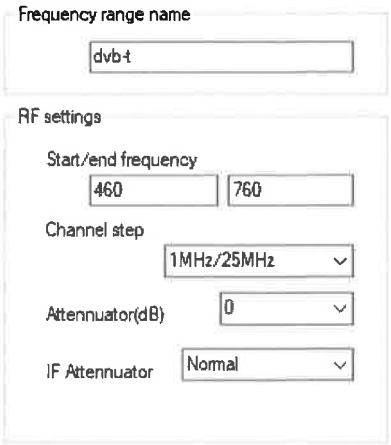
PR200

Mask detection	Broadband det.	Jammer det.	Spectrogram	Statistics	DF
flatFM 100 kHz	OFF	OFF	ON Skudra Server Locally	OFF	1x >10 dBuVm Any 1 s ,80%
OFF	15 dB 0,5 prob. umsdvbt3	OFF	OFF	ON 5 minutes	OFF
OFF	OFF	OFF	OFF	OFF	5x >30 dBuVm NRS 10 s ,80%
OFF	OFF	3 dB 30 - 180 kHz 10 dB	ON Locally	OFF	OFF

4.3.1 RF configuration

Parameters available to set for each range:

- Use - does the range need to be scanned during measurements. This is only parameter settable in measurement range list;

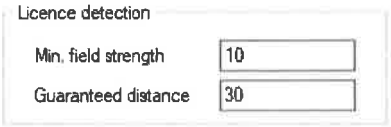


- Name - the range's name will be listed in the signal detection result list to distinguish frequency channels where measurements were done in the framework of different bands overlapping by frequency;
- Start and End - The range edge frequencies in MHz. When choosing the start and end frequencies, range overlapping is allowed, even several identical bands are allowed. The software automatically will not allow the start frequency to exceed the end frequency;
- Channel step - four measurement frequency steps are available in the software:
    - 100kHz/200kHz - for signals containing their characteristic features in a range of 200 kHz and signals observed are aggregated in a step of 100 kHz (typically FM broadcasting)
    - 6.25kHz/25kHz (and 6.25kHz/25kHzIQ for PR100) - for signals containing their characteristic features in a range of 25 kHz and signals observed are aggregated in a step of 6.25 kHz (typically private land mobile service)
    - 1MHz/25MHz - for broadband detection using machine learning (5.2.2), for signals containing their characteristic features in a range of 25 MHz and signals observed are aggregated in a step of 1 MHz, still channel frequency is specified in detection process to 250 kHz (typically used public mobile service and dvb-t)
    - 10MHz/100MHz - for jammer detection (5.2.4), signals observed are aggregated in a step of 10MHz, and stored in 100MHz, 250 MHz or 500MHz bandwidth

However options except narrowband detection, broadband detection and jammer detection are available regardless of channel step;

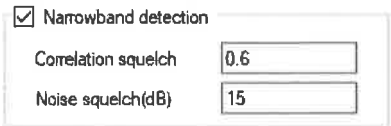
- Attenuator - The setting of the receiver's attenuator. This parameter's value depends on the receiver specifications. The parameter's menu shows values available to the receiver set in the receiver menu (D.2);
- IF attenuator - The setting of the receiver's intermediate frequency attenuator. This parameter's value depends on the receiver specifications. The parameter's menu shows values available to the receiver set in the receiver menu (D.2);

4.3.2 Licence detection configuration

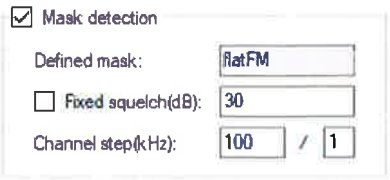


- Guaranteed distance - Distance in km from the monitoring site, where all assignments are considered valid. This parameter does not limit (filter) accessible assignments, it shows additional assignments, which in cases (e.g. FM broadcasting) when all transmitter parameters are known, are not necessary. At high values (>30km) this can introduce additional errors in determining the assignment. The value is practically applied to finding the mobile station assignment in a large territory (e.g. in a large city);
- Minimum level - theoretically calculated threshold of field strength (dBμv/m), exceeding which the assignment is considered detectable at the monitoring site. Adjustment of this parameter is foreseen in sites of unusually high or low noise level to refine the amount of assignments determined automatically;

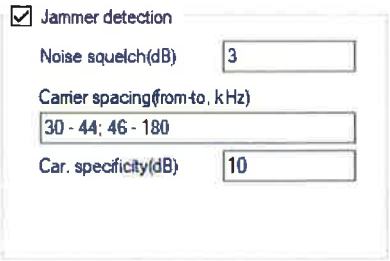
4.3.3 Signal detection configuration



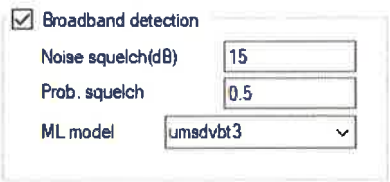
- Narrow band detection is available only for 6.25kHz/25kHz, 6.25kHz/25kHzIQ and 100kHz/200kHz channel steps;
- Correlation squelch - The squelch value is from zero to one. To detect a signal the squelch value is compared to the maximum squared correlation coefficient achieved doing Pearson's correlation with sample spectra.
- Noise squelch - Squelch value in dB over noise. The noise squelch is used to determine the frequency channels where signals should be further detected using correlation;



- Mask detection is available for any channel step;
- Mask detection can be used by setting fixed squelch (dBuV/m). In that case no mask definition is necessary;
- To use mask detection with mask spectrum mask must be generated (5.2.3 and 4.7). Defined mask name is shown in text box if spectrum mask is defined for start frequency, stop frequency and resolution (channel step) combination;
- Channel step for mask detection is independent for measurement range channel step and it will override signal aggregation channel step expected for measurement range channel step;
- Mask detection's channel step divisor enables non integer channel steps, for example 25kHz/3 =8.333 kHz;



- Jammer detection is available only for 10MHz/100MHz channel step;
- In depth guidance selecting parameters for jammer detection is provided on 5.2.4;
- Noise squelch determines neccessary interdecile range of emission's spectrum in 10 MHz bands, to proceed to jammer detection;
- Carrier spacing determines ranges of carrier spacing (periods) to be considered related to jammer. Values are in format is "period1start - period1end; period2start - period2end;...";
- Car specificity determines how much more power has to be concentrated in particular periodic carrier frequency, compared to average of other periodic components;



- Broadband detection is available only for 1MHz/25MHz channel step;

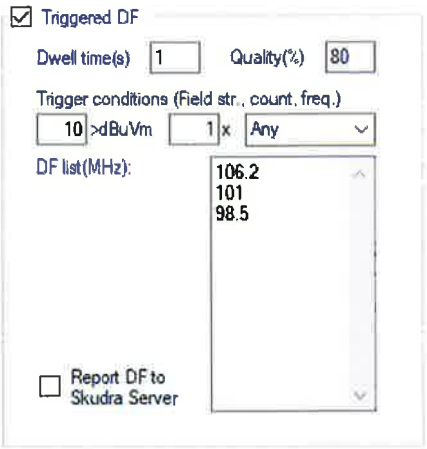
- In depth guidance selecting parameters for broadband detection is provided on 5.2.2 and 4.6;
- To use broadband detection ML model has to be imported (4.6). Dropdown box provides list of currently imported ML models;
- Noise squelch determines level difference of spectrum sample to be used for broadband detection. Generally it is appropriate to use value similar to one used when fitting model;
- Broadband detection provides probability value of signal being detected in range from 0 to 1. Probability squelch determines, whether emission to be regarded as signal depending on the probability value;

4.3.4 Statistics and spectrogram configuration

- Report statistics - enable functionality of reporting statistics to Skudra Server and set reporting interval (seconds).

- Spectrogram storage enables recording (and display) of waterfall spectrogram. Spectrogram can be stored on local computer, on Skudra Server or both;

4.3.5 Triggered DF configuration



- If enabled triggered DF, direction finding on each signal detection event that trigger conditions is requested (5.3);

- Trigger conditions are minimum field strength of aggregated signal, minimum count detections in particular frequency channel and frequency channel characteristics, which includes whether there is no licence associated to frequency ("NRS"), whether frequency is contained in DF list ("listed"), and no condition ("any");
- DF list contains frequencies in MHz, for which only direction finding will be requested, if trigger condition "listed" is selected. Multiple frequencies can be added to DF list from clipboard, or added after keyboard shift-enter combination;
- Dwell time determines how long each DF request is carried out. During the dwell time many df measurements may be performed, in such case one most probably direction is output;
- Direction finding is successful and result is output only if at least one direction measured, has quality higher or equal to that set in quality(%) textbox. Also directions bellow quality(%) textbox value, are not included in calculation of most probable direction;
- It is possible to send each direction finding result in realtime to Skudra server by enabling Report DF to Skudra server (5.4). This functionality is separate from sending direction finding histogram as part measurement results.

4.3.6 Editing the range setting list

- The range settings available depend on the receiver specification. The range editing list contains values available to the chosen receiver (D.2);
- If a different monitoring receiver is chosen in the menu (D.2) and the new receiver supports a parameter in the range list, the parameter is left unchanged. In the opposite case, the default value of the parameter is set;

- By clicking the button "*refresh*" (D.3), the receiver having the IP address in the window (0) will be automatically be chosen and set in the receiver menu (D.2);
- By clicking the button "*add range*" (D.4), the measurement range editing list will be appended by a new entry with default settings of the receiver chosen in menu (D.2),
- By clicking the button "*delete range*" (D.5), the highlighted entry will be deleted from the measurement range editing list;
- By clicking the button "*open*" (D.6) and selecting an earlier saved range setting file you may load this to the software;

- By clicking the button "*save*" (D.7) the software will offer to save the currently presented bands in a user named file for it's future loading into the software by clicking the button "*open*" (D.6).

4.4 The Sample Spectra Functionality

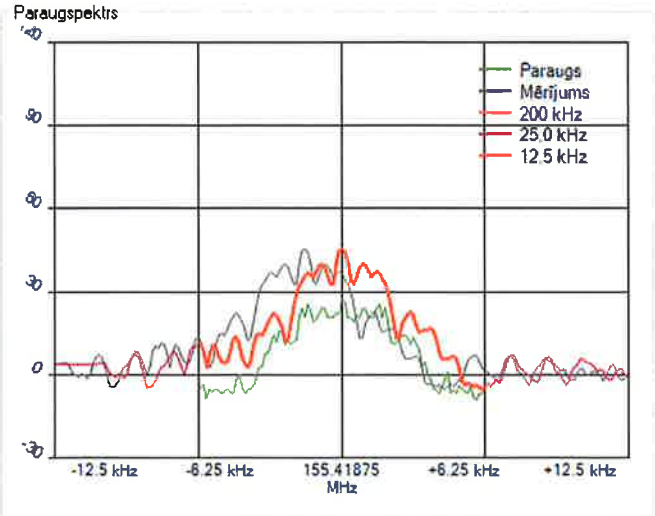
To determine signals correctly, a sufficient stock of sample spectra is neccessary. The majority of signal types need their own sample spectrum. The more sample spectra is available, the higher the correlation coefficient and the more it will differ from increased noise or out of range emisssions, leading to better signal determination.

The collected sample spectra section is created for spectra sample analysis and creating new sample spectra.

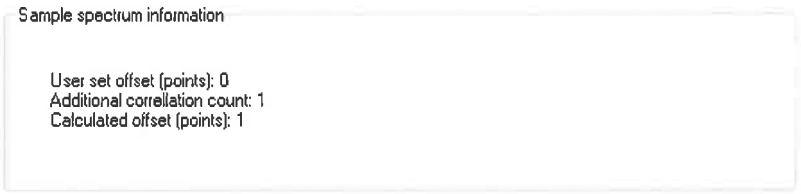
4.4.1 Adding and Displaying Sample Spectra

- Data defining new spectrum are taken from the cumulated signal spectrum. Thus before defining a new sample spectrum we must make sure that the corresponding signal is highlighted in the signal detection result list;

- To start a new sample spectrum project, the button "*load*" (E.12) should be clicked. The sample spectrum curve lies within the maximum values of each frequency component's cumulated spectrum that falls within the 90% interval assuming that the dispersion of values follows a Gaussian distribution. (Inaccurately, but simpler - 90% of the maximum value);



- In the process of creating a sample spectrum project, several curves are ploted in the sample spectra display and defining graph (E.2), differing by frequency offset. The calculated sample spectrum "*measurement*" without frequency offset (E.5) is displayed, and, depending on the sample spectrum's range's step, sample spectrum with a frequency offset corresponding to the centering of the signal in the 200 kHz range (E.6) or two sample spectra with a frequency offset corresponding to the centering of the signal in the 25 kHz range (E.7) and 12.5 kHz (E.8);
- By selecting a sample spectrum on the graph with the left mouse button, it is possible to adjust the automatically determined frequency offset with the buttons "*left*" (E.10) and "*right*" (E.11);



- The automatic and manual sample spectrum offsets are shown in the group "*Sample spectrum information*", respectively, "*Central frequency offset*" and "*User set offset (points)*" (E.21);
- The group "*Sample spectrum information*" also displays the information "*Additional correlation count*" (E.22), which characterizes the number of correlations neccesary to the project (value exceeds 1 for most spectra containing multiple carriers);
- The manually corrected offset may be reset by clicking "refresh" (E.13);
- When creating a sample spectrum project, the sample spectrum usage statistics chart (E.3) of the closest signals to the source of the new sample are also shown. Only those sample spectra are shown in the chart rows that were detected as the closest signals, including occurance count (E.9). The chart can also display how often a particular sample spectrum is used in various frequencies. To repeatedly view the source sample spectrum source spectra statistics, the button "*refresh*" (E.13) should be clicked;
- In order to add the sample spectra project to the list of sample spectra, the button "*confirm*" (E.14) should be clicked, and the columns "*information*" (), "Use" and "*Em. Class*" should be filled-in directly in the list of sample spectra (E.1).

4.4.2 The list of sample spectra

- The available sample spectra with their parameters are displayed in the list (E.1) in columns:

- Information - A description of the sample spectrum, e.g., the model of the emitting equipment, radiofrequency application or spectrum description. A unique identificator is allocated to each sample spectrum, thus several sample spectra may have the same description.
- Use - A checkmark indicating the particular sample spectra is in use by the software to determine signals. Unchecking this parameter enables temporary disabling the particular sample spectra without deleting it;
- Em. class - The class of emission associated with the sample spectrum is used to predict the measured signal's class of emission. The class of emission in the signal determination results corresponds to the most often observed sample spectrum most closely resembling the signal;
- Step - sample spectra differ significantly depending on the frequency channel step (thereby of frequency ranges and the typical signals in the range). To efficiently use the computer's processing power two goups of sample spectra are used - one for frequency ranges with a channel step 6,25 kHz and the other for frequency ranges with a channel step 100 kHz.
- Corr. - Correlation (coefficient of determination) between the cumulated sample spectrum and the spectrum project created from measurement results. The correlation column's entry is blank when no sample spectra project was acquired, when the sample spectrum project was acquired at a frequency channel step not conforming to the sample spectrum, as well as if the ratio of the standard deviation between the level values of the sample spectrum project and cumulated spectrum is less than 0.67;
- StDev - The standard deviation ratio of the level values of the sample spectrum project and cumulated sample spectrum. The columns entry is blank when no sample spectra project was acquired and when the sample spectrum project was acquired at a frequency channel step not conforming to the sample spectrum;

Sample spectra list

Information	Use	Em. class	Step	Corr.	StDev
Motorola GM300	☑	8K50F2D	6.25kHz/25kHz	0.844	0.73
testpr100	☑	8K50F2D	6.25kHz/25kHz	0.798	1.17
Unknown	☑	8K50F2D	6.25kHz/25kHz	0.461	2.97
8K50F3E CTCSS	☑	8K50F3E	6.25kHz/25kHz	0.335	0.72
8K50F3E CTCSS ar skaņu	☑	8K50F3E	6.25kHz/25kHz		0.64
8K50F3E CTCSS full	☑	8K50F3E	6.25kHz/25kHz	0.743	0.9

- Correlation, sample spectrum and signal spectra standard deviation ratio columns are blank if the range or point number does not match the spectrum.

The corelation column also is blank when the standard deviation of spectrum level values is half of the sample spectrum standard deviation;

- The corelation and signal spectrum standard deviation of entries characterize how well the sample spectrum matches the project sample source - how precisely such as signal may be determined. Standard deviation characterises the difference between lowest and highest level values in sample spectra - whether sample is derived from low or high level signal.
- By highlighting a sample spectrum entry it is displayed as a sample spectrum in the sample spectrum defining graph;
- The sample spectra list may be sorted by clicking the column headers.

4.4.3 Editing the sample spectra list and exchanging it with Skudra Server

Under the Sample spectra list is a group "*Edit sample spectra list*" for editing the sample spectra list and it's exchange with Skudra Server;

- To delete the highlighted sample spectrum from the sample spectra list the button "*delete*" (E.16) should be clicked;

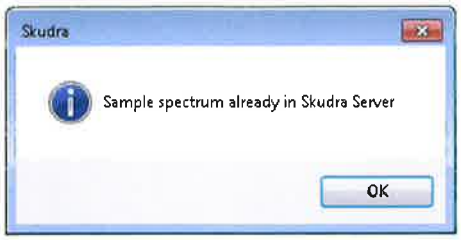
- To undo unsaved changes in the sample spectra list the button "*refresh*" (E.17) should be clicked;
- In order to save changes to the sample spectra list so that they are available also after restarting Skudra, the button "*save*" (E.20) should be clicked;
- In order to compare the sample spectra list to the saved spectra on Skudra Server, the button "*load*" (E.18) should be clicked. When loading will complete, entries both in the sample spectra list and in Skudra Server will appear in black font, in red those only in Skudra Server and blue - only locally saved spectra samples;

Sample spectra list

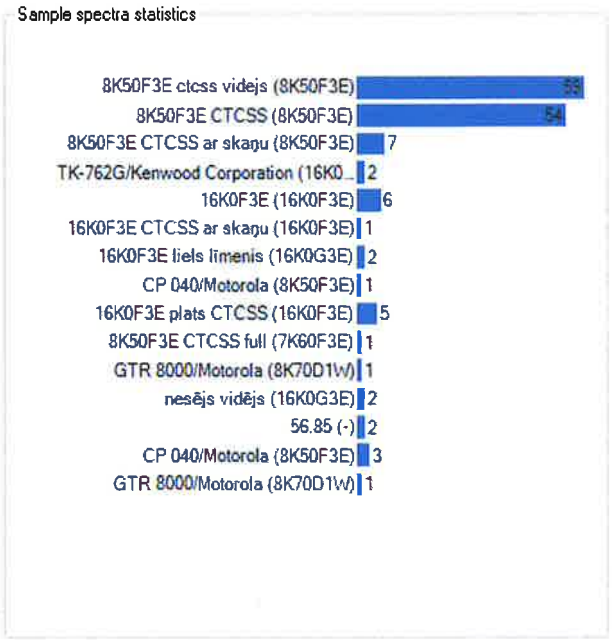
Information	Use	Em. class	Step	Corr.	StDev
Latvenergo	☑	24K0D2D	6.25kHz/25kHz		
aCiparu	☑	8K50F1D	6.25kHz/25kHz	1	1
173_4	☑		6.25kHz/25kHz	0.713	1.22
Latvenergo	☑	15K3F1D	6.25kHz/25kHz	0.527	0.69
FM apraide (plats)	☑	300K8EHF	100kHz/200kHz		
ciparu446	☐		6.25kHz/25kHz	0.644	1.27
16K0G2B bez 6 nesēji	☑	16K0G2B	6.25kHz/25kHz	0.06	1.63

- To upload highlighted sample spectrum to Skudra Server, the button "*upload*" (E.19) should be clicked. Only authorized users having acquired the authorization token from Skudra Server may update the sample spectra

database. If a sample spectrum is already stored in the database, no copy will be added. A pop-up message on the upload results will appear.



- Upon clicking the button "*information*", the distribution of sample spectrum use across different frequency channels will appear on the chart Sample spectra statistics (E.3). The distrubution rows comprise all frequency channels where the highlighted sample spectrum was identified as the most alike. Each row is also marked how often the spectrum has been identified.



4.5 The functionality of the frequency assignment database

Upon clicking the button "*import licence database file*" (C.16) , "Licence database download" or "recalculate licences" (C.13) the table of valid licences at the monitoring site is calculated. The array of valid licences is calculated by the following algorithm:

- The theoretical transmitter field strength at the monitoring site is calculated using the Hata-Davidson radio wave propagation model (TIA TSB-88A), based on the following input data: frequency, effective radiated power of the transmitter, distance, antenna height, propagation environment at the monitoring site, the receiving antenna's height;
- The theoretical field strength intensity is calculated for all transmitters whose licences include coordinates, effective radiated power, antenna height, class of emission;
- The user of the licence with the highest theoretical field intensity exceeding the established field intensity threshold is considered as the most probably detectable at the monitoring site. Additionally, the numbers of all other licences over the threshold are stored for the use of Skudra Server;
- Using a geographical distance calculation method (not taking account of the Earth's curvature) from all the transmitters having coordinates in their licences, only those are selected that are not farther then the established threshold. If a valid licence was not established applying the previous clause, the user of a licence with coordinates nearest to the monitoring site within the distance threshold is considered valid;
- Additionally, the numbers of all other licences over the threshold are stored for the use of Skudra Server;
- All licences without coordinates are considered valid everywhere and are appended in parentheses to the list of valid licences at the monitoring site;
- Additionally, the numbers of all the licences without coordinates are stored for the use of Skudra Server;
- Frequencies which are not found in the Skudra Server database, but are included in the user-prepared file of specific frequencies are appended to the array of valid licences;
- Additionally, for display in the measurement section's map and manual tweaking of the licence, all licence information is stored, their theoretical field intensity at the monitoring site and their distance.

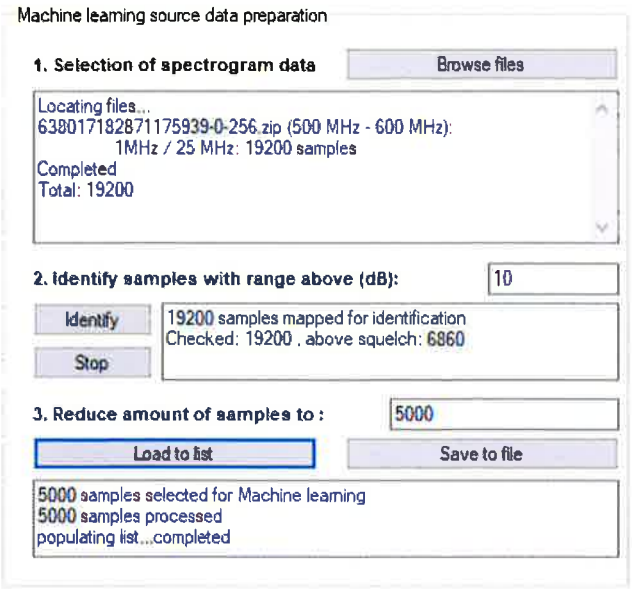
4.6 Functionality of Machine Learning

To use machine learning signal detection, corresponding function has to be enabled for particular measurement range (see 4.3). One of the parameters that is necessary to set in order to use machine learning detection is ML model. This paragraph provides instructions on how to generate ML learning model.

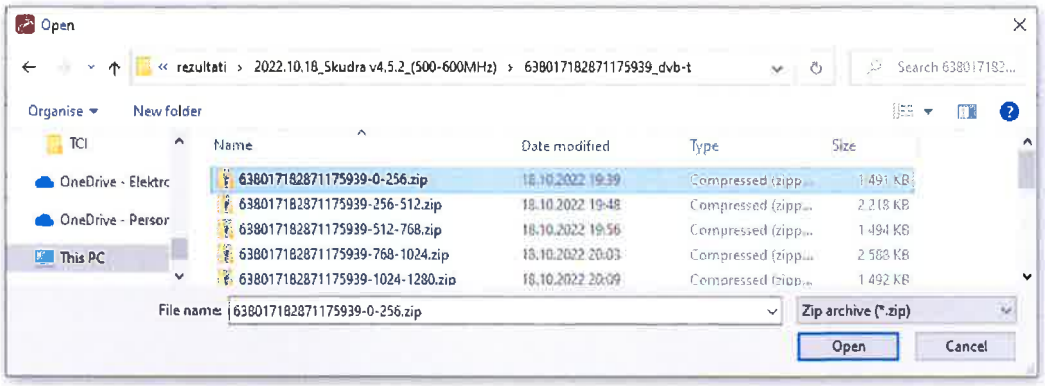
4.6.1 Generation of Machine Learning models

Functionality necessary to generate ML models is available in "Machine learning" panel;

Generation of ML model is divided into five steps. The first step is to select stored spectrogram data (for measurement of spectrogram see ranges and waterfall functionality).



Selection of spectrogram data is provided by "Browse files" button. In following open file dialog, it necessary to select single or multiple zip files that are contained in spectrogram folder. Opposed to selecting spectrograms for waterfall display, where it is necessary to select folder, for ML model generation it is necessary to select files inside spectrogram folder:

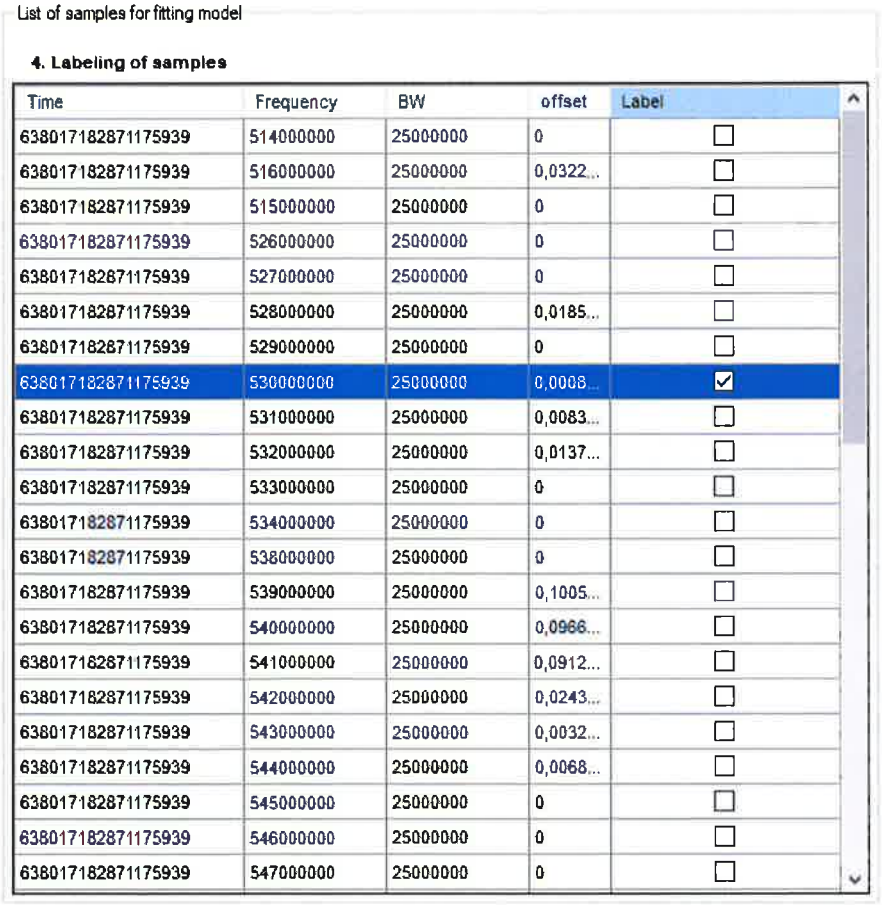


After selection of zip files and pressing "Open" button, information text box is filled with names of selected files and number of samples they contain;

Second step is to select (identify) spectrum samples to be used for generation of ML model based on difference between maximum and minimum field strength in each sample. This removes samples without change of field strength from using further steps which includes manual selection of samples that must be considered as signal.

Practical value of necessary difference between maximum and minimum field strength may be considered 10 dB;

Third step is to reduce number of samples used for ML model generation, however there no practical use to limit the number bellow 10000. User must pay attention to set limit, because limit value is not automatically updated after identifying new samples in second step. Reduction of data is commenced by pressing button "Load to list" or "Save to file". By pressing "Save to file" samples will be stored in file in format, that will allow to load it to list later, including together with other files (functionality in group box management of spectrum samples). Pressing "Load to List" will load samples to list for selection of samples to be considered as signal:


List of samples for fitting model

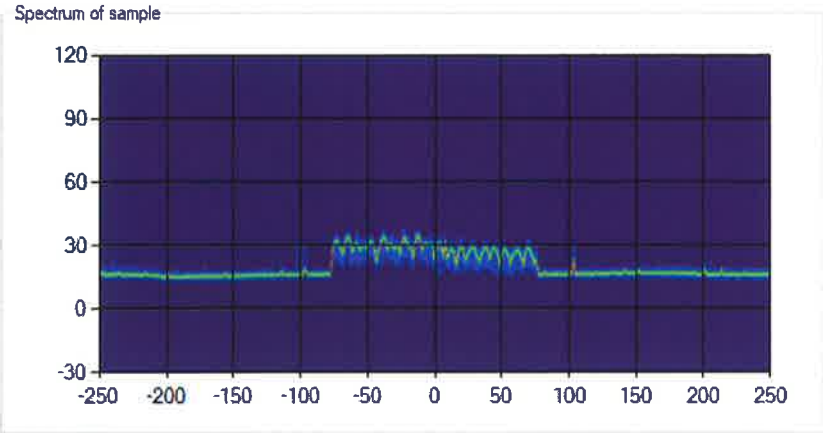
4. Labeling of samples

Time	Frequency	BW	offset	Label
638017182871175939	514000000	25000000	0	☐
638017182871175939	516000000	25000000	0,0322...	☐
638017182871175939	515000000	25000000	0	☐
638017182871175939	526000000	25000000	0	☐
638017182871175939	527000000	25000000	0	☐
638017182871175939	528000000	25000000	0,0185...	☐
638017182871175939	529000000	25000000	0	☐
638017182871175939	530000000	25000000	0,0008...	☑
638017182871175939	531000000	25000000	0,0083...	☐
638017182871175939	532000000	25000000	0,0137...	☐
638017182871175939	533000000	25000000	0	☐
638017182871175939	534000000	25000000	0	☐
638017182871175939	538000000	25000000	0	☐
638017182871175939	539000000	25000000	0,1005...	☐
638017182871175939	540000000	25000000	0,0966...	☐
638017182871175939	541000000	25000000	0,0912...	☐
638017182871175939	542000000	25000000	0,0243...	☐
638017182871175939	543000000	25000000	0,0032...	☐
638017182871175939	544000000	25000000	0,0068...	☐
638017182871175939	545000000	25000000	0	☐
638017182871175939	546000000	25000000	0	☐
638017182871175939	547000000	25000000	0	☐

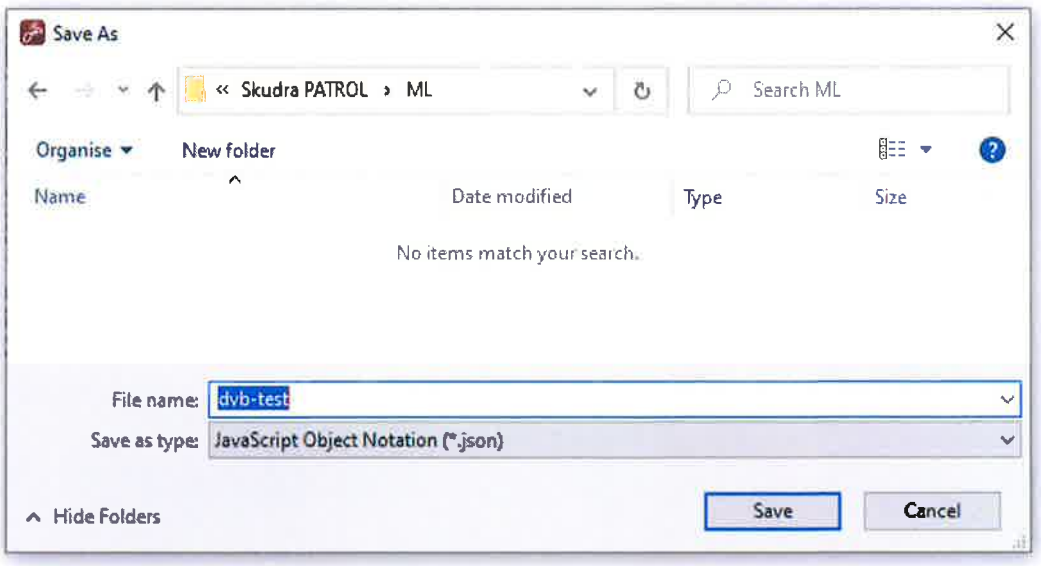
Step 4 provides functionality to mark samples that must be considered as signals. Correctness of this marks has direct influence on usefulness of resulting ML model. For broad band signals, list will have several records for single signal. In such case it is important to select only the sample record that is centred on signal, otherwise broad band detection will detect signal not only on centre frequency of spectrum, but also on offset frequencies depending on how samples was marked;

To support selecting samples to mark as signals, cumulated spectrum of sample is shown for selected record, and also value of frequency offset from record frequency

(usable as additional guide to select between nearby records, when spectrum alone is not definitive) is shown in column "offset" list of samples.



After marking samples that must be considered as signals, it advisable to save marked samples to file for combined, by pressing "Save samples" button:



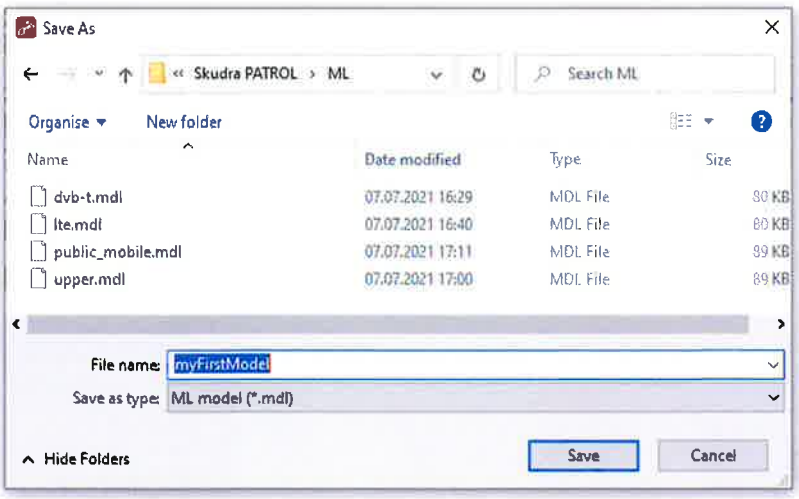
After successfully saving spectrum samples, corresponding information line is added to information text box:

Saving spectrum samples to file provides possibility for later loading samples to be used to fit ML model from several files. Those files can be created at different

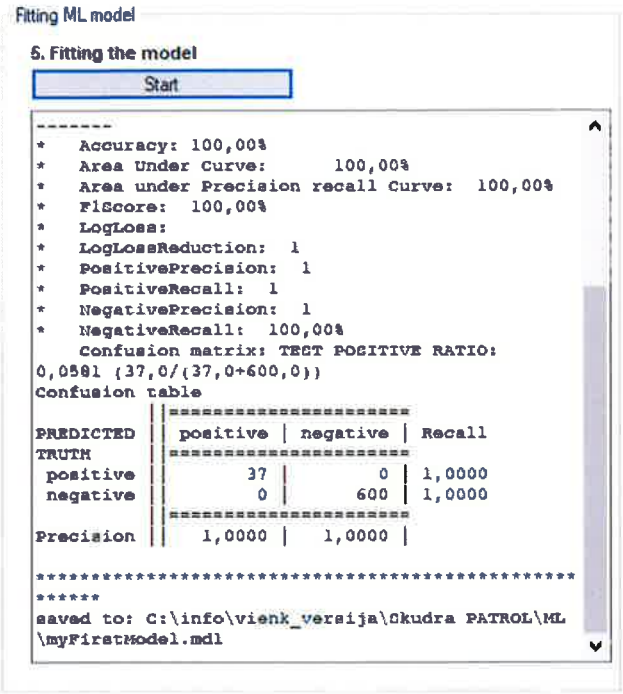
channel, different antennas, different signal to noise ratios to provide most diverse spectrum samples. By pressing "Load samples" can load all files deemed necessary for fitting model. Samples contained in files will be added to "List of samples for fitting model". Any samples contained in "List of samples for fitting model" before loading files will be lost:

When necessary samples are loaded in list and signals are marked, Fitting of ML model can be started by Pressing "Start" in "Fitting ML model" group box:

Fitting Starts with selecting file for saving ML model. Selected file name will be used to select available ML models, when defining broad band detection in Ranges panel;

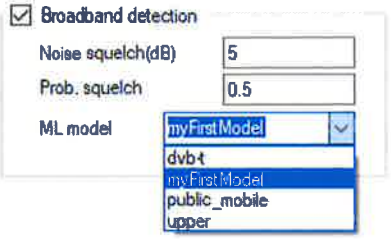


After selecting model name fitting of model is started. At the end of fitting, information on success of fitting in "Fitting ML model" group box is shown, for example: accuracy, whose low values (<90%) sometimes may be sign of incorrect marking of spectrum samples and confusion matrix, where number of cases when negative truth (no signal) is predicted as positive (signal) can be seen;



Any ML model, previously or newly created, must be imported to be available when setting measurement ranges in Ranges panel. Import of models is started by pressing "Import models" button in "Import of fitted models for broadband detection" group box.

Importing models provides possibility to select several ML models. ML models previously imported will be unloaded, and only newly selected models will be available for setting Broadband detection for measurement ranges:



4.7 Functionality of Mask Detection

Skudra Patrol provides two approaches to detection emissions above the set limit. First is detecting emissions above fixed squelch field strength, regardless of measurement range parameters. Second approach is to compare measured field strength to spectrum mask that is specifically designed for frequency range defined by its start frequency, stop frequency and resolution.

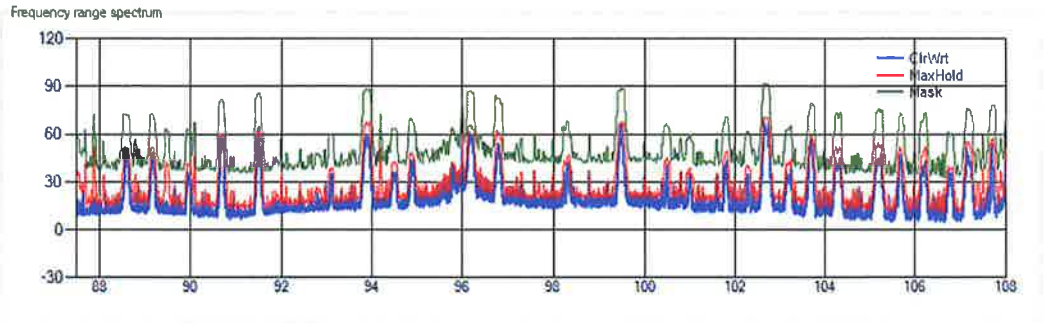
For mask detection with fixed squelch no mask generation is needed. Generation of specific masks for particular measurement ranges is described in section 4.7.1.

4.7.1 Mask generation

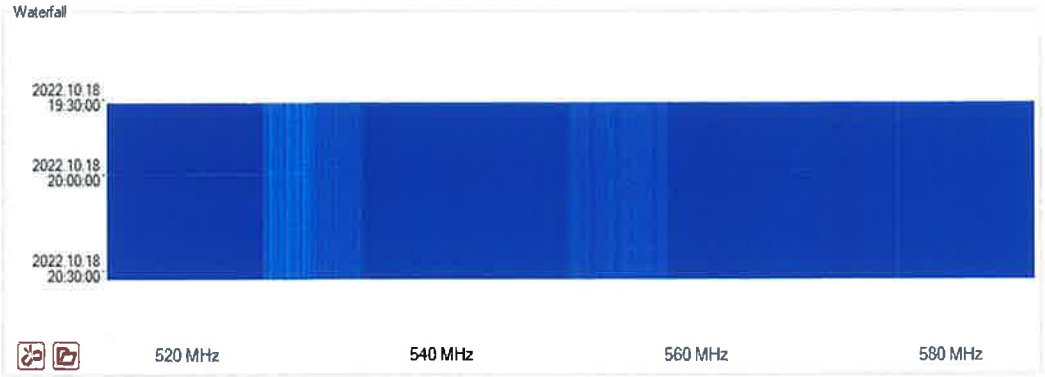
Functionality of spectrum masks' generation is available in "Masks" panel.

Skudra Patrol provides two methods of generating spectrum masks: using MaxHold spectrum from measurement range frequency range spectrum or using stored waterfall spectrogram.

- To define spectrum mask using frequency range spectrum it is necessary to select corresponding range in "Measurements" panel. Source for the frequency range spectrum can be either live measurements or saved measurement file;



- To define spectrum mask using waterfall spectrogram it is possible to select corresponding range in "Measurements" panel, after what, if available, selected waterfall spectrogram will be shown in "Masks" panel. Another is to load waterfall spectrogram directly using "Folder open" button as described in 4.1.17. Spectrum mask will be generated using only data in time range visible in plot, thus providing means to select parts (or whole) of spectrogram for generation of spectrum mask;



- Generation of spectrum mask is initiated by pressing "From waterfall" or "From MaxHold spectrum" buttons. In case of using waterfall only the generated spectrum mask is shown, yet using maxhold spectrum generated spectrum mask will be displayed together with MaxHold and ClrWrt spectra;

- Generation of spectrum mask can stopped any time, including during calculation of mask from waterfall, by pressing "Abort" button.

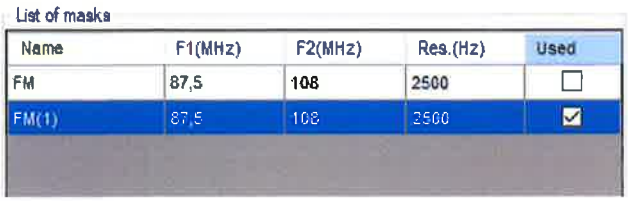
4.7.2 Mask manipulation

There are several functions available to handle generated mask, the same functions applies either mask is newly generated or selected from previously generated (List of masks)

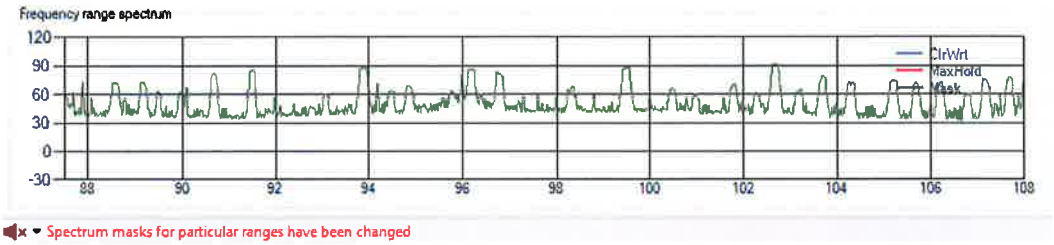
- It is possible to increase or decrease field strength value of each spectrum mask's point, by pressing buttons "+dB" and "-dB", respectively. Each points level is changed by value set in text box;
- It is possible to broaden spectrum mask to accommodate frequency instability of signal. Each time pressing "Broaden" button spectrum masks each point is given value maximum value of itself and two closest neighbours;
- Maximum and minimum values of spectrum mask is 120 dBuV/m and -30 dBuV/m, respectively. Therefore, to shape spectrum mask's base as straight line it is possible to decrease values below -30 dBuV/m, where values will clipped, and then increase values again.

To be able use selected mask it has to be saved and set as used:

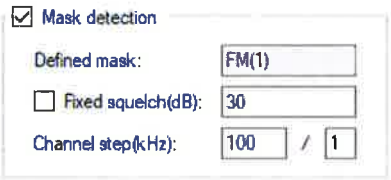
- Mask can be saved as new item in list of masks by pressing "Add to list" button. Name of the mask will be as set in text box;
- Mask can be saved by overwriting existing item in list. Name of the mask will also be overwritten with text set in text box. This functionality can be used to change name of selected mask in "List of masks" group box;



- For mask to be used it has to be set as "Used" by pressing "Set as used" button. Only one mask with distinct Start frequency (F1), Stop frequency (F2) and Resulution (Res.) combination can be set as used;
- If mask manupilations render changes in spectrum masks for measurement ranges set in Ranges panel, warning text "Spectrum masks for particular ranges have been changed" is displayed on statusbar;



- Mask name set as used with corresponding Start frequency, Stop frequency and Resulution combination to measurement range is displayed in Mask detection's Defined mask text box in Ranges panel.



4.8 Functionality of Remote Control

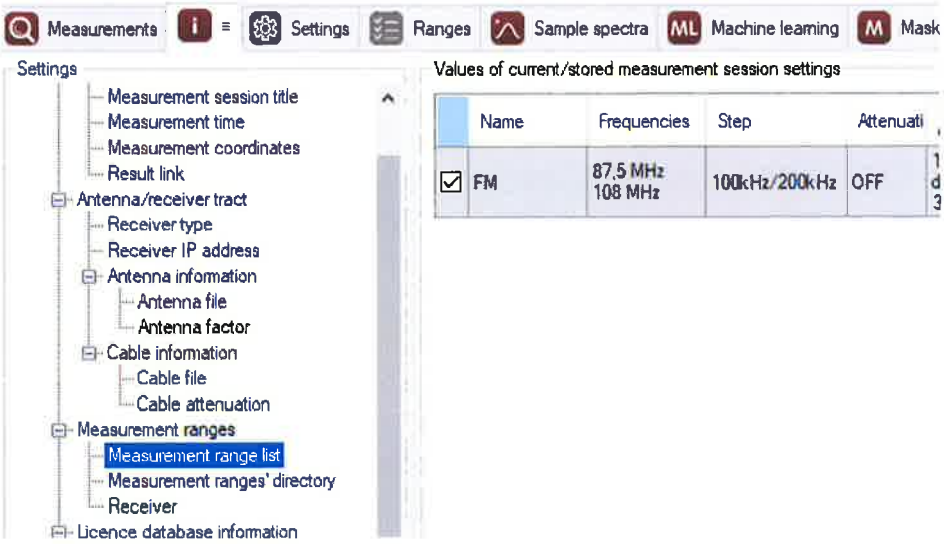
If set to remote control (4.1.1) operation, Skudra Patrol signal Skudra server for acceptance of remote tasks and performs measurement according to received tasks.

- To set Skudra Patrol to remote mode, it is necessary to that user is authorised (4.2.6);
- By toggling "Remote" button to enabled, remote operation is started in following order:
    - Skudra Patrol registers on Skudra Server as available for remote control. Information registered contains computer host name and IP address, location (N/E), receiver model and serial number;
    - Additionally spectrum masks an machine learning models available at local Skudra Patrol is registerd on Skudra Server;

- Skudra patrol requests measurement ranges set for particular receiver/ computer at Skudra Server;
- If there are no set measurement ranges at Skudra Server, Skudra Patrol idles until measurement ranges is added or remote mode disabled;

- Measurement ranges set at Skudra Server are time limited (the have defined start and stop times). If start time is set to be in future, Skudra Patrol start measurement at set time (provided that remote mode still active) and stop at stop time;
- If measurement ranges are edited or added at Skudra Server, Skudra Patrol immediately receives notification and if necessary updates measurement ranges. If changes set at Skuda Server impact remote measurements currently performed, measurement is stopped and results are saved and if necessary new measurement is started;
- Informative message is displayed at status bar's left side, informing that remote control is active ("Remote control proceeding...") and that "New task received", if Skudra Server has notified of changes in scheduled measurements;

- Options available in measurement ranges (4.3), start and stop times, and option to upload measurement's results to Skudra Server;



- Information on currently remotely measured ranges and other settings is available in "Stored measurement settings" panel(3.2).

5 Software operating principles

5.1 Measurement of range spectra

- Measurements are done in the chosen bands with start and end frequencies set in the settings, with a defined signal attenuation and channel step. Other spectrum scanning parameters are specific to signal determination and no editing is foreseen. The bands selected cannot be changed during scanning;
- Scanning of the bands is cyclic - after scanning the last range scanning is continued in the first range;
- Signal detection is done parallel to spectrum scanning, thus in real life the scanning speed and repetition rate is determined by the performance of the receiver.

5.2 Signal detection

Manipulation of the signal detection process during measurement is not foreseen - the process depends on settings applied before the measurement (functionality of settings and ranges).

5.2.1 Narrow band detection

- The receiver is controlled according to the chosen measurement bands. Arrays of spectra blocks in the receiver's FFT range are acquired;
- The noise level of each frequency block is determined by a practically acquired algorithm;
- In cases when the emission levels in the frequency channels exceed the noise level set to be the detecting threshold (squelch setting functionality), signal search continues in the particular channel;
- In cases when the central frequency of an emission determined by a practically acquired algorithm corresponds to the frequency channel under investigation, the emission's spectrum is compared to the sample spectra. If not, the comparison will be done in the next channel or any other channel where the signal central frequency will be located
- Comparison of spectra is done by Pearson's correlation function. If the correlation result's determination coefficient exceeds the set value (setting functionality), a signal (transmitter operation) is detected on the frequency;
- If frequency channels overlap (in case of 12,5 kHz and 25 kHz channels), the channel with the highest correlation is considered to be detected.

5.2.2 Broadband detection

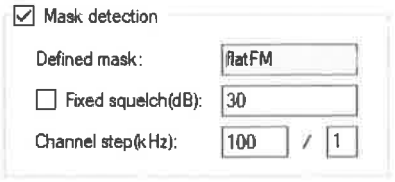
The sample spectra functionality is best suited for detection of signals whose spectral shape is defined mostly by signal itself. That is not the case for broadband signals, where received spectrum shape is influenced by multipath fading. To cover detection of broadband signals Skudra Patrol employs machine learning algorithms.

- It is important to note that machine learning approach is highly dependant on diversity of spectrum samples. For example, if model is fitted for dvb-t signal, it won't detect LTE signal. Further, if model is fitted for single dvb-t signal, model's applicability will be reduced, when there are two signals side by side. The same is true for high power signals versus signals close to noise floor or inside interfering signals. To accommodate various reception scenarios, best way is to fit ML models using data obtained from drive test (provides different signal to noise ratios and interference scenarios) and data from different regions where different channel configurations exist;
- Output of ML model is 1 if emission classifies as signal, 0 - as not signal, values between 1 and 0 denotes probability of emission being signal. If value of probability reaches set probability squelch (see Prob. Squelch 4.3), emission is considered as signal.
- Compared to correlation techniques used in narrow band detection, where correlation values have continuous distribution, probability values tend to have values closer to 1 or 0. Therefore limiting probability values has less influence on detection of compared to narrow band's correlation squelch, and generally to change behaviour broadband model refitting is necessary;
- Before ML model is applied, value close to interdecile range of emission's spectrum in 25 MHz band, is compared to noise squelch (see Noise squelch(dB) 4.3). Detection of signal is continued with ML model only if noise squelch value is reached. It is recommended to set noise squelch value close to that used when fitting ML model (4.6.1), otherwise ML model would be used on data it was not fitted for, which may yield unexpected results.

5.2.3 Mask detection

In general functionality of Skudra Patrol is aimed towards detection of actual operation of transmitter at particular frequency. However, there are cases when any emission or elevated noise outside above specified limits must be identified. Typical use cases would be detection of out of band emissions form FM broadcasting stations or detection of emissions in public mobile guard bands.

To meets these requirements Skudra Patrol provides functionality of Mask detection.



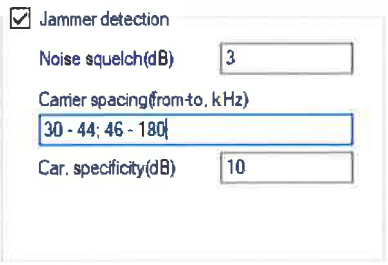
- Mask detection records frequency channel as occupied when field strength of any spectrum points in +/- half channel step around centre frequency overshoots set spectrum mask. Detection further is regarded and processed as signal detection;
- Mask can be increased (see 4.7.2) to allow naturally increased levels of field strength (for example sporadic propagation) or broaden to allow reasonable high frequency offsets (high Fm deviations of broadcasting stations);
- Channel step for mask detection is set independently from measurement range's channel step. This allows to use any channel step. Further channel's step divisor is introduced, to use channel steps that are not integer values, for example 25kHz/3 = 8,333 kHz;
- Width of spectrum channel is defined by measurement range's channel's step second value (e.g. 25 MHz for "1MHz/25MHz" channel step), unlike narrowband and broadband detection, width of spectrum has no influence on mask detection channelling; Spectrum corresponding to width of channel will be used to establishment of signal parameters (5.6);

Mask detection is dependent on receiver conditions at particular site, therefore specific procedure for transfer of masks from one measurement site to another is not foreseen.

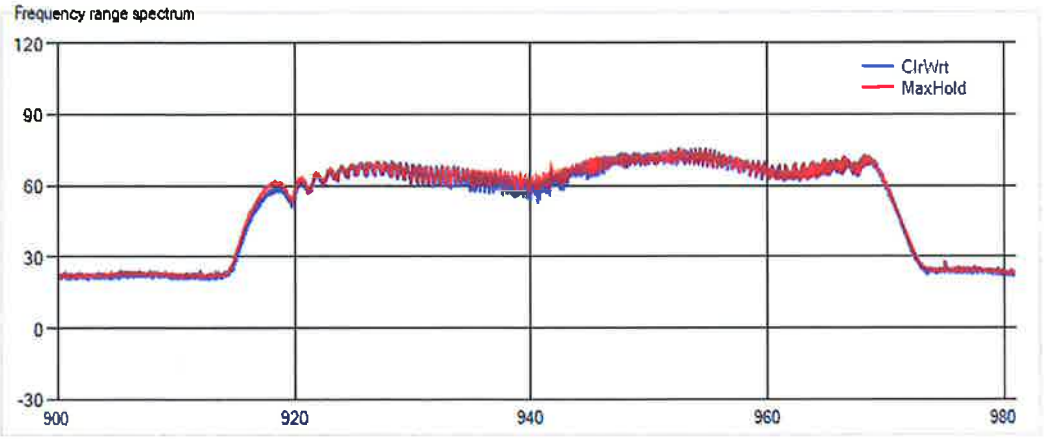
5.2.4 Jammer detection

Skudra Patrol provides specific detection of signals generated by public mobile and GNSS jammers. Usually, jammer signal is constructed by mesh of carriers. In order detect jammer signal repetitiveness of jamming carriers is measured.

- Repetitiveness of jammer's carriers is expressed as Carrier specificity for required carrier spacing ranges. For example, if emission contains carriers separated from each other (carrier spacing) by 100 kHz and power contained is those carriers is 10 dB higher than typical value of other spacing components, then (provided that carrier spacing range includes 100 kHz, and carrier specificity squelch is set to 10 dB) emission will be detected as jammer;

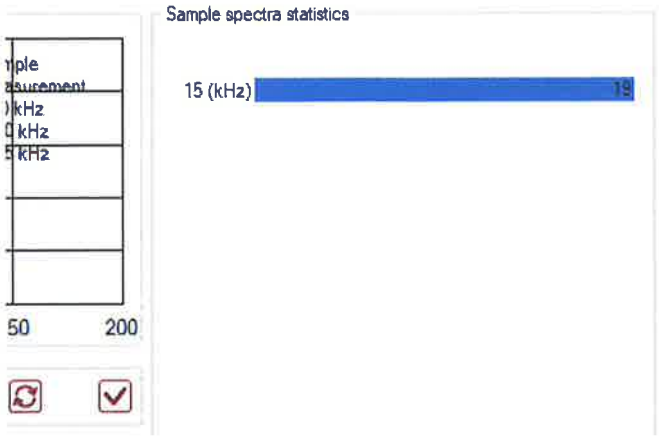


- Jammers for public mobile networks and GNSS usually have carrier separated by 60 to 160 kHz, yet jammers designed for 433 MHz band can have carrier spacing in range 1 to 5 kHz. To provide jammer detection for diverse types of jammers, spectrum resolution of measurement range step ("10MHz/100MHz") dedicated to jammer detection is 625Hz, that ensures detection of jammers with carrier spacing starting from few kHz;
- Detection carrier spacing is divided in 10 MHz steps, accordingly maximum detectable carrier spacing is 5 MHz, however plausible results are expected bellow 1 MHz;
- Selected wanted signals contains repetitive carriers. For example, LTE signal has traces of repetitive carriers with spacing of 15 kHz and 45 kHz, and lesser extent at 22-23 kHz. To exclude such carriers from calculation carrier spacing ranges has to be set (example: 1-14;14-21;24-44;44-180);
- Rarely local emissions, for example, from power adapters, may have repetitive carriers. Their influence can be limited by setting noise squelch. However unnecessary setting high noise squelch values may limit potential of jammer detection, because even emissions with low signal to noise ratio (lower that carrier specificity) can have high carrier specificity. Caution setting high noise squelch is particularly important, because usually jammer's signal power density is low and most detection will happen close to noise level;



- Guidance what repetitive carrier spacing frequency to exclude from by spacing ranges, can be obtained by selecting false jammer detection record

in signal detection result list (4.1.8) and in sample spectra section (3.5) clicking "download" button (E.12, otherwise used to obtain new sample spectra). After that breakdown of carrier spacing with highest specificity is displayed in "Sample spectra statistics" group. Carrier spacings displayed may be excluded by spacing ranges to mitigate false jammer detections.



- Usually jammers cover broad frequency ranges, sometimes in excess of 100 MHz. Therefore, depending on bandwidth of jammer, signal will be stored in 100 MHz, 250 MHz or 500MHz span, resolution will be reduced to 400 kHz, 1 MHz or 2 MHz respectively. However, if waterfall spectrogram storage is enabled, spectrum in full resolution will be available through waterfall spectrogram.

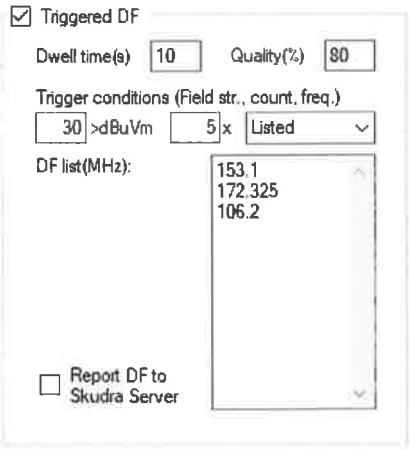
5.3 Direction finding

Skudra Patrol provides functionality to trigger direction finding (DF) on detected signals. Ranges panel (4.1.7) provides DF triggering configuration for each measurement range. Direction finding results for each frequency channel are displayed on map (4.1.16) and stored in measurement results file.

Intended objectives of DF triggering to is provide quality directions to the source of detected signal, to reasonably share DF time between continuous and infrequent signals, and to reserve DF time for most important detections. Objectives are realised through following functions:

- Direction finding is triggered by signal detection event. Considering that direction finding is more time-consuming operation than spectrum scanning in most cases que of direction finding requests is created. Each DF request has distinct frequency and measurement range combination;
- To limit time delay between signal detection and direction finding, DF request que is clipped when the request is older than twice the scan time of all measurement ranges;

- Direction finding request que is prioritised by more seldom requests, so that infrequent signals and continuous signals have equal chance of being DF-ied;



- Receiver's DF measurement time (averaging time) always is set 100 ms. If triggered DF dwell time is set to 0 seconds, direction received from DF equipment is returned as result of request. If dwell time is set longer that 0 seconds, most probable value of direction results received from DF equipment during dwell time is returned. When calculating most probable direction, it is taken into consideration that signals during the dwell time may be received from several sources;
- DF results with quality lower that set limit in text box "Quality(%)" are not taken into account, when calculation most probable direction during dwell time. If no result from DF equipment above quality squelch is received, DF request is returned as unsuccessful e.g. no direction is stored;
- To ensure reliable direction finding DF bandwidth is automatically switched between 7,5 kHz, 24 kHz, 250 kHz and 2MHz depending on bandwidth of detected signal;
- Trigger field strength condition determines that DF request is made only for signals above set field strength threshold. This condition is usable to ensure that DF request are made only for signals with field strength sufficient for direction finding, or to limit direction to signals of highest field strength;
- Count of signals trigger condition limits the number times signal has to be detected for DF request to be made. Functionality can be used to exclude from direction finding signals with low probability of repeating;
- Frequency trigger condition can be configured whether all signals ("Any" satisfying other conditions are DF-ied, or only those without licence assignments, or only those with channel frequencies listed in text box "DF list (MHz)";

5.4 Direction finding: Report DF results to Skudra Server

If accordingly configured (4.3.5) Skudra Patrol reports direction finding results realtime to Skudra Server. For further storage, realtime display and triangulation. Following data is sent to Skudra server:

- Frequency channel;
- Most probable direction to signal source, obtained according to 5.3;
- Timestamp of DF;
- All DF results, obtained during the dwell time period;
- Coordinates of direction finder during the dwell time, if compass functionality in settings panel (4.2.2) is enabled. Otherwise coordinates set in settings panel (4.2.4) are sent;
- If direction finding is unsuccessful, field strength of signal associated with the coordinates is still sent to Skudra Server.

5.5 The storage of signals detected

All detected signals are aggregated by frequency channel to minimise storage space and processing power, as well as efficient access to monitoring results.

- All signals found in any single frequency channel are stored in one array (cumulated spectrum) creating a matrix, the elements of the matrix showing how often the index value (frequency and level) is detected;
- Every time when, monitoring a frequency channel, a signal is detected, it's level is stored. Information on the number of scans when no signal was detected is also stored;
- The average correlation value of all signal detection events in a channel is stored;
- Each scan's start time is stored. This value corresponds to signal detection time and is referenced to each detection event
- The sample spectra use statistics are stored - how often each sample spectrum was detected as most appropriate;
- Distribution of triggered DF results (if available) is stored.

5.6 The establishment of signal parameters

A single value for each parameter is obtained for each frequency channel.

- The field strength is calculated as the maximum electromagnetic field strength dBµV/m, exceeded in 2 % of signal detection cases. The intensity is calculated adding to the signal level the earlier set antenna factor (C.8) and cable attennuation (C.9);

- The field strength for each signal detection case is calculated as the spectrum maximum value in the signal bandwidth (the FFT resolution for 100 kHz channel step FFT is 2,5 kHz, for 6,25 kHz step - 125Hz, *Blackman* windowing);
- Bandwidth - The detected signal maximum bandwith exceeded in 5 % cases of signal detection at a signal to noise ratio at least 30 dB. If the signal to noise ratio never has exceeded 30 dB, the presented bandwidth is calculated as the maximum unique bandwidth level pairs exceeded in 5 % of detected signals;
- The signal bandwidth in each detection event is determined by the 1% B (99% power in bandwidth) method if signal to noise ratio at least 30 dB, and by the mid-level between the maximum level and noise level if the signal to noise ratio is less than 30 dB;
- The signal activity percentage is calculated as a percentage of signals detected over the total number of scans.

6 File formats

6.1.1 The file format of the antenna factor and cable attenuation

- The antenna factor and cable attenuation is delivered to the software by an UTF-8 text file (**.txt*). Each row of the file comprises pairs of frequencies in MHz and attenuation coefficient in dB separated by the tabulation symbol (TAB). The decimal sign is point (.).
- The antenna factor and cable attenuation should be delivered with a positive sign enabling the calculation of the resulting field intensity by summing up the received signal level, the antenna factor and the cable attenuation.

6.1.2 The file format of the licence database

- The antenna factor and cable attenuation is delivered to the software by an UTF-8 text file (**.txt*).
- Each file row comprises 20 tabulation symbol seperated (TAB) values:
    1. Reserved for future use
    2. Frequency (MHz)
    3. User
    4. Reserved for future use
    5. Reserved for future use
    6. Comment
    7. Effective radiated power (dBd)
    8. Reserved for future use
    9. Reserved for future use
    10. Antena height over ground (m)

11. Class of emission
12. Reserved for future use
13. licence identificator
14. Reserved for future use
15. Decimal coordinate (E)
16. Decimal coordinate (N)
17. Reserved for future use
18. Reserved for future use
19. Reserved for future use
20. Reserved for future use

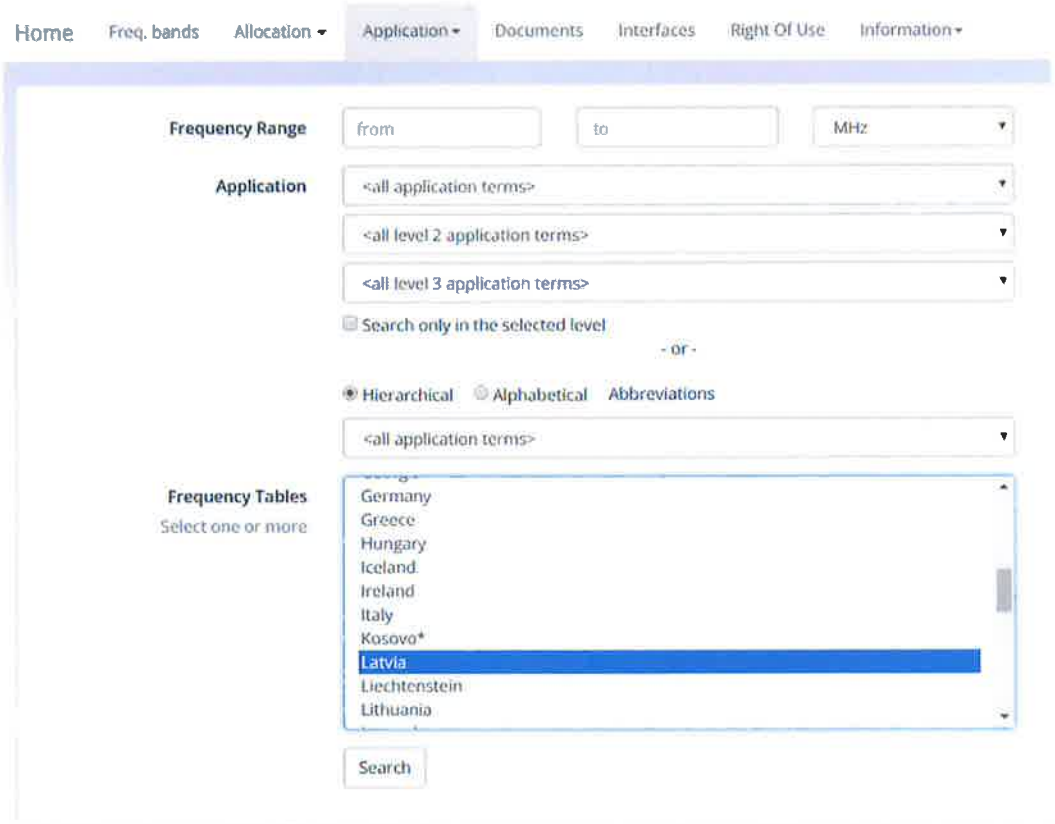
- All values are given in single quotes as '*value*'. The decimal sign is point (.).

6.1.3 The format of the specific frequency file

- The specific frequencies are delivered to the software by an UTF-8 text file (**.txt*). Each file line contains a frequency in Hz, the frequency user and class of emission separated by the tabulation symbol (TAB).
- The frequency may only be a positive integer. The class of emission is not mandatory.

6.1.4 The file of radiofrequency applications

- The radiofrequency application information is delivered by a "csv" format file, that should be downloaded from the web-site www.efis.dk , choosing necessary country in the tab "*Application*"



and choosing to save the results as a “csv” file.

VAS
Elektroniskie
sakari

SKUDRA SERVER v.5.3.2 user guide

Riga, 2022

CONTENTS

1 Introduction

Skudra Server software module purpose is to provide radio control monitoring function operators with frequency user information, current radio monitoring information and historical radio monitoring information in the most effective way.

The system provides an opportunity to visualize and analyze monitoring data, thus helping to perform more efficient monitoring and control of the radio frequency spectrum. The system also collects information about the hardware and equipment used in monitoring and other measurements, their technical data and other important information. The Skudra Server application is regularly updated and renewed, so there may be situations when one of the described functionalities works partially or is temporarily unavailable.

2 started with SKUDRA Server

You can work with the app using one of the web browsers (e.g. *Google Chrome* or *Microsoft Edge*). You can activate the home screen in:

1. Type in the address line of the browser: ***https://skudra/***

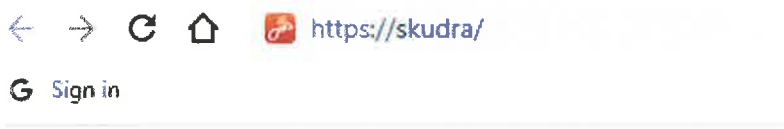


fig. 2. 1Command line entry

By choosing the access path described in the first two points, in the next step we get to the login screen, where the user name and password must be entered.

fig. 2. 2Login screen

In order for a VASES employee to become an authorized user of Skudra Server , it is necessary to contact the main specialist of RMD, who will assign the user an account.

After successful authorization, a start screen appears with several sections, the actions of which are described in the following points (content points 3-9).

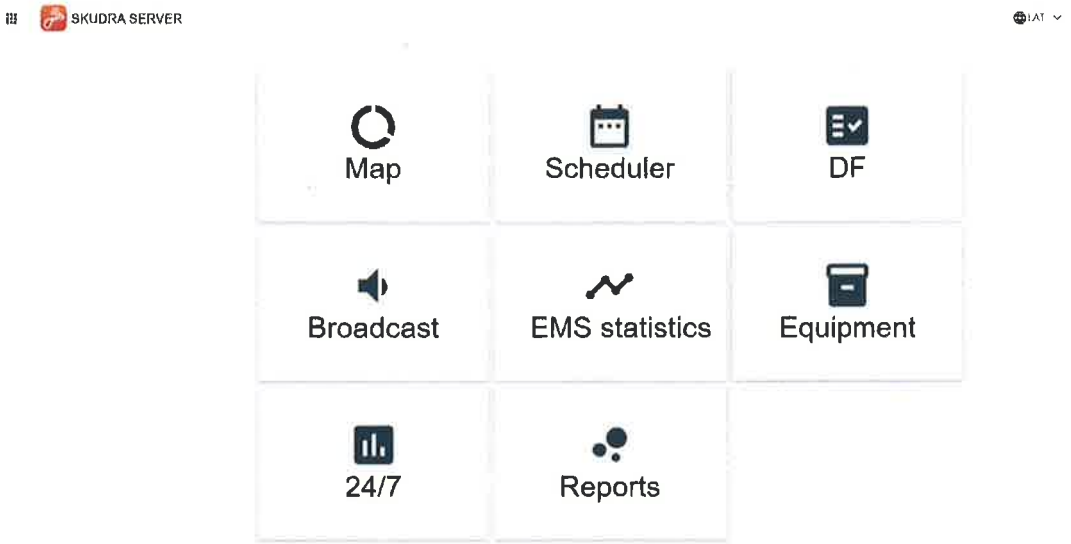


fig. 2. 3SKUDRA Server home screen with menus

3 Map

The "Map" section shows current and historical information about all individual frequencies registered during monitoring with the SKUDRA Patrol program from fixed monitoring points or mobile monitoring. Both registered users and NRS.

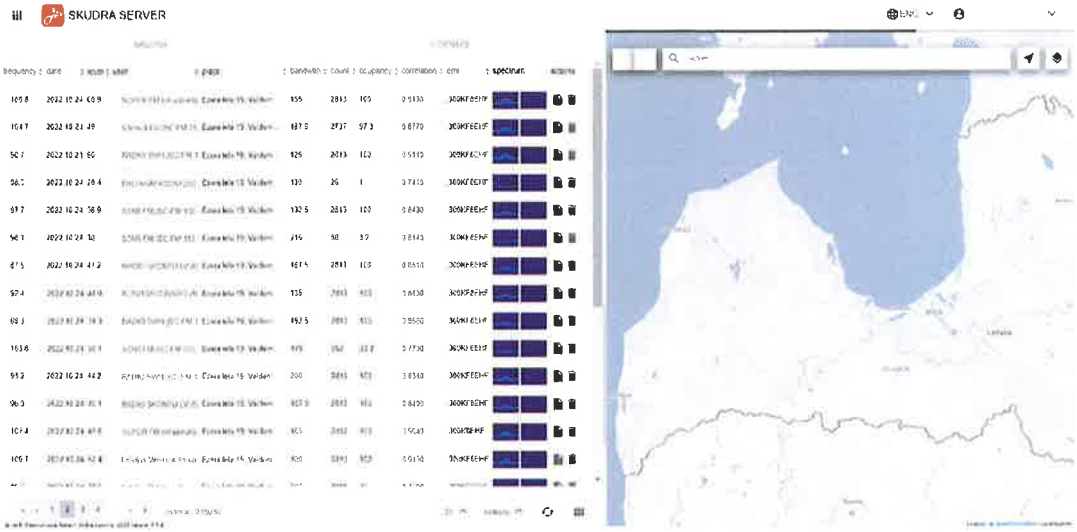


fig. 3. 1Monitoring data and map

The amount of data in the columns can be changed by zooming in or out of the map on the right side of the screen. This can be done both by scrolling the mouse wheel, placing the cursor over the map beforehand, and also by using the + and – (to scale) buttons in the left, upper corner of the map. When you zoom in on Riga, the columns will show only the information registered in Riga's fixed RMP, or mobile monitoring data, if they were made within the zoomed-in map. Likewise in other regions.

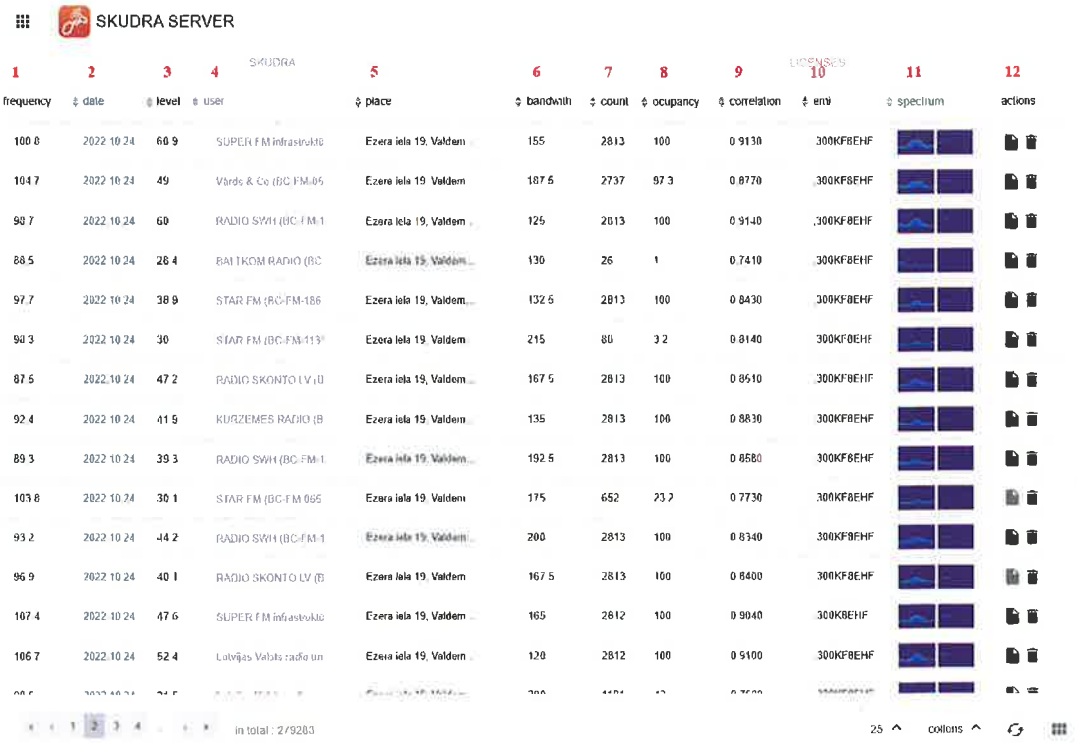


fig. 3. 2Data arrangement in columns

The left side of the screen with the data arranged in columns. Data in columns can be sorted in ascending or descending order by clicking on the column headings.

The columns show the following information:

1. Frequency, the use of which is fixed during monitoring.
2. Start date of the monitoring during which the frequency is fixed.
3. Signal level dBµV /m.
4. User. The data in this column are active links to user permission information (see 3.3). It can also be as NRS without additional data.

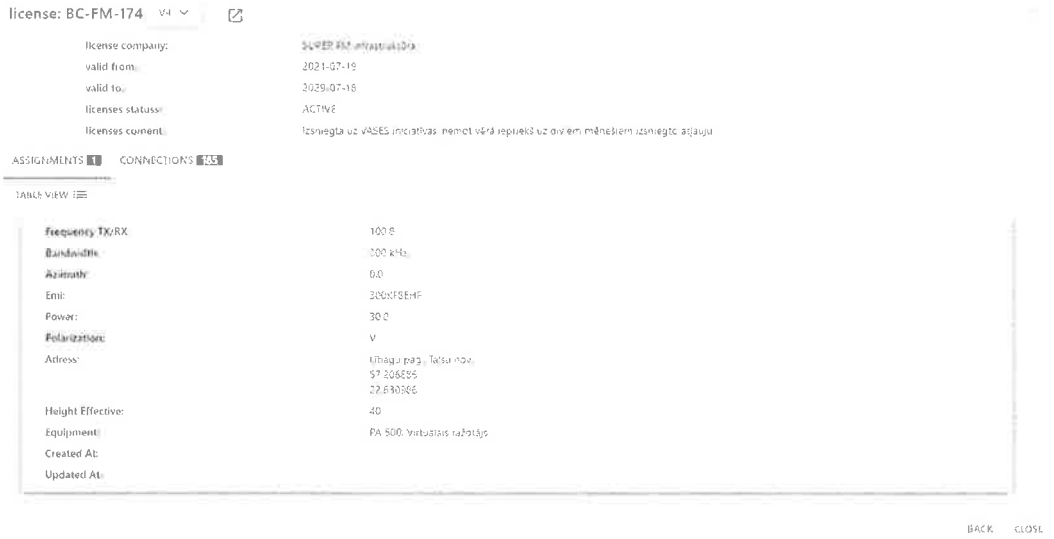


fig. 3. 3User authorization data

5. The fixed monitoring point or place from which the monitoring was carried out.
6. Frequency average bandwidth.
7. The number of times the frequency was fixed during monitoring.
8. Frequency occupancy in percent of the total monitoring time.
9. The correlation threshold indicates how reliably the frequency corresponds to a sample spectrum . The higher, the more likely.
10. Class of electromagnetic radiation.
11. Accumulated spectrum and bandwidth images and occupancy graph. The information in this column also contains active links (see Fig. 3.4).

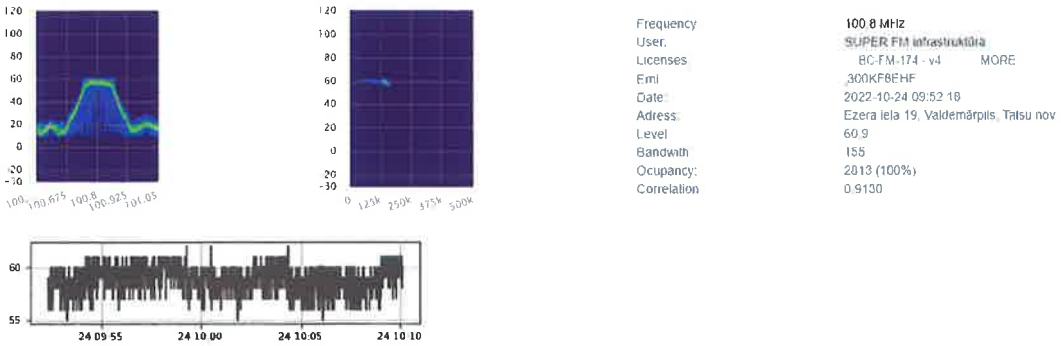


fig. 3. 4Accumulated spectrum, bandwidth and occupancy schedule

12. You can get more detailed information about the measurement by clicking on the " go to event " icon (see fig . 3.5). And it is also possible to correct or delete the measurement.

fig. 3. 5Detailed information about the measurement

The number of columns can be changed by pressing the "Columns" button on the bottom edge and selecting the required number of columns in the additional window .

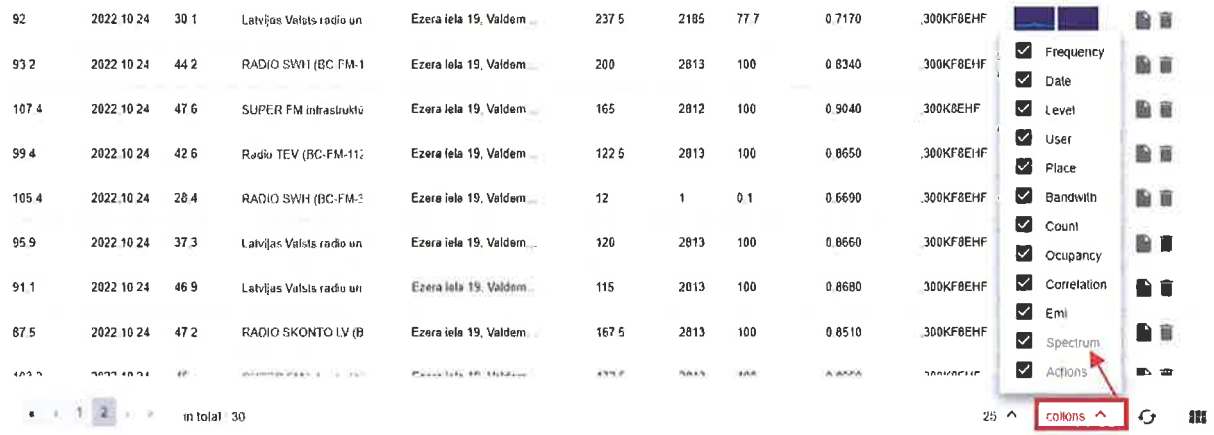


fig. 3. 6Changing the number of columns

The display of information on the side of the columns can be changed by clicking on the "Grid display" button at the bottom of the page

fig. 3. 7Grid view button

Now, on the left side of the screen, instead of columns, pictures of the spectrum accumulated in the measurements for each frequency are displayed.

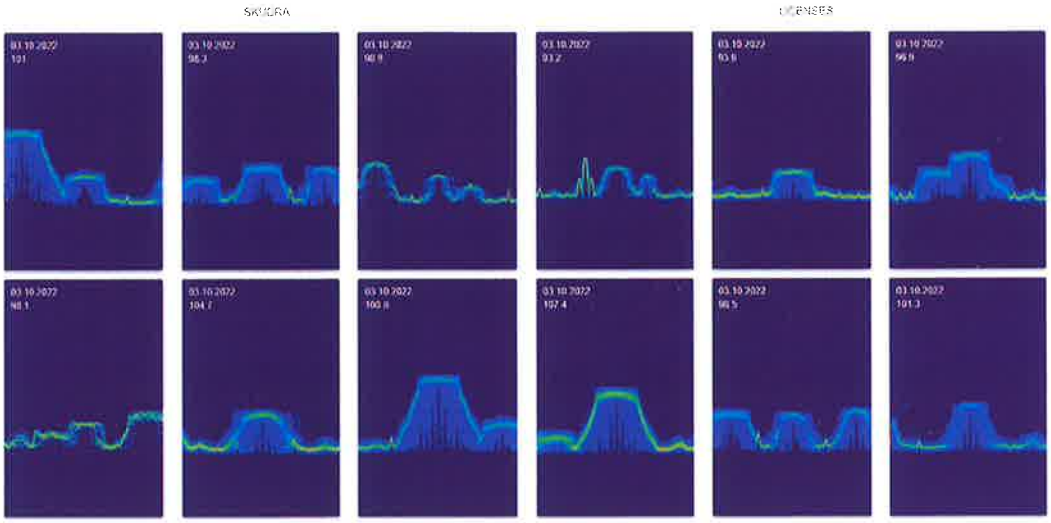


fig. 3. 8Grid representation

Details can be obtained by clicking on any of the pictures.

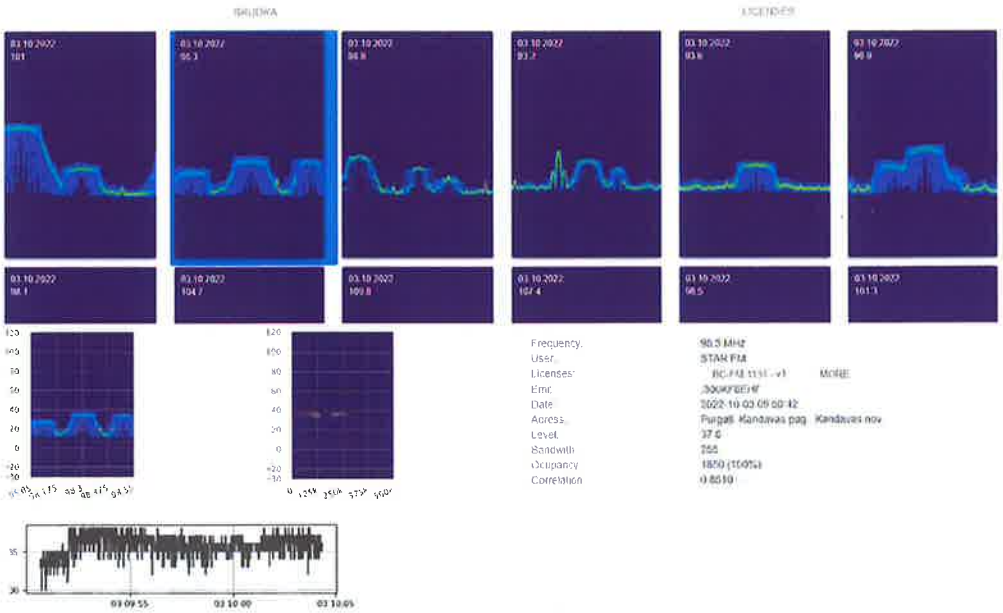


fig. 3. 9Detailing in grid representation

In the upper right corner of the screen, above the map, there is a search menu window.

fig. 3. 10Location of the search window

When you left click mouse on it, it scrolls down, and you can enter search/filter parameters (frequency, user, level) to select information.

fig. 3. 11Search window

Searching information - frequency, level, date can be entered in the fields with a limitation from – to, thus expanding the search range. After entering the data in the search fields, the filtered information appears in the columns on the left side of the screen.

Next to the search window are two square buttons :

1. DF (bearing) spread button.
2. Map layout button.

att. 3.12 Pelengācijas un kartes izklājuma pogas

By pressing the DF layout button, an additional window opens , in which, by default, the names of Riga monitoring points are displayed:

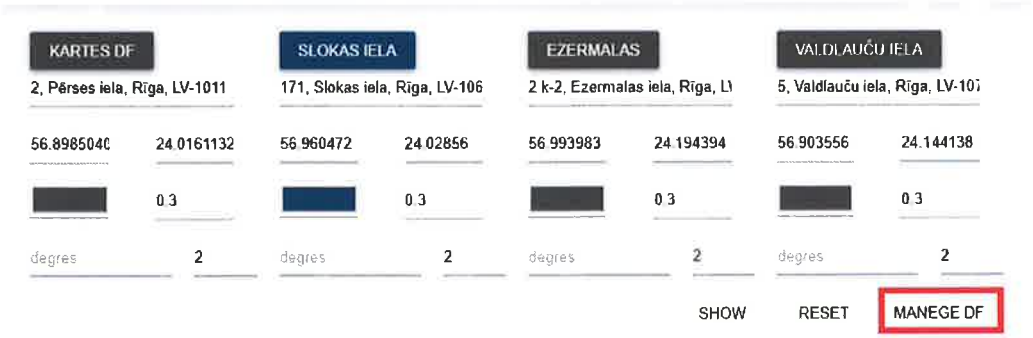


fig. 3. 13DF pop-up window

To add other Latvian points, press "MANAGE DF":

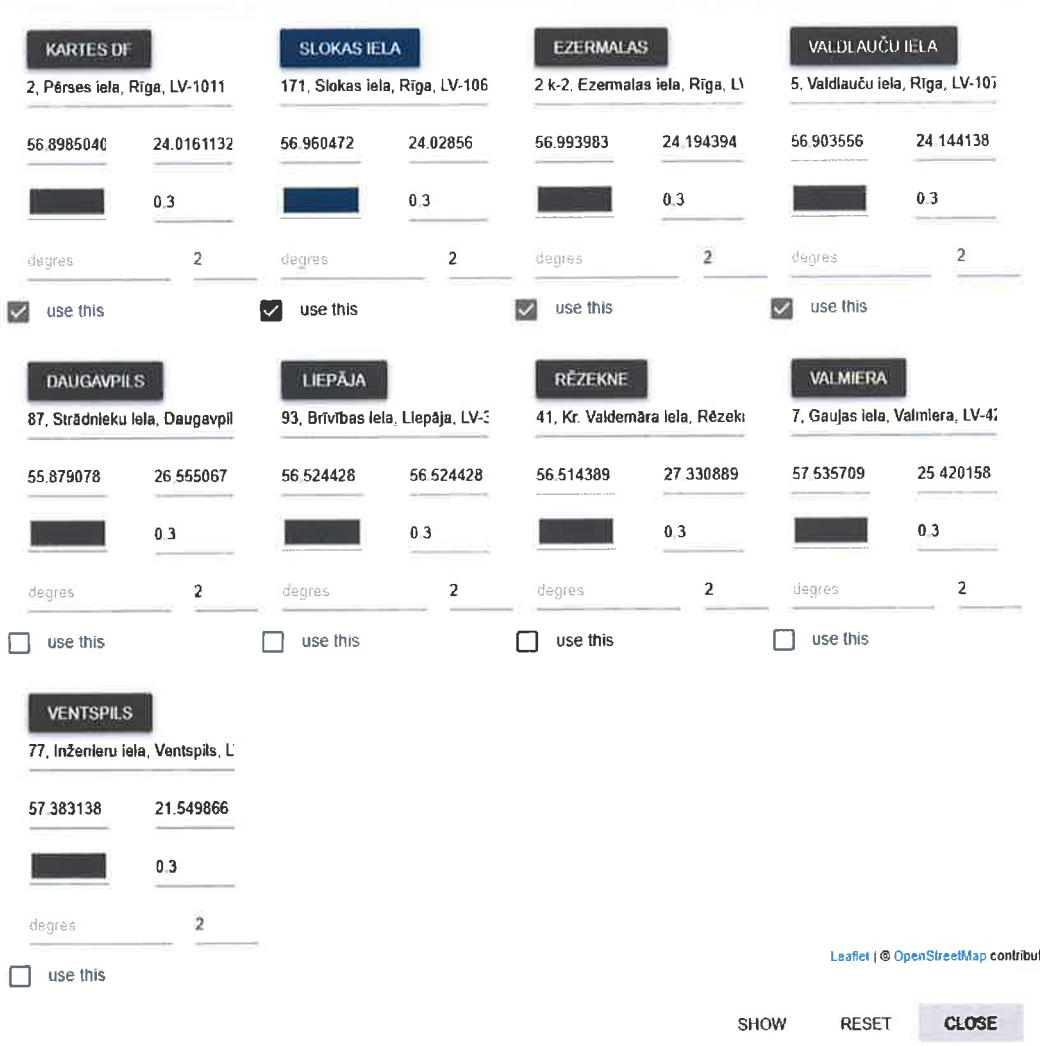


fig. 3. 14DF Management window

Now you can add or remove the points needed for data analysis in the table. Instead of the fixed points, you can also record longitude and latitude degrees, so you can see the bearing picture from any other point in Latvia where monitoring with direction determination has been carried out. It is also possible to change the color of each dot's outline:

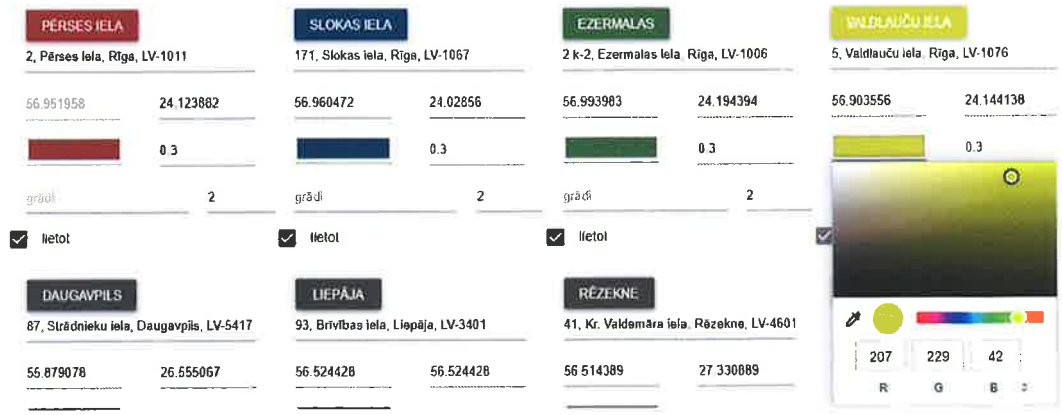


fig. 3. 15Options for changing the colors of the directional beams

In the fields "Degrees" write the results of measurements, in the next cell the tolerance +/-. By default, the tolerance is +/- 2. In the example picture, the map of surveying results from all Riga monitoring points. It can be both zoomed in and out.

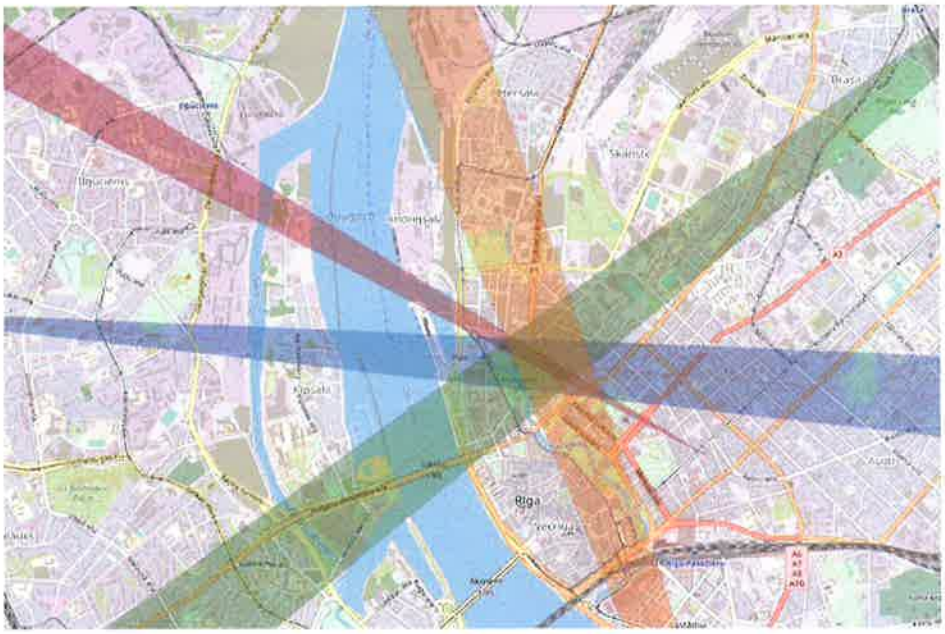


fig. 3. 16Map of bearing

The map layout button allows you to select map layers and overlays:

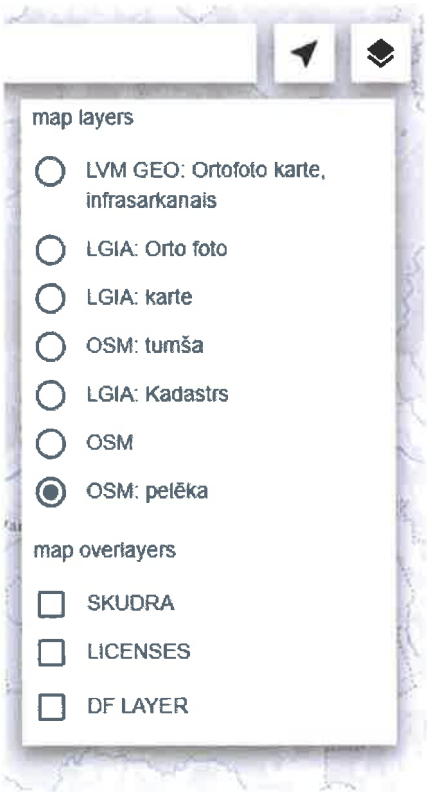


fig. 3. 17Map layout options

To return to the initial view, the "CLEAR" and "CLOSE" buttons must be pressed on the DF layout screen.

fig. 3. 18How to return to the home screen

4 24/7

the "24/7" section of Skudra Server , you can view the measurements made during monitoring with Skudra Patrol within the limits of whole ranges together with the spectrum diagram of the waterfall.

When opening the section , columns with range monitoring diets are visible on the left, and a map that can be zoomed in or out on the right. Highlighting one of the lines on the left side at the bottom of the screen below the map, a spectrum diagram of the waterfall appears, which can also be zoomed in or out:

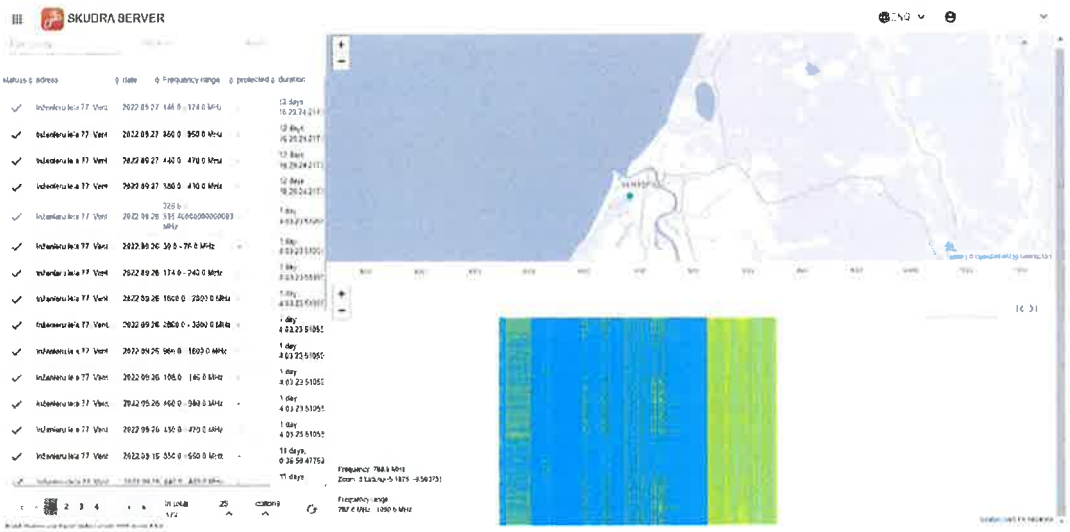


fig. 4. 1Range monitoring data, map and waterfall spectrogram

In the data columns, you can see information about the point from which the measurements were made. Frequency range and monitoring date and duration.

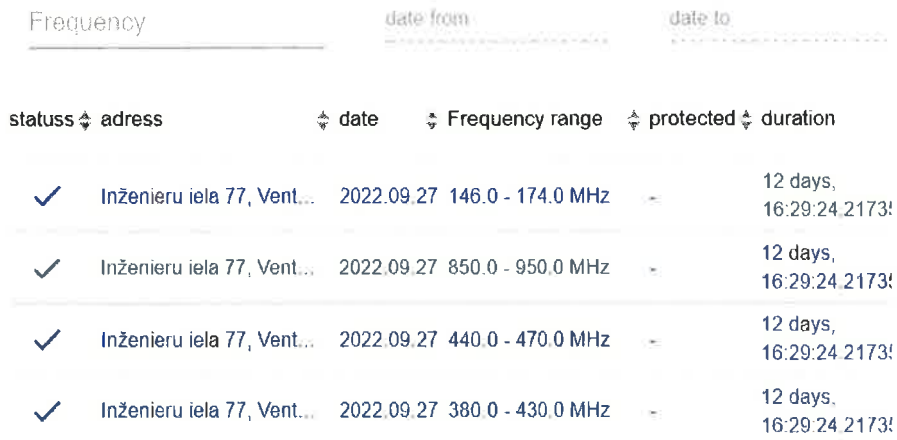


fig. 4. 2Range monitoring detail

Dragging the mouse cursor over the spectrogram of the waterfall changes the information about the frequency and signal level in the field next to the spectrogram.

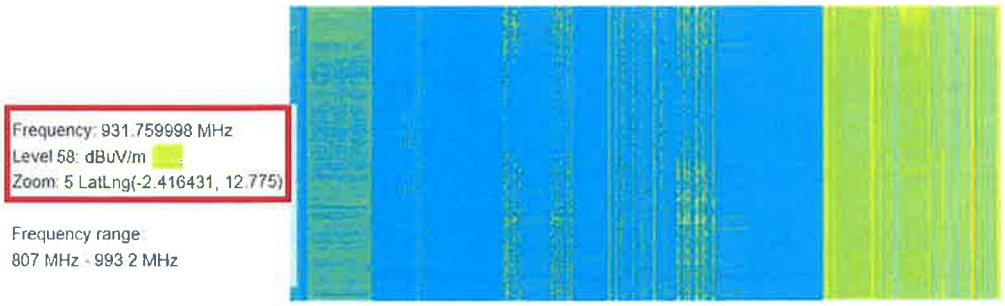


fig. 4. 3Waterfall spectrogram information

5 Broadcasting

Monitoring of broadcast ranges is performed at fixed points with the help of frequency spectrum analyzer ETL and the results are automatically saved on the Skudra Server website after the end of the measurements. With ETL, measurements of broadcasting stations and DVBT signal levels, scanning of broadcasting and DVBT ranges, as well as deviations and MPX measurements of broadcasting stations are performed. You can get to the broadcast measurement results directly from the Skudra Server environment by clicking on the "Broadcast" icon,

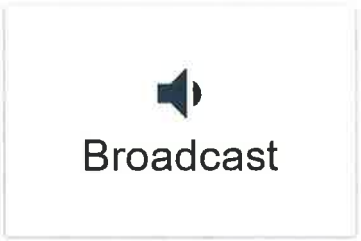


fig. 5. 1Broadcast icon SKUDRA Server

When opening one of the menus, we arrive at a page with signal level measurements of broadcast stations (dBμV /m).

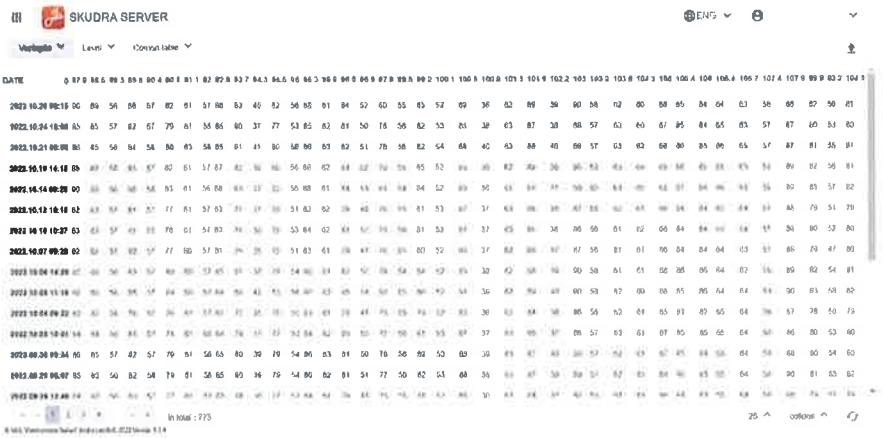


fig. 5. 2Measurements of broadcast station levels

In the left, upper corner of the screen, you can choose which monitoring point's measurements to view.

fig. 5. 3Selection of monitoring point

Next to that, you can choose what kind of measurements you want to review (level, direction, deviation, scan, DVB-T scan, DVB-T level or MPX).

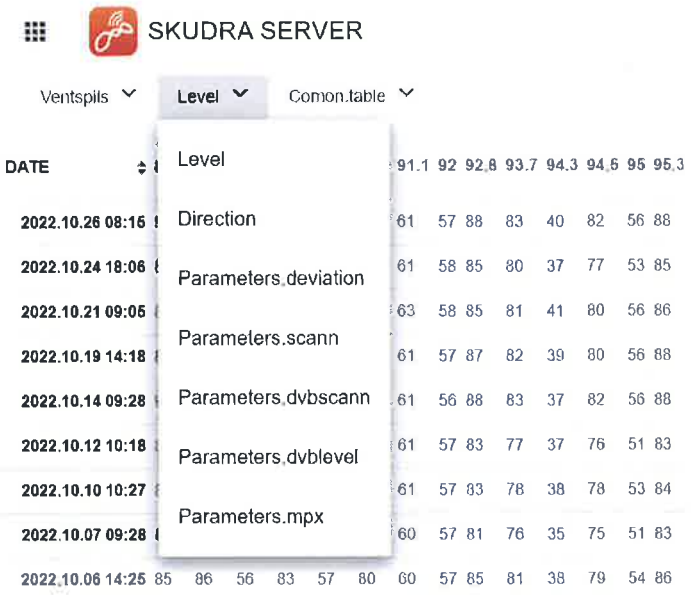


fig. 5. 4Choice of measurement type

For measurements, with some exceptions, it is possible to choose the arrangement of the data in a table or graphical representation.

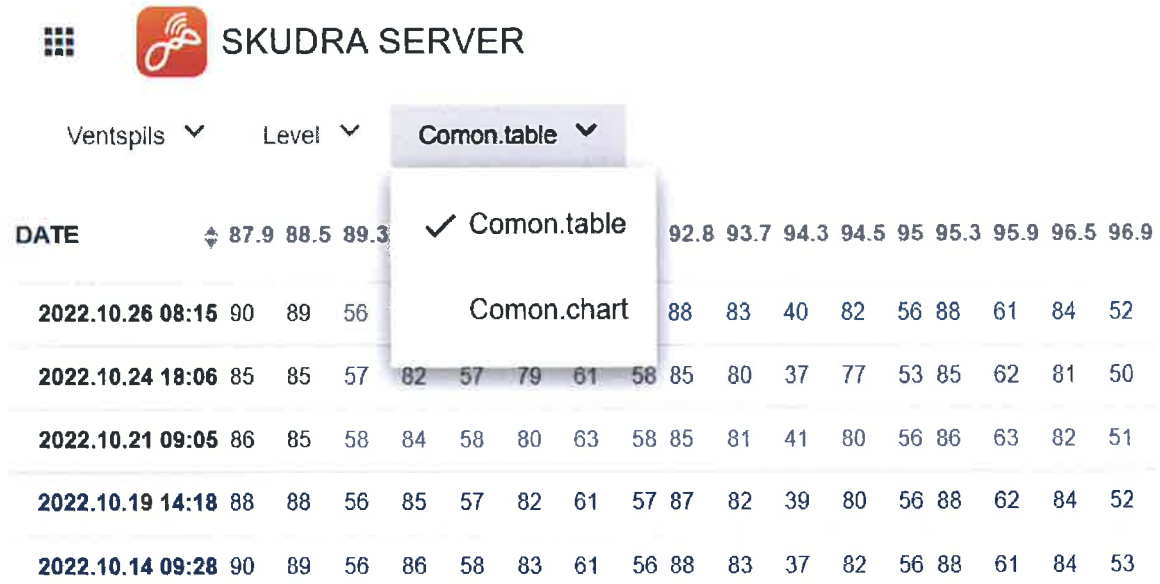


fig. 5. 5Arrangement of data in a table

Only graphical display is for broadcast scan and DVB-T scan measurements. Below is the broadcast scan schedule. When you move the cursor over the circles of the graph, you can see information about the level at different points.

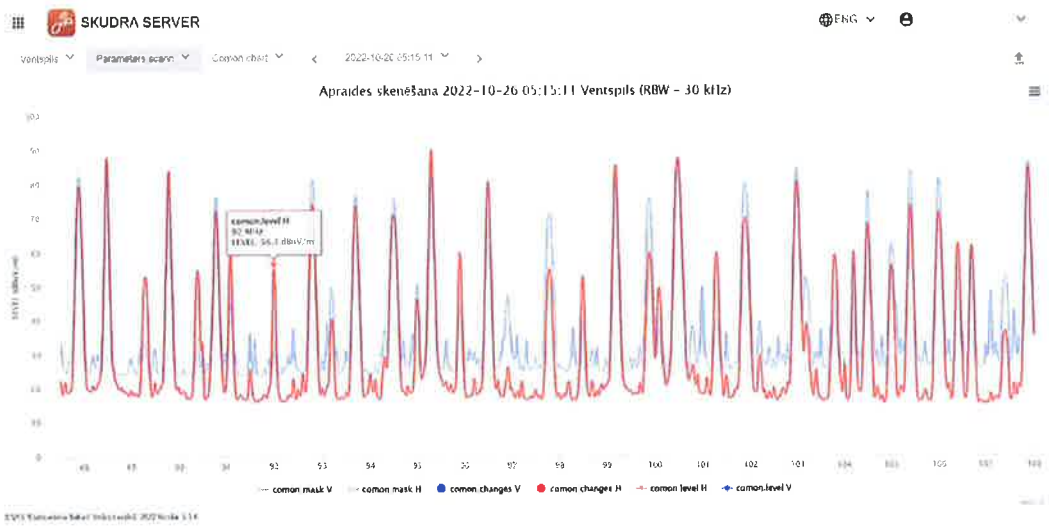


fig. 5. 6Broadcast station scanning schedule

DVB-T broadcast scan schedule.

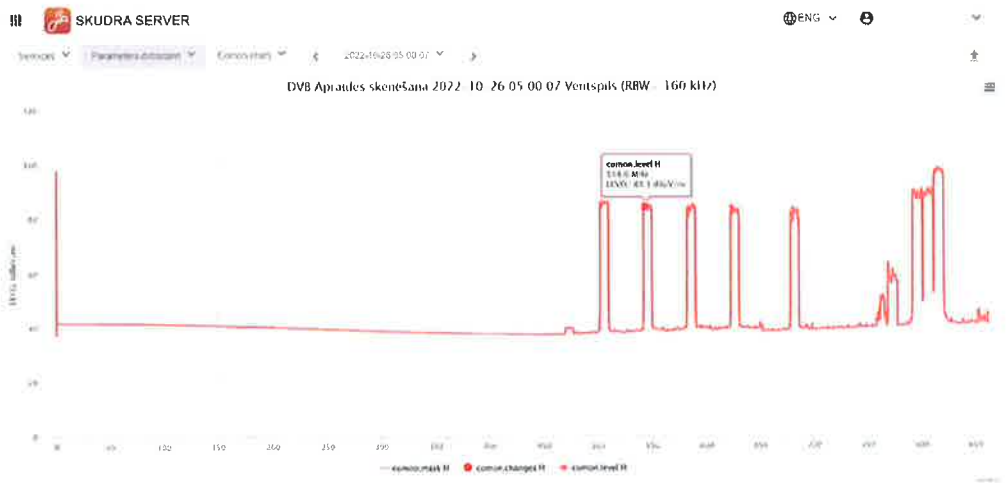


fig. 5. 7Scan schedule for DVB-T stations

In the graphs of the levels of broadcasting stations, it is possible to view the graphic changes of the levels of individual stations over a longer period of time. Before that, you must select a specific frequency in the field next to "Schedule". Also in this graph, by following the line with the cursor, it is possible to see the values at different points of the circle.

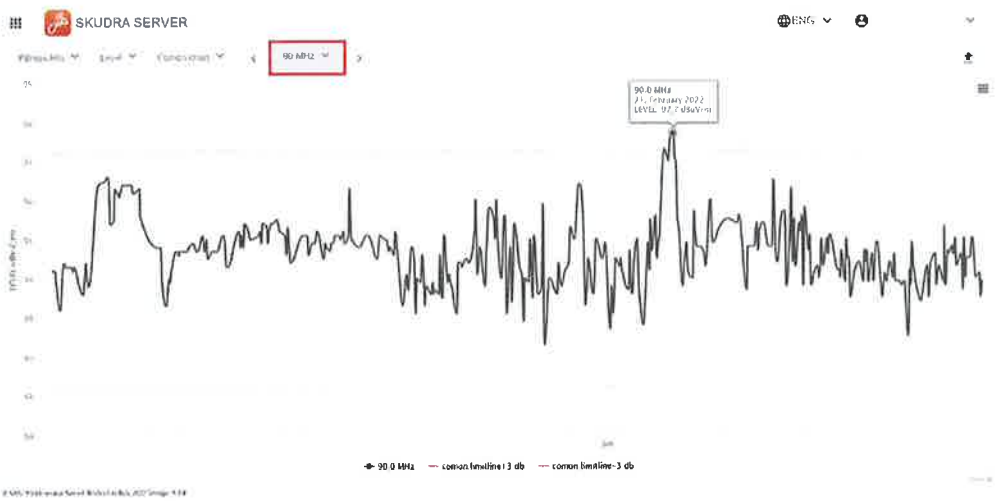


fig. 5. 8A schedule of individual broadcast station level changes during the period

In the table view, it is possible to change the number of columns on the screen, excluding frequencies from the list.

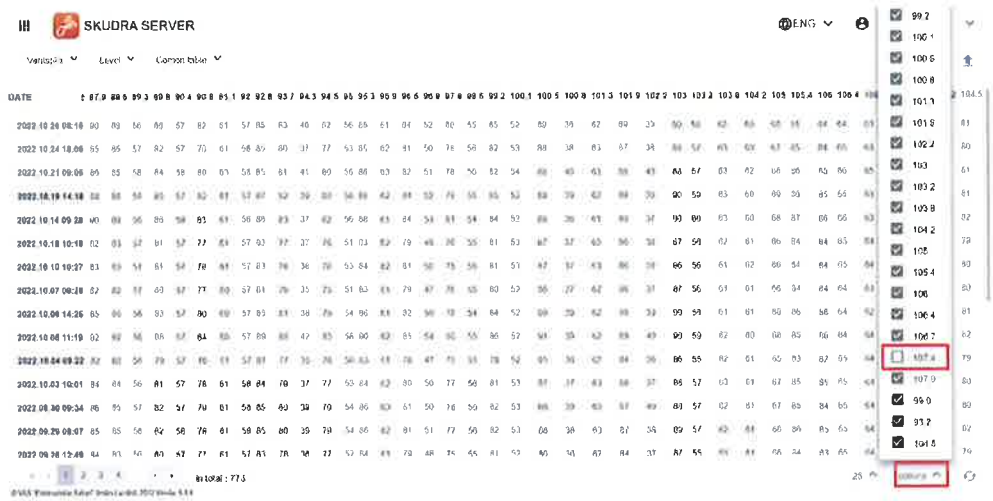


fig. 5. 9Changing the number of columns in a table

Location directions of broadcasting stations at monitoring points are made with other hardware (not ETL) and are described in the Argus software, as defined monitoring measurements. After they are done, special csv format files are prepared at the points and imported into the Skudra Server environment. This is to be done by clicking on the "Add new measurement" button in the upper right corner of the "Broadcast" page.

fig. 5. 10Start of loading of broadcast station direction measurement files

You have to choose the location of the file and select the import option.

fig. 5. 11File loading process

N/A.

6 DF (Direct Finding / direction measurements)

In section DF, are stored direction measurements made at monitoring points with the Skudra Patrol software, with a condition that the operation of Skudra Patrol with direction finding equipment is possible at monitoring point and the setting to send data to Skudra Server is activated.

The DF section is activated by entering the Skudra Server website and clicking on the corresponding "DF" icon.

fig. 6. 1Directional measurement icon in Skudra Server

A window appears with the ID numbers, locations, times and ranges of the saved measurements.

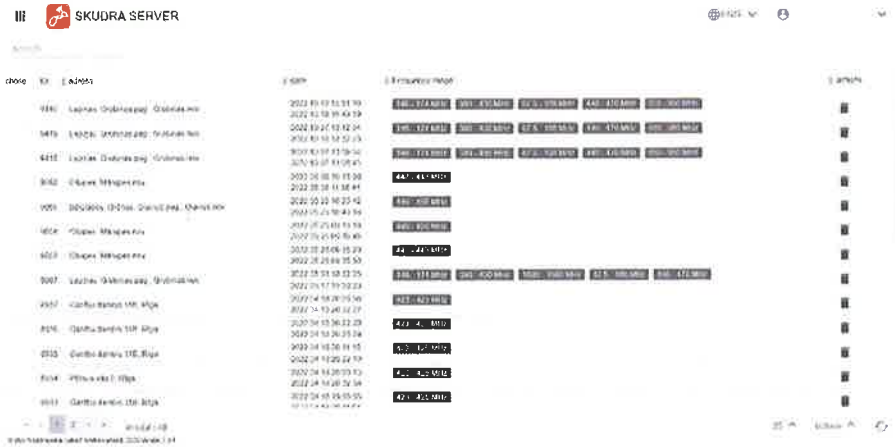


fig. 6. 2Directional measurement data table

In the next step, highlight the required line and press the "CHOSE" button on the upper left corner of the screen.

fig. 6. 3A path to directional measurement detail

Details of direction finding measurement and map with frequency direction, if frequency direction finding was successful appears, which you can zoom in and zoom out.

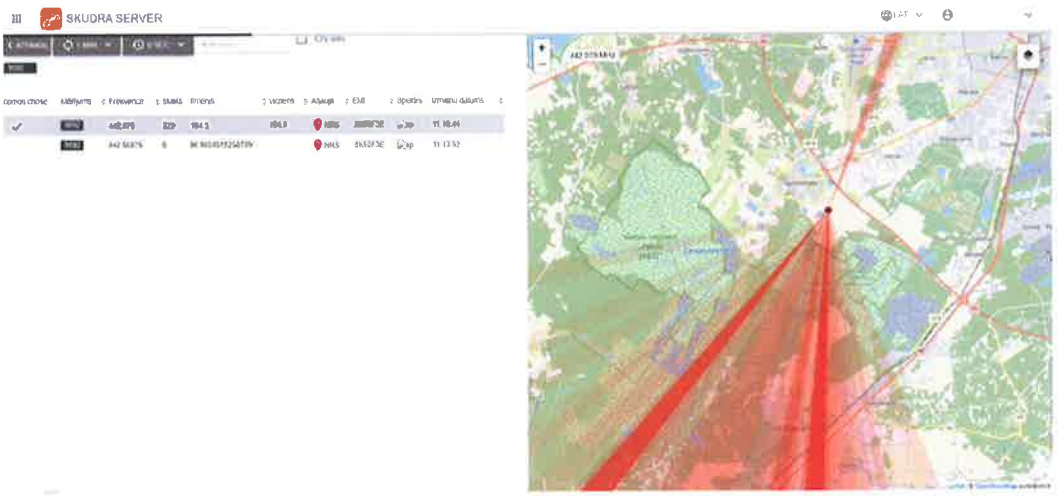


fig. 6. 4Detailing of direction measurements with a survey map

You can return to the list using the "BACK" button

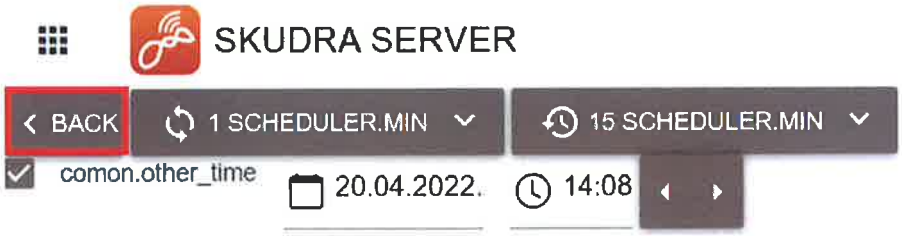


fig. 6. 5Return to the DF home screen

7 Equipment

The Equipment section of the system gathers information about the equipment at the disposal of the monitoring department, which is used in the work process. Here you can find information about equipment location and calibration dates, as well as equipment instructions and calibration certificates, etc.

The Equipment section of the System is available to all users registered in the System in reading mode.

You can get to the equipment registry directly from the SKUDRA Server environment by clicking on the " Equipment" icon,

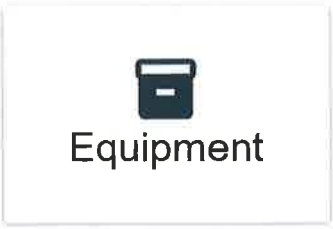


fig. 7. 1Equipment registry icon for SKUDRA Server

Opening one of the menus, we get to the list of equipment. The columns contain information about inventory number, name, type, material responsible person, user, location, calibration data and technical documentation or user manual.

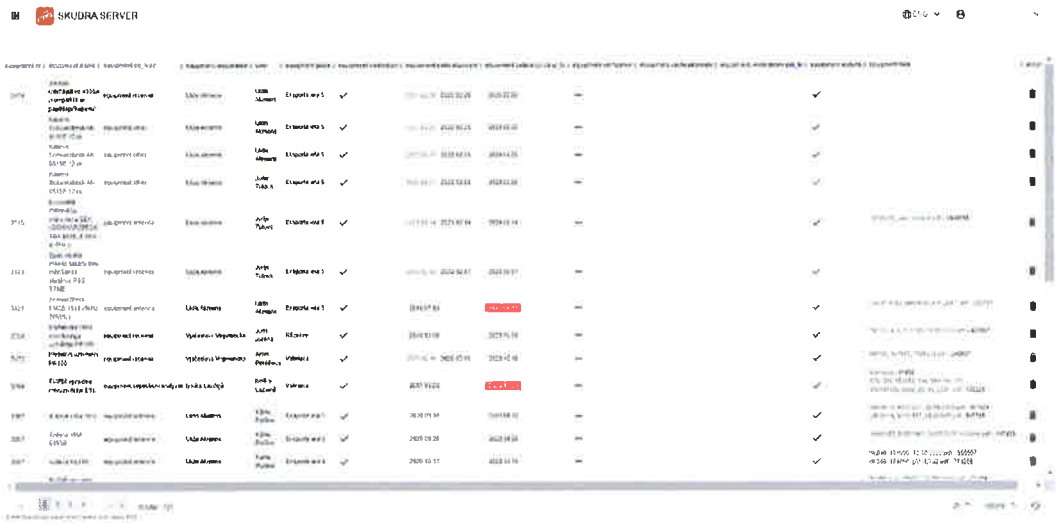


fig. 7. 2Equipment Registry Master Table

By highlighting one of the lines, a details with all the above information and a link to the documentation can be downloaded for familiarization purposes.

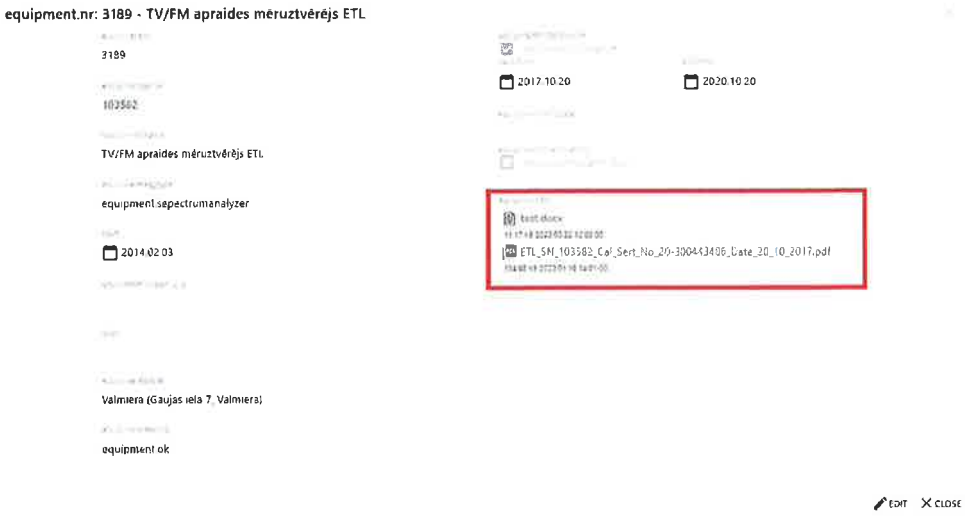


fig. 7. 3Single line detailing

The required number of columns can be turned on and off by pressing the "COLUMNS" menu in the lower right corner of the page.

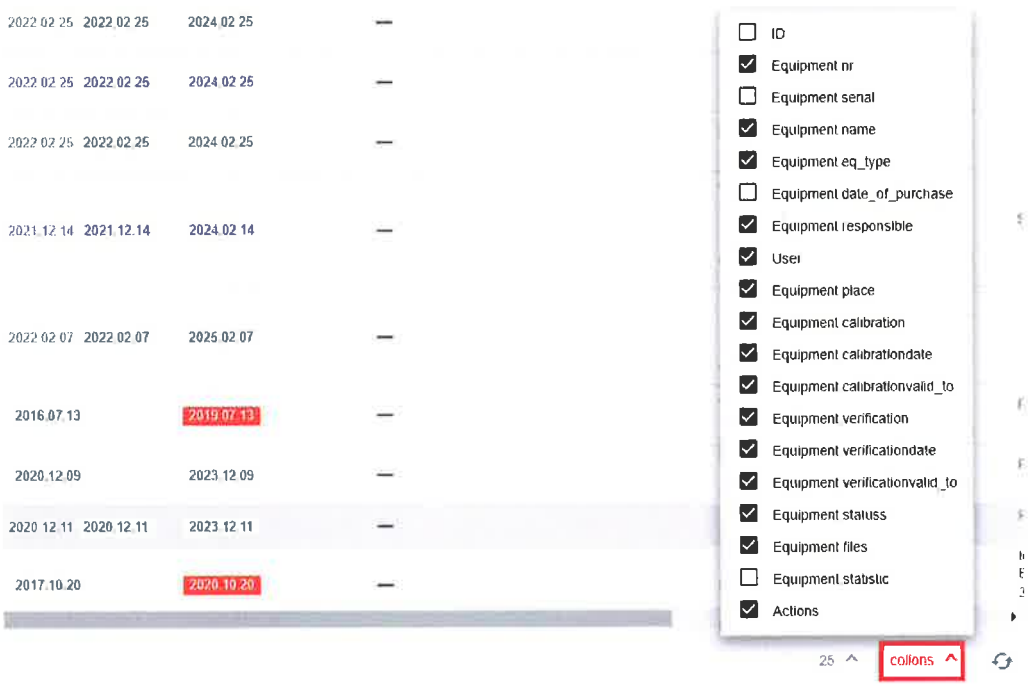


fig. 7. 4Option to change the number of columns

Adding new hardware is described in the RUNIS user manual.

8 Scheduler

This module is intended for Skudra Patrol measurement task planning from on user interface to all registered Skudra Patrol instances.

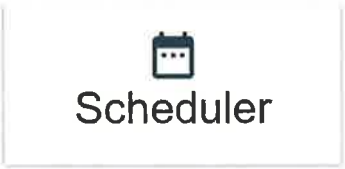


fig. 8-1 Scheduler icon SKUDRA Server

Scheduler consist on 3 sections, where each section main functionality will be described in this chapter.

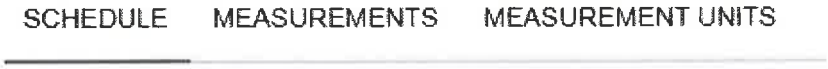


fig. 8-2 Scheduler sections

8.1 Measurement units

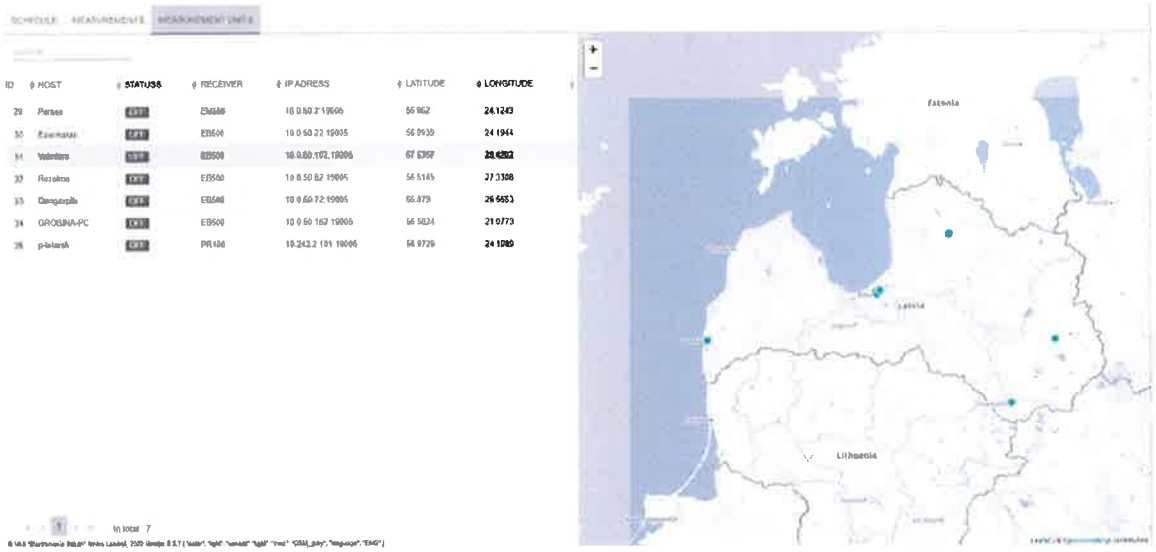


fig. 8-3 8.1 Measurement unit section

In this section user can see all registered Skudra Patrol instances, their parameters and location, in table and map view. Each instance has fallowing parameters:

- Host – PC host name where is instaled Skudra Patrol;
- Status – status of Skudra Patrol instance, options are OFF/ON;
- Receiver – Skudra Patrol instance used receiver;
- IP address – ip adress to Skudra Patrol instancel;
- Latitude – Skudra patrol instance locations latititude (in WGS84);
- Longitude – Skudra patrol instance locations longitude (in WGS84);

Each Skudra Patrol instance have unique record in database, if in Skudra Patrol is changed on of listed parameter (Host, Receiver, IP address) new instance record will be created. When Skudra Patrol instance is set to remote, status update is send to server.

8.2 Measurement

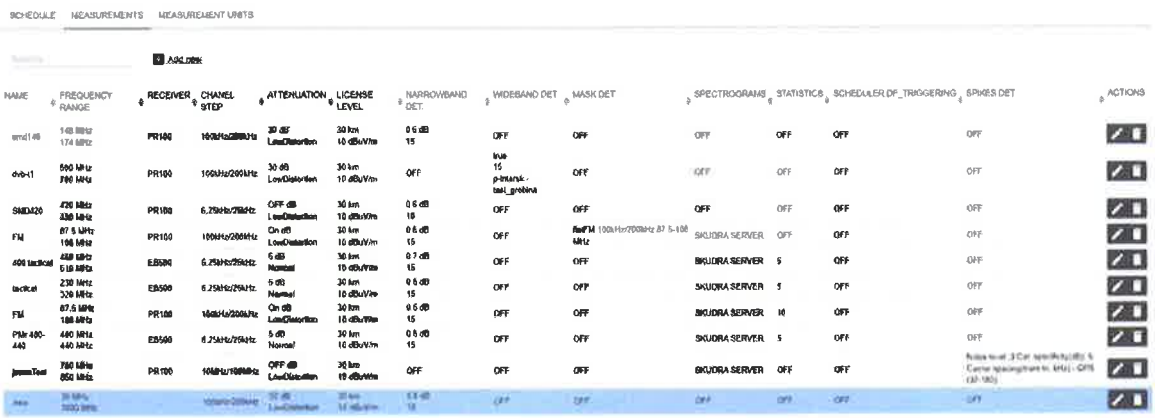


fig. 8-4 Measurement section

Measurement section consist of user defined measurement tasks. Users with corresponding rights can add, change and remove measurement tasks. It also provides functionality to search

defined tasks, it is possible to search by – Name, frequency range start, stop frequency, receiver name.

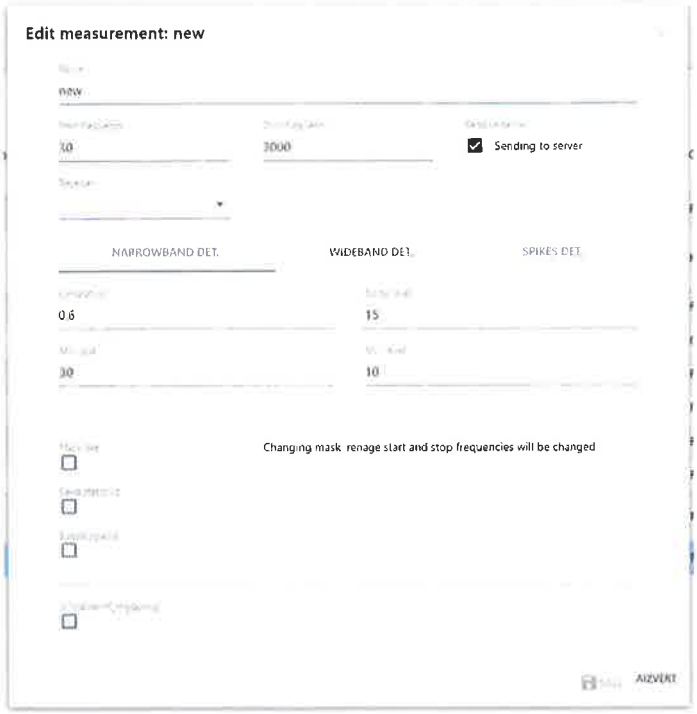


fig. 8-5 Measurement edit window

Editing Skudra Patrol measurement task will show up form for creating and editing tasks, task form corresponds to all the same range definition form in Skudra Patrol, for more details see Skudra Patrol user manual "3.2. Range definition section".

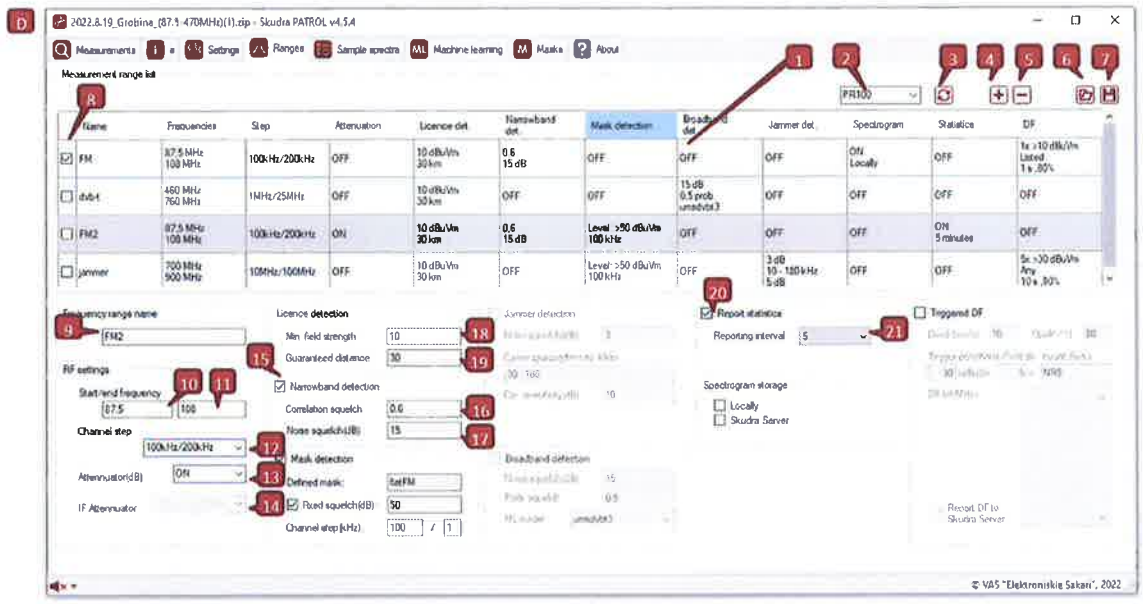


fig. 8-6 Skudra Patrol Range definition section

when connecting to Skudra Patrol instance to Server it also send available ML models and spectrum Masks on this instance, see "3.6. Machine learning section" and "3.7. Masks section". After connecting instance it is possible to assig responding ML models and Masks, that means, if Instance is disconnected, it is not possible to add it to task.

8.3 Schedule

Schedule section allows to plan predefined tasks to registered Skudra Patrol Instances.

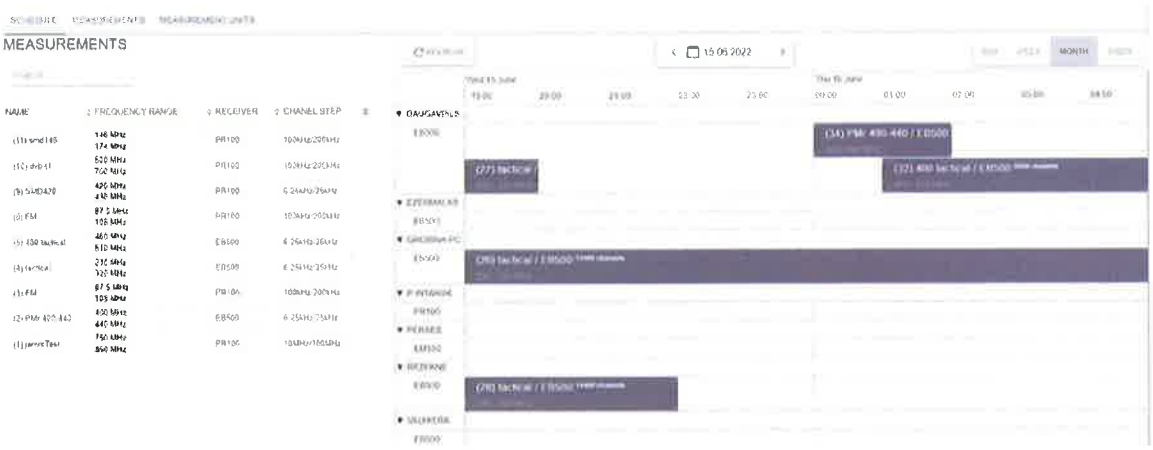


fig. 8-7 Schedule section

Schedule section consist of two parts – predefined tasks and horizontal calendar consisting of registered Skudra Patrol instances in separate rows. Multiple instances (receivers) of one host are grouped.

To plan task in schedule, it is needed to drag and drop task in desired calendar row, where is responding Instance, receiver.

fig. 8-8 Dragged and dropped task.

When task is dragged and dropped it is not saved in schedule, to save user need to double click on it and edit/review tasks start, stop and recurrence. Only after pressing "SAVE" button task will be sent to Server.

fig. 8-9 Planed task review.

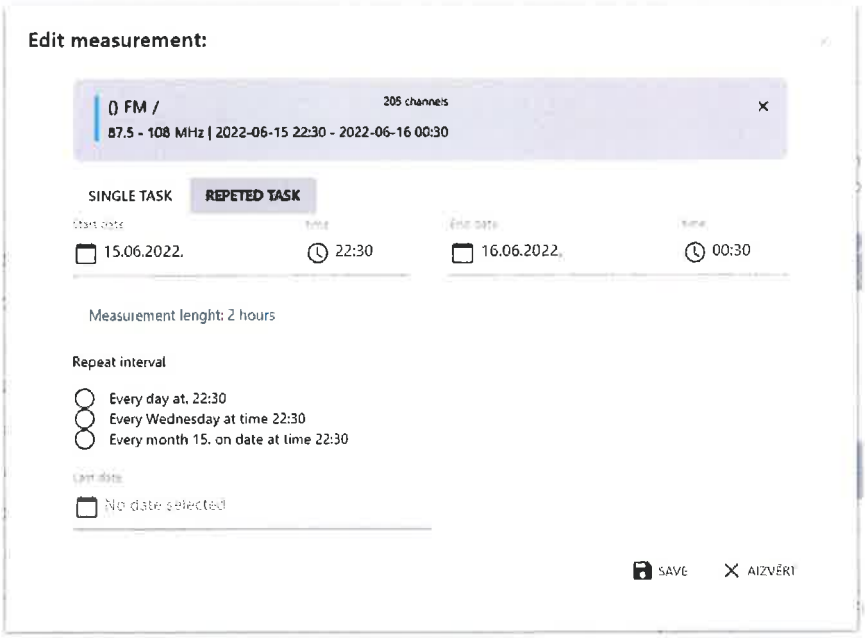


fig. 8-10 Repeated task

it is also possible to plan repeated task, repeating period options are following:

- Every time at …;
- Every week on curent weak day;
- Every month on curent month day;

And also last measurement date, until which date all repeated tasks will be created.

By changing task start and stop date it will show in task list overlapping tasks.

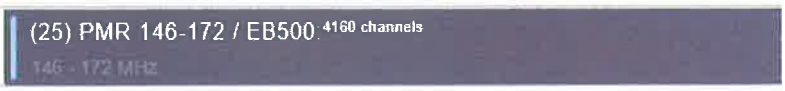


fig. 8-11 Saved tasks represents color-coded statuses: grey – saved, not sent. Blue – sent and accepted.

9 Reports

This module is intended for conducting reports on monitoring activities, as well as on current events in the company and industry, both in Latvia and around the world. Access to the section is through the Skudra Server app by clicking on the "Reports" icon.

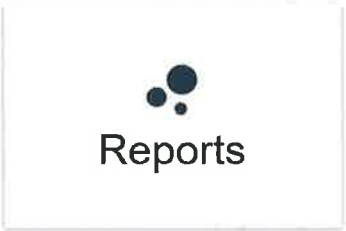


fig. 9. 1Reports icon SKUDRA Server

A window appears where you can select the type of report. They are MONITORING, ACTIVITIES and SKUDRA PATROL. You can also choose a reporting period.

fig. 9. 2Selection of report type

MONITORING. Graphical information about fixed and mobile monitoring reports drawn up in the defined period.

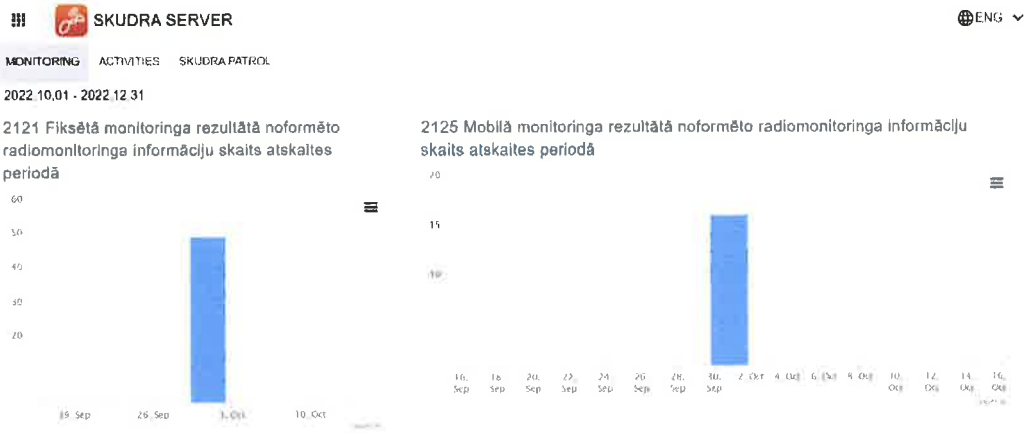


fig. 9. 3Monitoring reports window

ACTIVITIES. Information about current events in the company, industry and binding regulatory acts. The activity section is used as a system for recording daily and other important tasks, the textual information of which is used to create various reports. It is possible to add classifiers from the Administration environment.

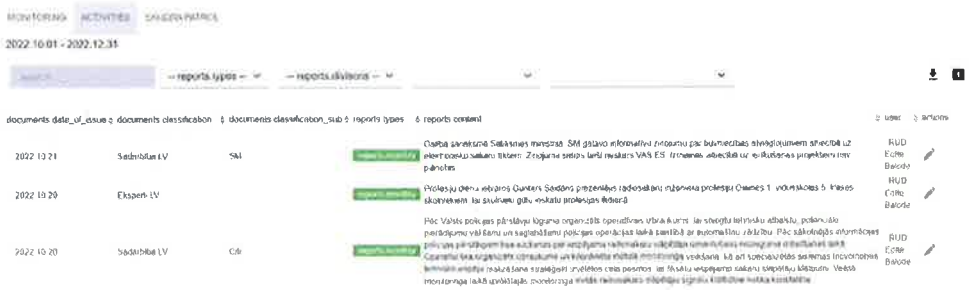
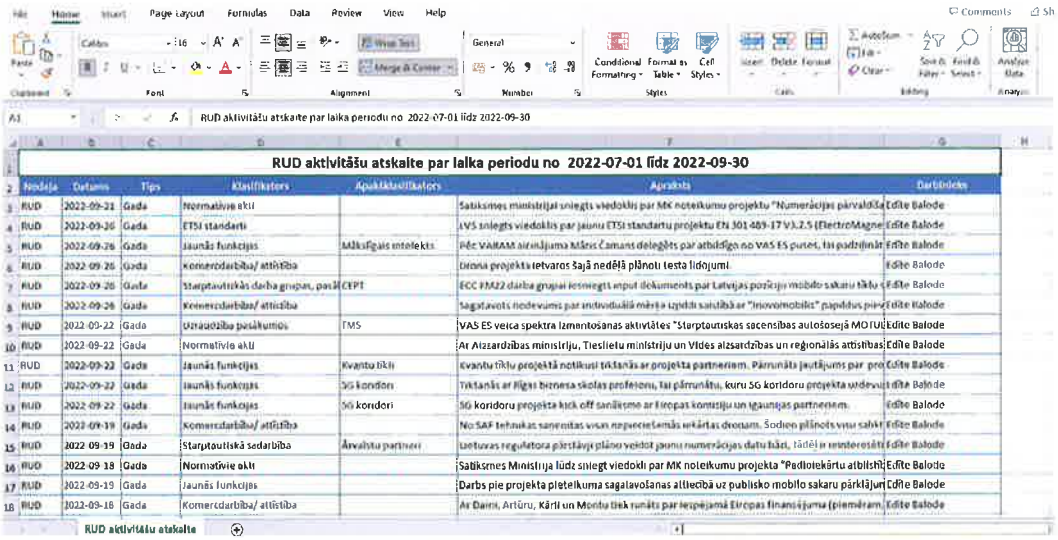


fig. 9. 4Current information window or ACTIVITIES

The list can be exported as an xls file by pressing the button "EXPORT" in the upper right corner of the screen

fig. 9. 5Option to export current information

As a result, the downloaded files folder shows:



RUD aktivitāšu atskaite par laika periodu no 2022-07-01 līdz 2022-09-30

Nodaļa	Datums	Tips	Klasifikators	Apakšklasifikators	Apraksts	Darbiniekis
RUD	2022-09-21	Gada	Normatīvie akti		Saeimas ministrijai sniegti viedokļi par MK noteikumu projektu "Numerācijas pārvaldība	Edīte Balode
RUD	2022-09-26	Gada	ETSI standarti		LVS sniegts viedoklis par jaunu ETSI standartu projektu EN 301 489-17 V3.2.5 (ElectroMagne	Edīte Balode
RUD	2022-09-26	Gada	Jaunās funkcijas	Mākslīgais intelekts	Pēc VARAM ministrijuma Mārtiņa Čamana deleģēts par atbildīgo no VAS ES puses, tai padziļināt	Edīte Balode
RUD	2022-09-26	Gada	Komercdarbība/ attīstība		Divona projekta ietvaros šajā nedēļā plānoti testa lidojumi.	Edīte Balode
RUD	2022-09-26	Gada	Starptautiskās darba grupas, pasā	CEPT	ECC FM22 darba grupai iesniegti input dokumenti par Latvijas pozīciju mobilo sakaru tīklu	Edīte Balode
RUD	2022-09-26	Gada	Komercdarbība/ attīstība		Sagatavots nodevums par individuālā mēroga izpildi saistībā ar "Inovomobilis" papildus pie	Edīte Balode
RUD	2022-09-22	Gada	Uzraudzība pasākumos	TMS	VAS ES veica spektra izmantošanas aktivitātes "Starptautiskas sacensības autošosejā MOTUL	Edīte Balode
RUD	2022-09-22	Gada	Normatīvie akti		Ar Aizsardzības ministriju, Tieslietu ministriju un Vides aizsardzības un reģionālās attīstības	Edīte Balode
RUD	2022-09-22	Gada	Jaunās funkcijas	Kvantu tīkli	Kvantu tīklu projektā notikusi tikšanās ar projekta partneriem. Pārrunāts jautājums par pro	Edīte Balode
RUD	2022-09-22	Gada	Jaunās funkcijas	5G koridori	Tikšanās ar Rīgas biznesa skolas profesoru, lai pārrunātu, kuru 5G koridoru projekta ietvaros	Edīte Balode
RUD	2022-09-22	Gada	Jaunās funkcijas	5G koridori	5G koridoru projekta kick off sanāksme ar Eiropas komisiju un igaunijas partneriem.	Edīte Balode
RUD	2022-09-19	Gada	Komercdarbība/ attīstība		No SAF tehnikas saņemtas visas nepieciešamās iekārtas drošam. Šodien plānots visu sakārt	Edīte Balode
RUD	2022-09-19	Gada	Starptautiskā sadarbība	Ārvalstu partneri	Lietuvas regulatora pārstāvji plāno veidot jaunu numerācijas datu bāzi, tādēļ ir ieinteresēti	Edīte Balode
RUD	2022-09-18	Gada	Normatīvie akti		Saeimas Ministrija lūdz sniegt viedokli par MK noteikumu projekta "Radiolokārtu atbilstīb	Edīte Balode
RUD	2022-09-19	Gada	Jaunās funkcijas		Darbs pie projekta pieteikuma sagatavošanas atliecībā uz publisko mobilo sakaru pārklājum	Edīte Balode
RUD	2022-09-18	Gada	Komercdarbība/ attīstība		Ar Daini, Artūru, Kārli un Mordu tiek runāts par iespējamā Eiropas finansējuma (piemēram,	Edīte Balode

RUD aktivitāšu atskaite

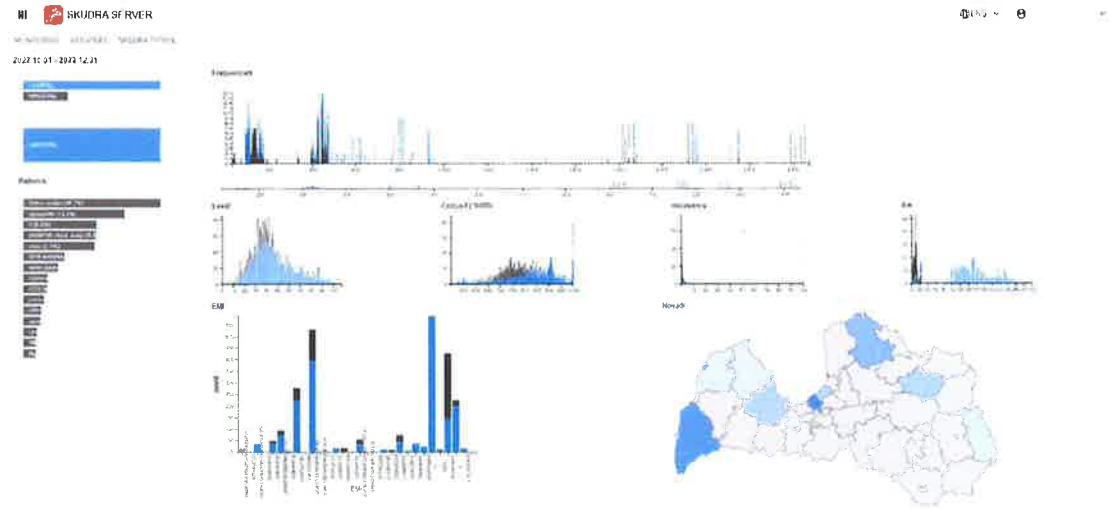


fig. 9. 7SKUDRA Patrol window in the SKUDRA Server app.

9.1 Sample spectra

After logging in to Skudra Server , in the upper right corner of the screen, next to the user name, there is a down arrow, which when pressed brings up the " Sample Spectra " menu.

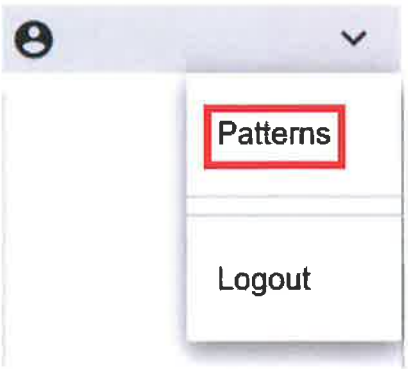


fig. 9.8 Sample spectra menu button

Selecting " Sample spectra " opens a window showing lines with the basic information of the so-called sample spectra . When you move the cursor over one of the rows, the spectrogram, radiation class and name appear on the right side of the screen. The monitoring program Skudra Patrol uses sample spectra in its operation , that is, it compares the frequency parameters recorded in daily measurements with one of the sample spectra .

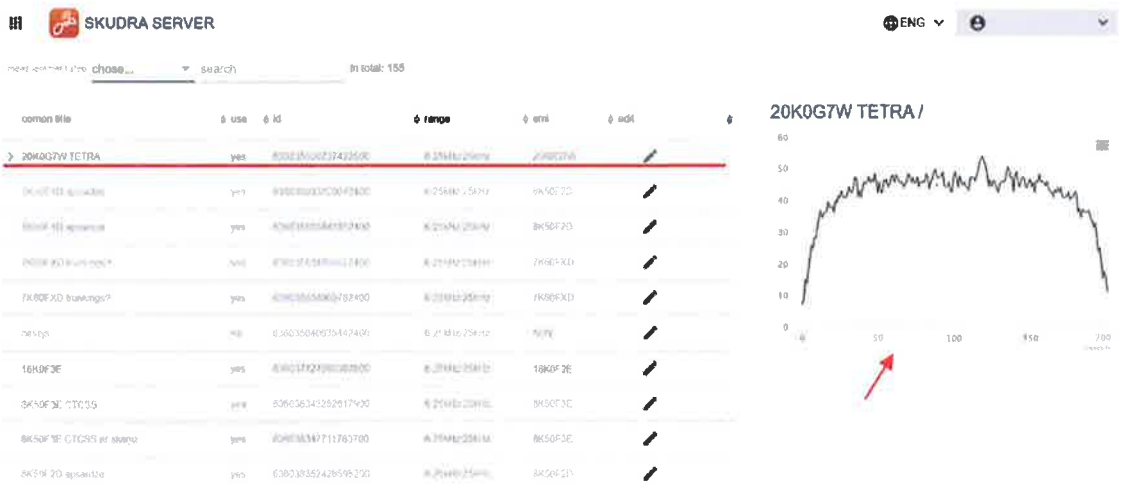


fig. 9.9 Table of sample spectra and spectrograms

10 Appendix

10.1 Abbreviations and terms used.

VASES – State joint-stock company "Elektroniskie sakari"

RUNIS – information system of the radio frequency monitoring department

RMP – radio monitoring point

EMI – electromagnetic radiation

EMS – electromagnetic situation

NRS – Unidentified Radio Signal

DF – Direction Finding , determination of direction

TMS – transportable monitoring station

VAS
Elektroniskie
sakari

Skudra Target

User manual
2022-Q4.1

CONTENT

1 INSTALLATION

To use Skudra Target, you must have the latest PostgreSQL database installed. The PostgreSQL Installation Guide provides information on how to download and install PostgreSQL .

During PostgreSQL installation it is important to set and note database port and password that will be necessary during Skudra Target installation.

This document provides instructions for installing and using Skudra Target.

1.1 Explanations

Skudra Target consists of three applications:

- Skudra Target Driver - for communication with radio monitoring equipment and storing results in database;
- Skudra Target Control - for measurement control and real time visualization;
- Skudra Target Analysis - for analysis of measurement results that are stored in database;

Three applications may be run on the same computer or on different computers providing that there are TCP and UDP communications allowed on ports in range of 19005-19100 in both directions.

UDP communications from monitoring receiver to computer with Skudra Target Driver installed have to be allowed at ports ranging from 19005 to 19100. Additionally TCP connection from driver's computer to monitoring receiver also has to be allowed on port 5555. Port 5555 is usual for R&S receivers, however it may be updated depending on receiver.

PostgreSQL has to be installed on computer where Skudra Target Driver is intended to work.

Software protection dongle is necessary only on computer where Skudra Target Driver is running.

1.2 Supported devices

Skudra Target supports in this chapter listed devices, additional devices can be added upon request.

1.2.1 Receivers

Current Skudra Target version supports fallowing receivers:

- Rohde & Schwarz ESMB
- Rohde & Schwarz EB200
- Rohde & Schwarz ESMD
- Rohde & Schwarz EB200

- Rohde & Schwarz EM100
- Rohde & Schwarz EM200
- Rohde & Schwarz EM500
- Rohde & Schwarz UMS100
- Narda SignalShark family receivers

1.2.2 Direction finders

Current Skudra Target version supports fallowing direction finders:

- Rohde & Schwarz ESMD with DF option
- Rohde & Schwarz EB500 with DF option
- Rohde & Schwarz EBD190
- Rohde & Schwarz EBD195
- Rohde & Schwarz PR100 with DF option
- Rohde & Schwarz PR200 with DF option
- Narda SignalShark family direction finders

With their peripheral devices (e.g. compasses, GPS) witch are provided with control units manufacturer.

1.2.3 Additional devices

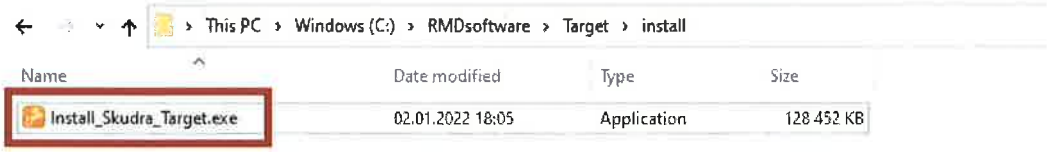
Current Skudra Target version supports fallowing additional devices:

- Antenna Control Units and Switches:
  - FU129
  - GB016
  - GB127M
  - GB127MU
  - GB127S
  - ZS129A1
  - ZS129A5

  With their peripheral devices (e.g. rotators) witch are provided with control units manufacturer.

1.3 Installation steps

1. To start installing Skudra Target, you need to start the installation file



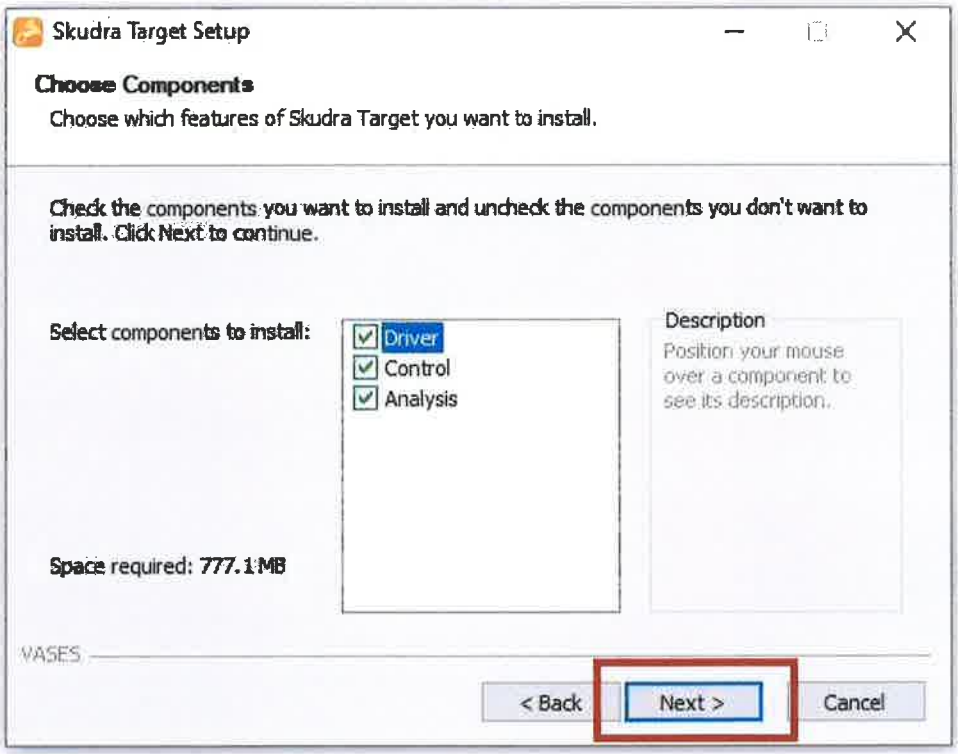
2. Depending on the settings of Microsoft Defender , the installation may be considered insecure, then you need to press "More info"

3. You have to press " Run anyway "

4. Depending on the security settings of the system, it is possible that there will be such a restrictive inscription below, then you need to press " Allow this file ":

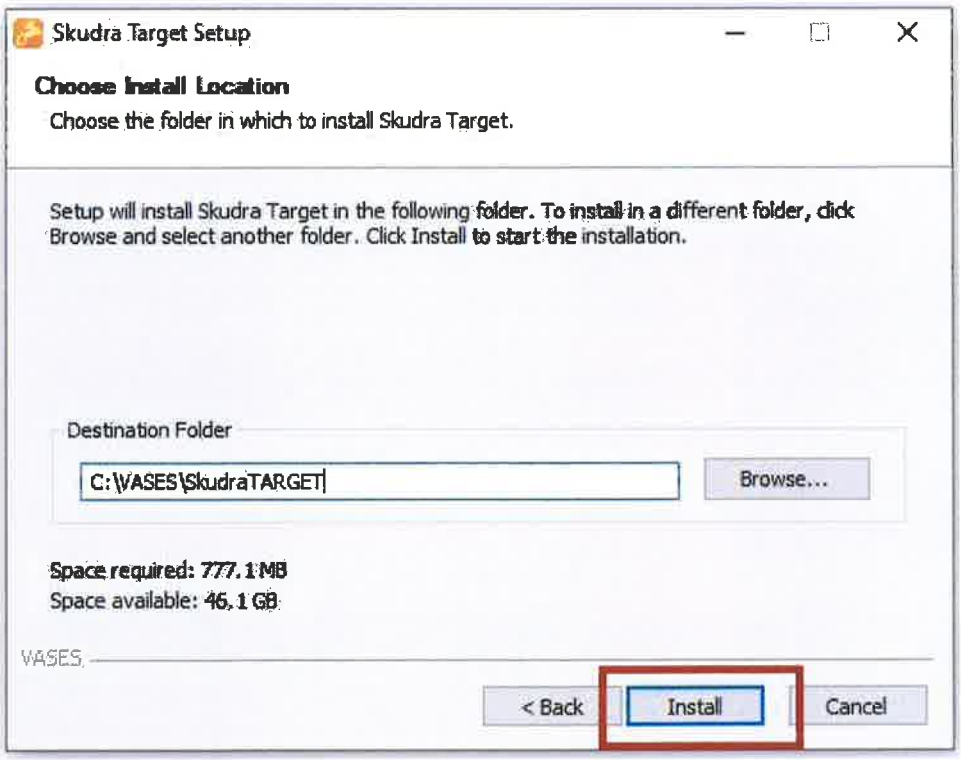
5. Permission to install must be approved

6. We select all three Skudra Target components and press " Next "



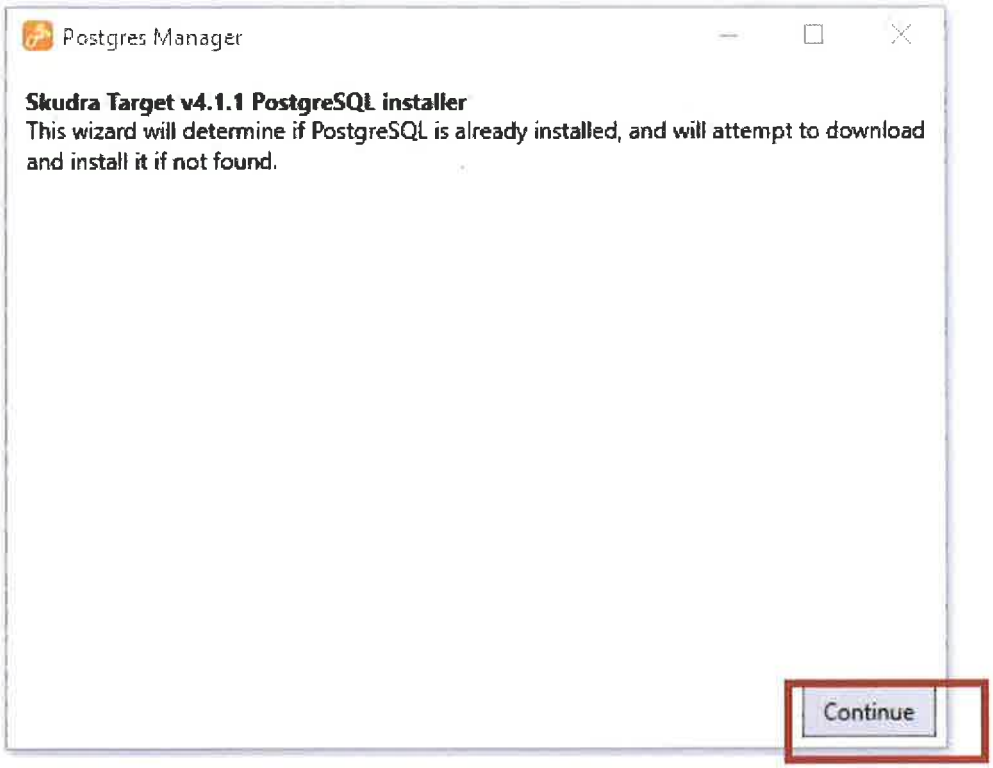
7. We select the folder where the program will be installed

Recommended installation path: "C:\SKUDRA\Skudra TARGET\"

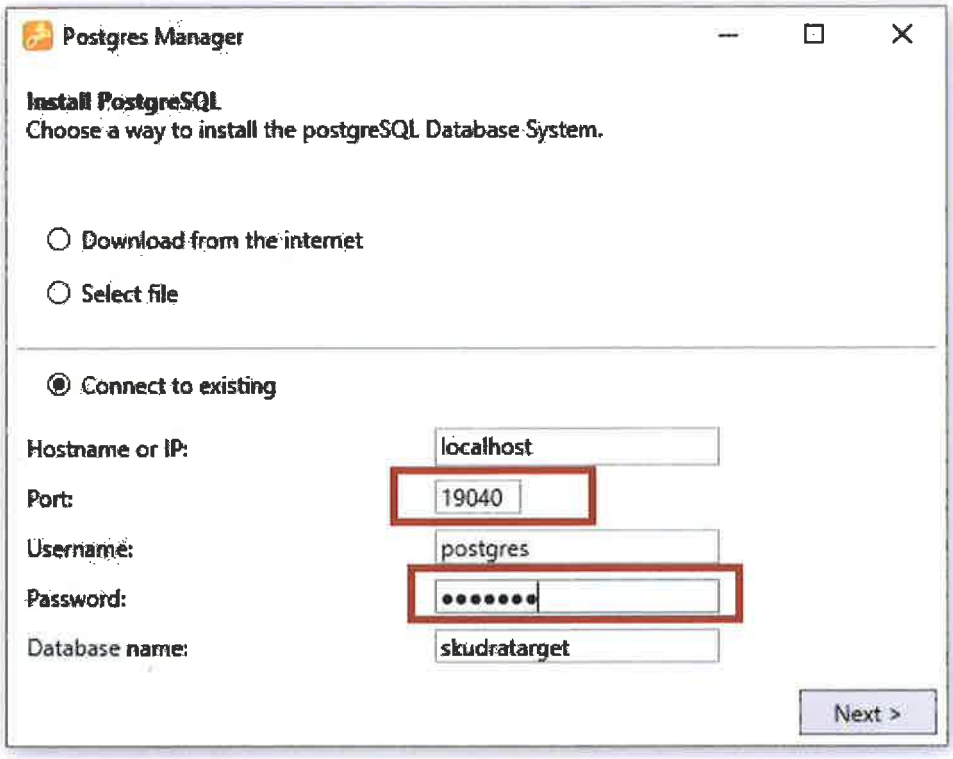


8. Some components require Administrator rights to install

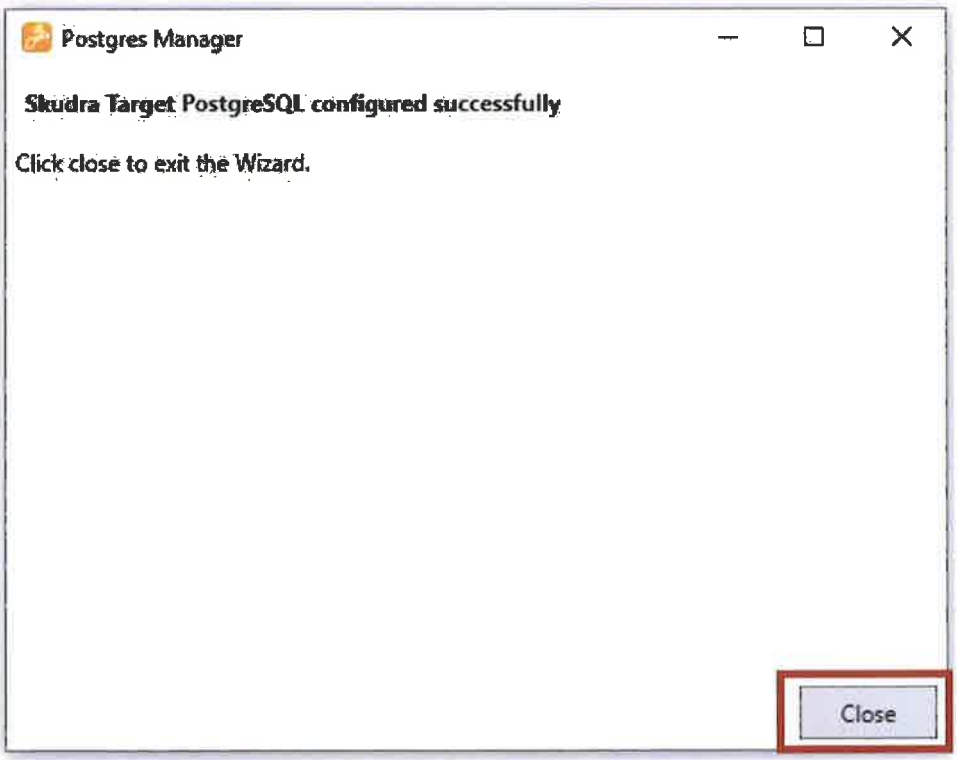
9. We press " Continue " so that Skudra Target connects to the database



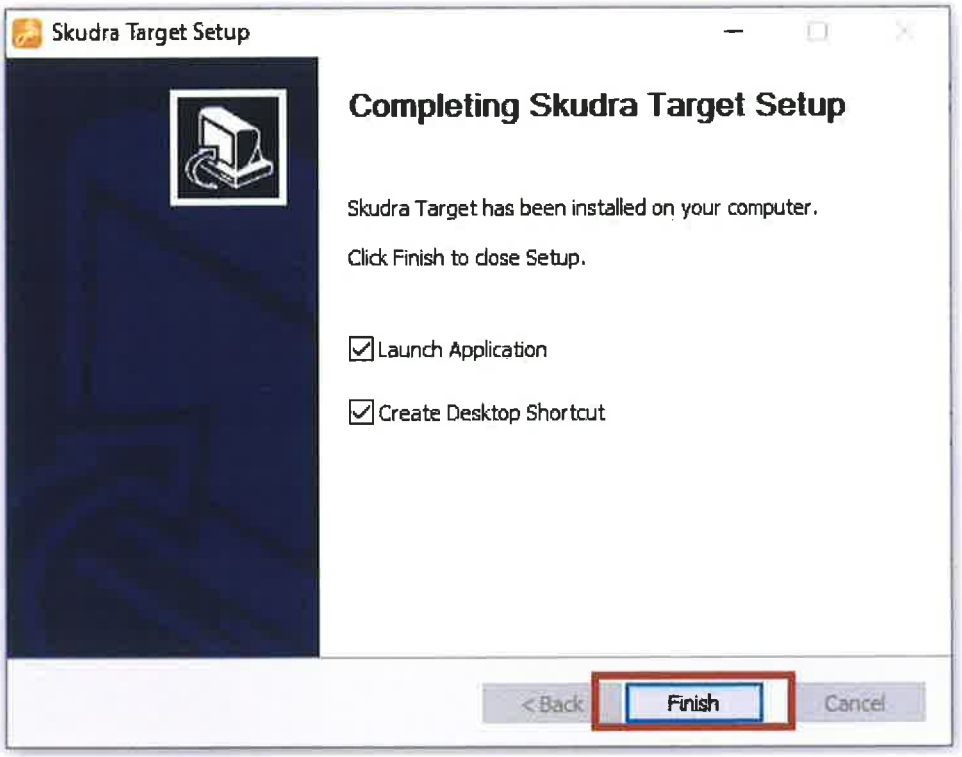
10. We choose " Connect to existing ", enter the Port and Password values that were entered during PostgreSQL installation (Port:19040, Password:monitor)



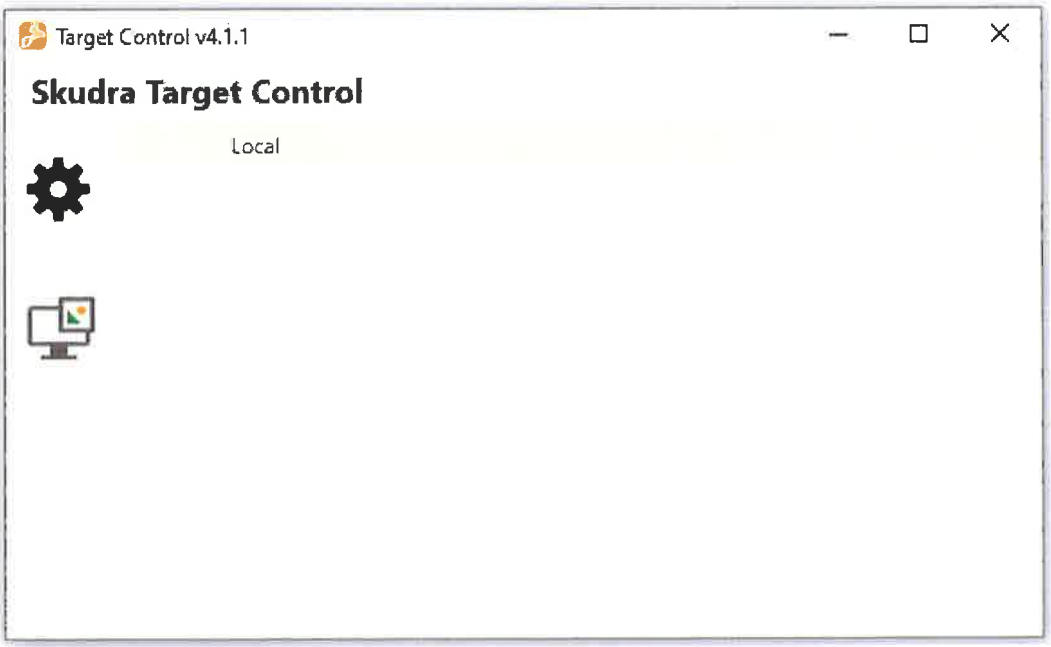
11. Press " Close " and continue the installation



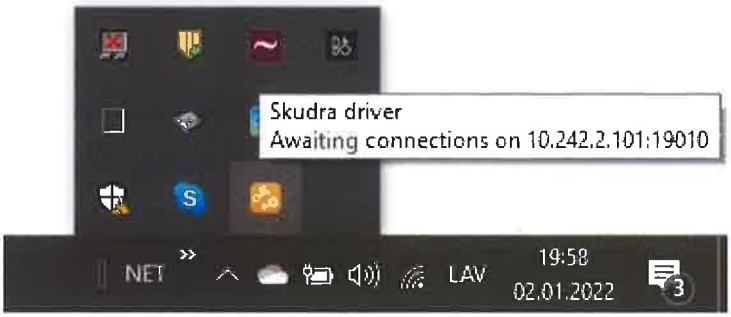
12. Press " Finish " after creating Desktop icons and Skudra Target and Control to start.



13. Skudra Target The Control window will look like this

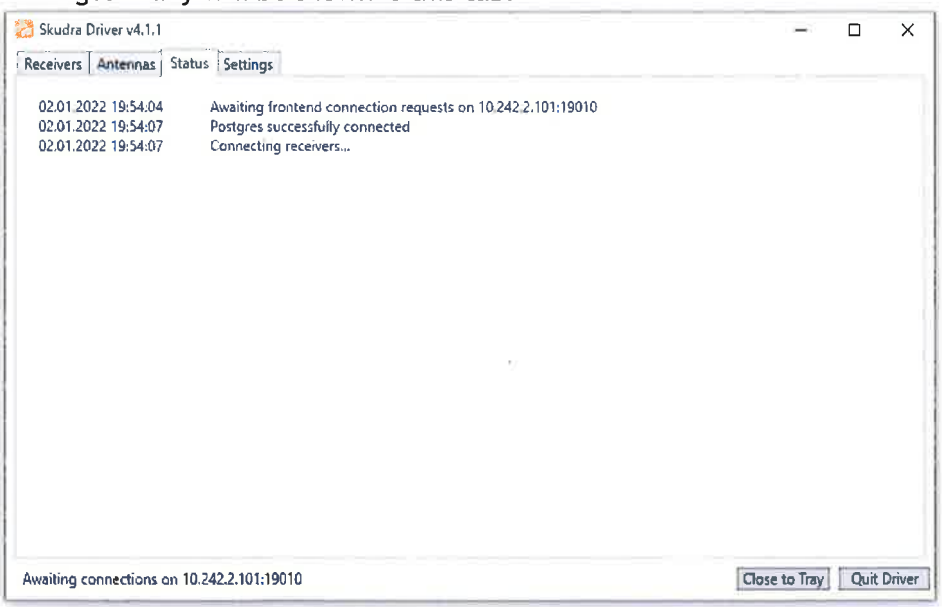


14. Skudra Target Driver will be available in notification area



15. Double-clicking the icon will open the Skudra Driver window

16. Skudra Target Driver status is available on corresponding tab. Error messages if any will be shown is this tab.



17. Skudra Target is successfully installed. Shortcuts for Skudra Target Driver, Control and Analysis are available on desktop.

2 CONFIGURING THE SKUDRA TARGET DRIVER

Skudra Target Driver is an interface for radio monitoring equipment and for storing measurement results into the database, so before starting measurements, it is necessary to make settings for the Skudra Target Driver for connected receivers, antennas and database connection.

Figure 1Skudra Target Driver

Skudra Target Driver consists of 4 sections:

1. Receivers:

   A section where you can connect and disconnect receivers (choosing from the available ones) and configure their connections

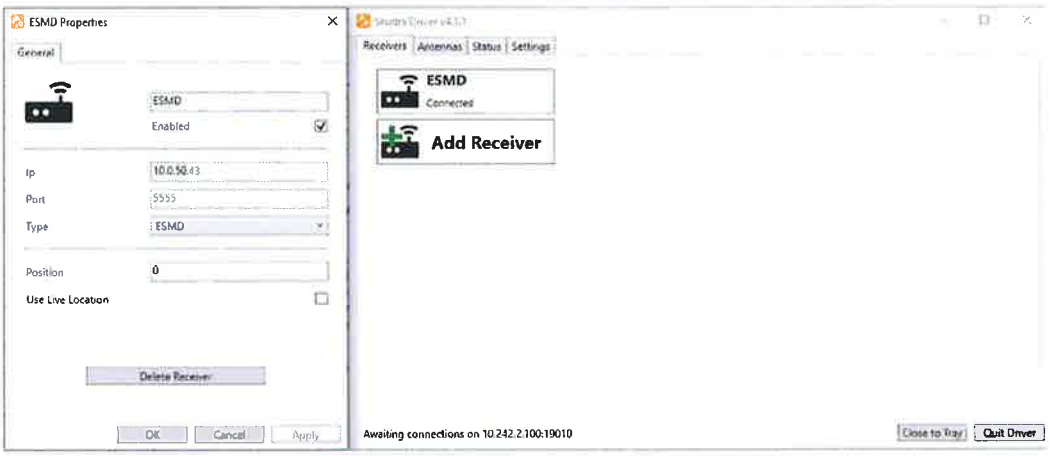


Figure 2Receiver section

To add a new receiver, you need to set the following parameters:

- Title;
- Status - Enabled/Disabled (tick next to " Enabled ");
- IP address of the local network of the receiver ;
- Port number for remote control (for Rohde&Schwarz receivers it is 5555, for others - according to the manufacturer's documentation);
- Type (list of available receivers);
- Position in antenna switch;
- Use of receiver-maintained (GNSS) location (Enabled/Disabled);

To delete a receiver, double click on the receiver and " Delete Receiver "

2. Antennas

Section for adding, selecting and configuring antennas.

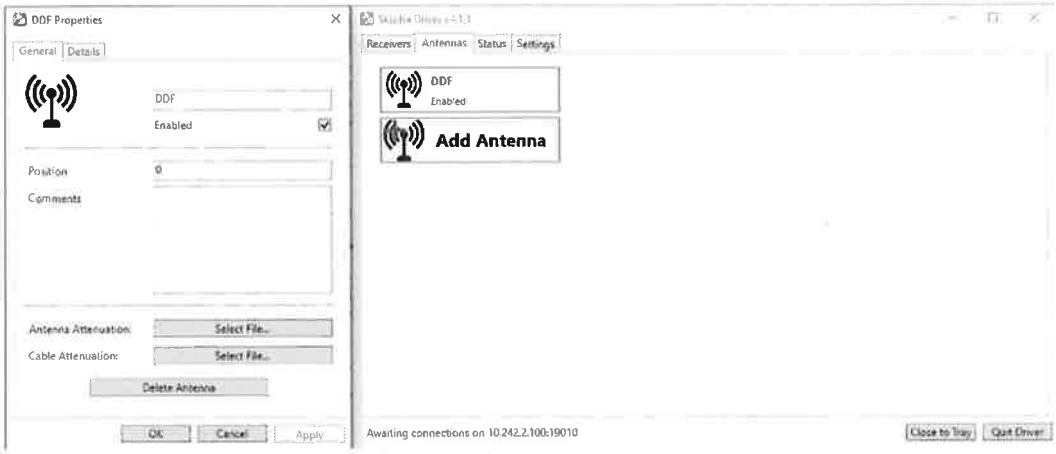


Figure 3Antenna section

To add a new antenna, you need to set the following parameters:

- Name - it is preferable to use the name given by the manufacturer;
- Status (Enabled/Disabled);
- Position in antenna switch;
- Comments;
- Antenna gain file (csv format);
- Cable attenuation file (csv format);

To delete an antenna, double-click on the antenna and " Delete Antenna "

3. Status

The status section is for driver connection and error information.

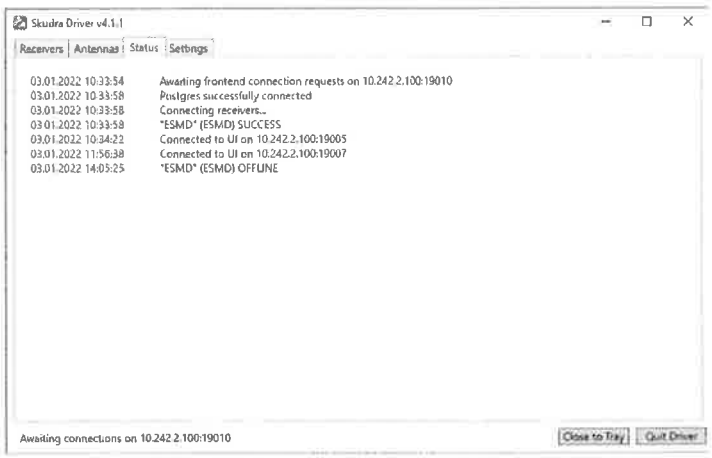


Figure 4Status section

4. Settings

Section for drivers connections credentials and settings.

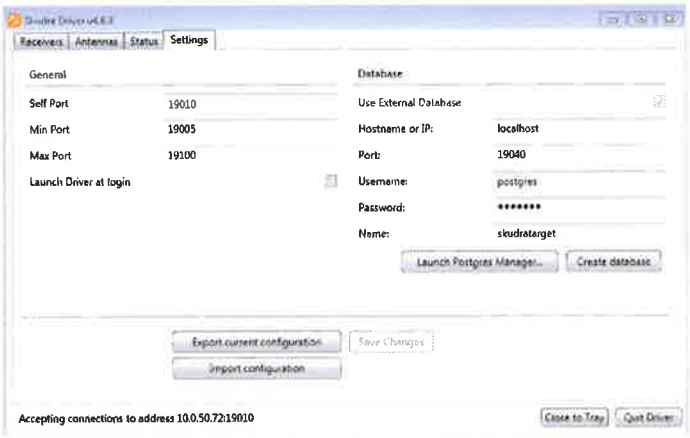


Figure 5 Settings section

General settings are used for client and driver communication, if client to driver is connected through VPN or restricted network, port range defined in these settings, should be opened as exceptions for communication.

> In general those settings should be left default values.

After successful drivers configuration it is advised to backup all user settings using "Export current configuration".

3 CLIENT CONFIGURATION

Skudra Target Control application is used as client for monitoring equipment remote control and perform and maintain measurements on multiple drivers instances.

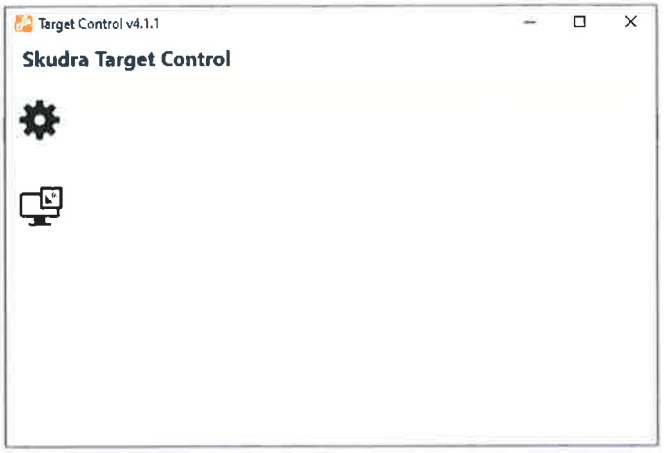


Figure 6Skudra Target Control main window

Figure 7 Control application setting window

In order to perform measurement, there is necessary to add driver instances to client configuration, it is possible to add multiple driver instances and use each connected device simultaneously.

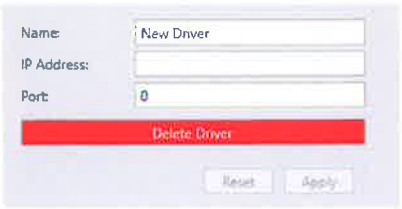


Figure 8Adding a new driver

The following parameters need to be set for each driver:

- Name - the name of the driver, it is preferable to use the name of the monitoring point;
- Driver computer IP address;

- Driver port number;

Drivers IP address can be found in drivers application window status bar, see "Figure 5 " ex. 10.0.212.23:19010.

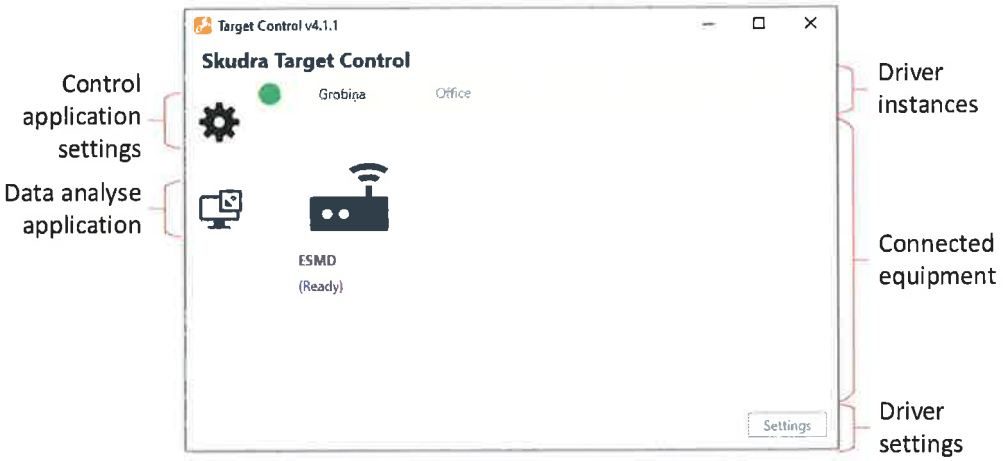


Figure 9Skudra Target Control main menu window with connected drivers

After completing the configuration settings, all connections are visible in the main menu window and also as a color indication (monitoring points):

- 🟢 - connected;
- 🔴 - disconnected;

The status is visible for each monitoring point hardware:

- Ready - equipment is ready to use;
- Busy - equipment in use;
- Unavailable - connection from diver to equipment is not available;

4 RECEIVER CONTROL AND MEASUREMENT

4.1 General settings

In the control window of the receiver, it is possible to perform measurements with measurement visualization in real time

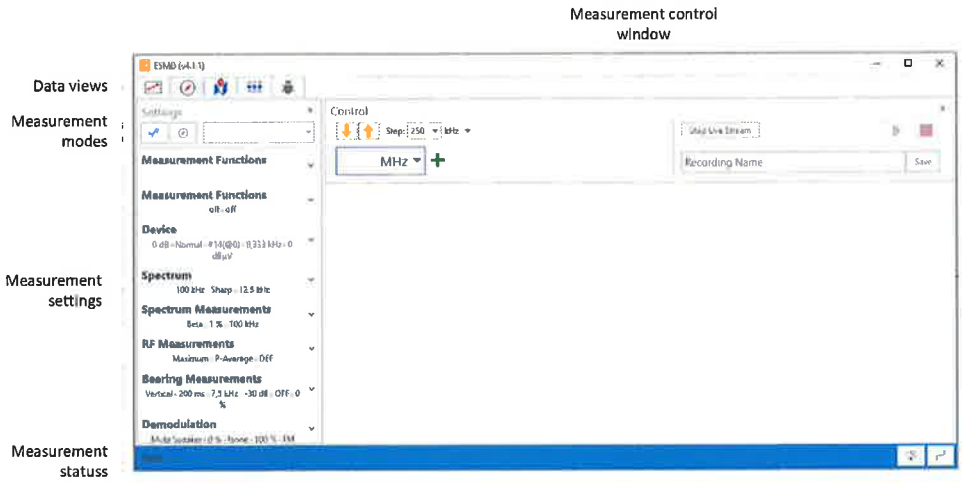


Figure 10Receiver control window

Workflow for measurements:

1. Choose measurement mode:
   - Level meter - signal technical measurements, e.g. level, bandwidth and modulation;
   - Bearing - direction finder measurements;
2. Set measurement settings;
3. Set frequency in measurement control window;
4. Start measurement ▶;
5. Open required data view.
   There is available following data view, depending on measurement mode:
   - Spectrum;
   - Compass;
   - Map;
   - Data table;

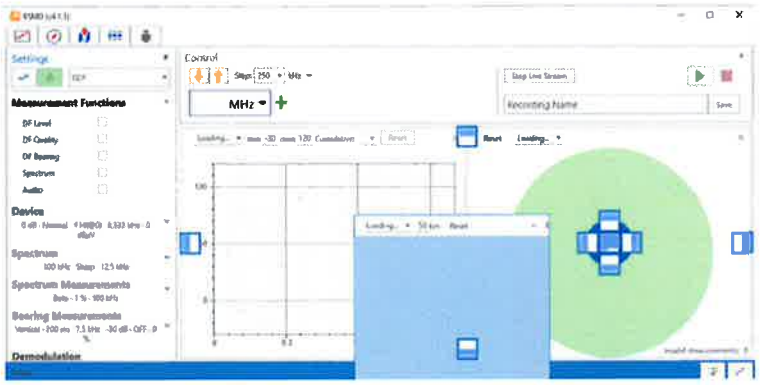


Fig 11 Data view floating panels

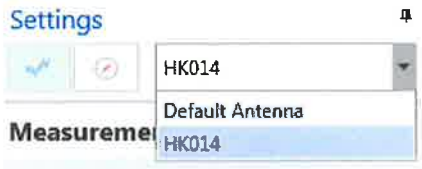
Data view panels are floating panels, which you can arrange by dragging and dropping to guided arrangements.

4.2 Settings for measuring radio emission parameters

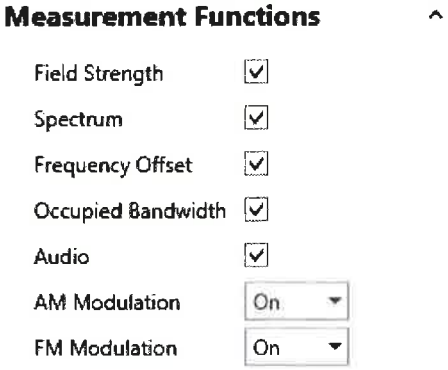
For measurements of radio emission parameters, it is essential to correctly select and set the required setting values for the result.

1. Antenna selection:

We select the necessary antenna from the available list:

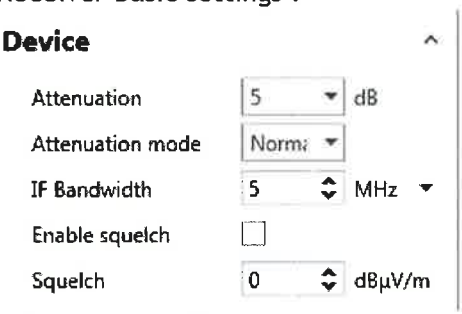


2. Selection of parameters to be measured (what the receiver will measure):



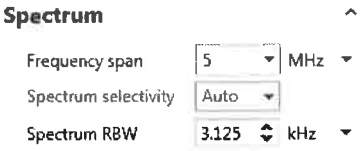
- Field Strength - Field intensity;
- Spectrum - Spectrum display;
- Frequency Offset - Frequency shift;
- Occupied Bandwidth - Occupied bandwidth;
- Audio - turning on the sound;
- AM Modulation - Amplitude modulation depth measurements;
- FM Modulation - Frequency deviation measurements.

3. Receiver basic settings :



- Attenuation - attenuation values;
- Attenuation mode - type of intermediate frequency attenuation;
- IF Bandwidth - measurement bandwidth;
- Enable squelch - Noise suppression threshold (on/off);
- Squelch - Threshold limit value for noise suppression.

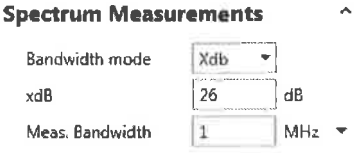
4. Spectrum display settings:



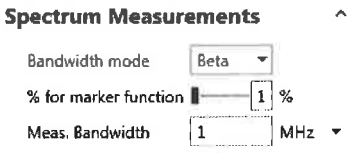
- Frequency span - the width of the spectrum to be displayed;
- Spectrum selectivity - display selectivity;
- Spectrum RBW - spectrum resolution.

Note - when changing Frequency span , the Spectrum RBW also changes automatically , but then the Spectrum RBW can be set manually.

5. Bandwidth measurements:

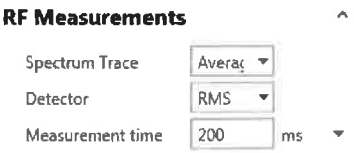


or



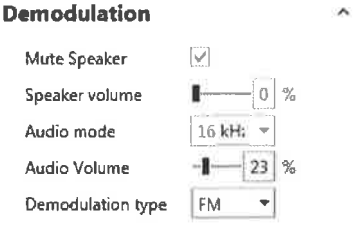
- Bandwidth mode - Bandwidth measurement method selection (Beta/ Xdb);
- xdB - parameter for the XdB method (minus dB from the peak);
- % for marker function - parameter for the Beta method (percentage of the spectrum);
- Meas . Bandwidth - bandwidth to be measured (it is possible to set less than Frequency span).

6. Additional settings:



- Spectrum Trace - Spectrum curve display selection;
- Detector - detector selection;
- Measurement time - measurement reading time.

7. Demodulation:

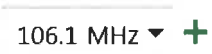


- Mute Speaker - turning on/off the receiver's speaker;
- Speaker volume - volume settings for the receiver speaker;
- Audio mode - audio quality for the demodulated signal;
- Audio volume - volume level when listening to the signal in Skudra Target;

- Demodulation type - selection of demodulation type (FM, AM, etc.).

4.3 Taking measurements

1. The frequency to be measured must be entered:

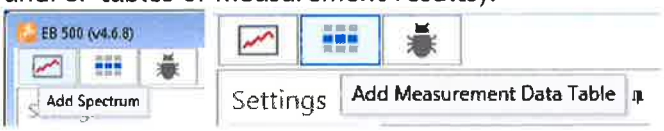
   Or frequencies (using +):

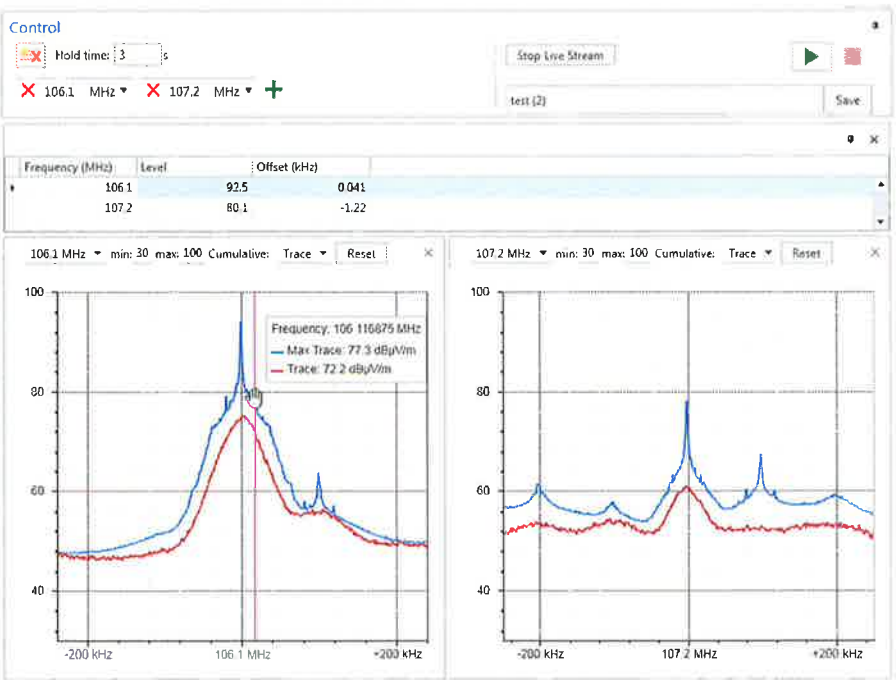
   Frequencies can be removed one by one by pressing the red X, or all by pressing the " Clear " button all frequencies ":

2. The type of display of the required information must be selected (spectrum and/or tables of measurement results):

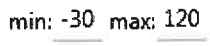
3. Start the measurement by pressing the button in the upper right corner 
4. Visual control of measurements:

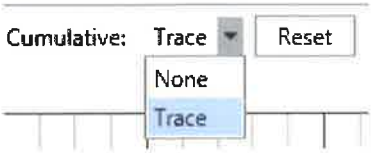
   - Selection of frequencies to be displayed (in the relevant spectrum graph, we choose to display either one frequency or several - in LIVE mode):

- Setting the limits of the vertical axis of the spectrum:

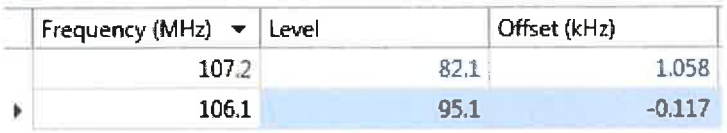


- Trace - spectrum accumulation option on/off; Reset - deleting the accumulated curve



- Hold time - measurement time for each frequency (Hold time defaults to 0):

- Instantaneous values of measurements in the data table window:



- To stop the measurement, press the key 

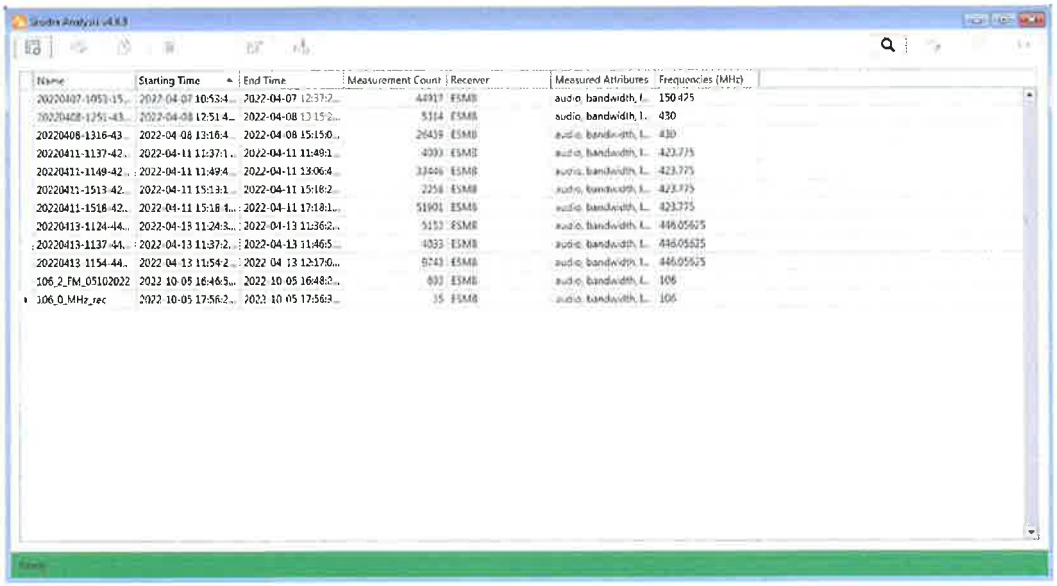
4.4 Measurement data recording and analysis

1. Recording measurement data:
   - Before starting measurements, or during them, in the field " Recording name " type the name of the file and press " Save ":

   - A green indication " Saving "is visible since recording is started:

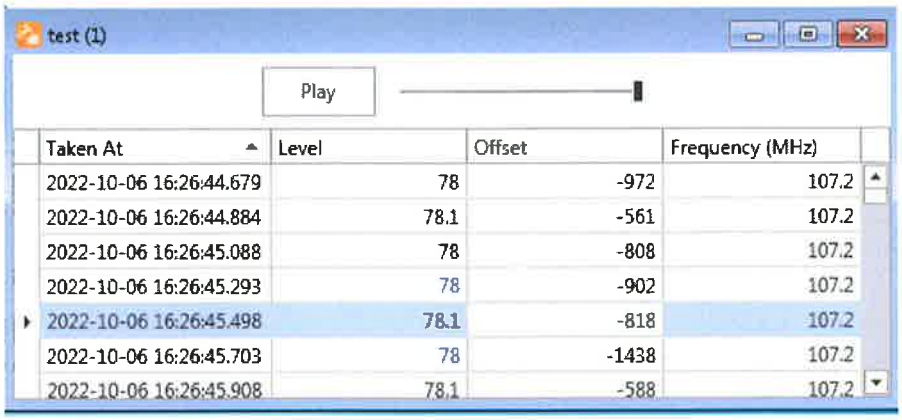
   - "Stop Live Stream " button stops the visual display of measurements in the spectrum and table, but does not stop measurements and recording;
   - It is not possible to change measurement settings during recording.

2. Analysis of recorded measurement data:
   - Target should start Data analysis tool. This can be done in two ways - starting from the computer's Desktop shortcut , or from Target Control bottom toolbars:



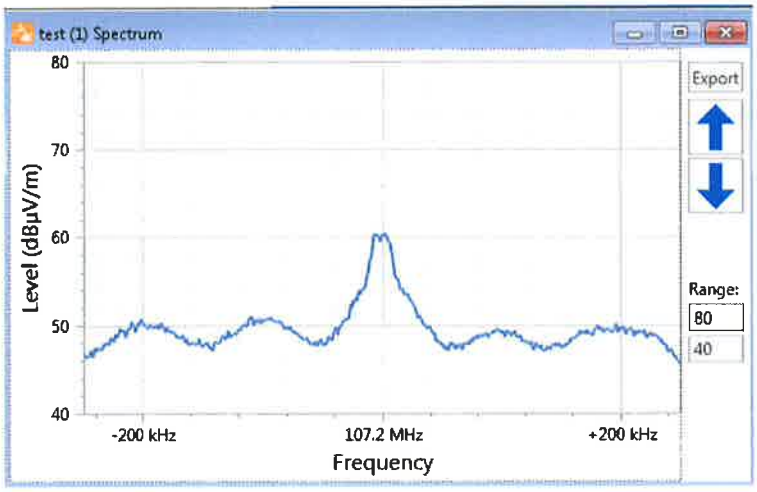
- A list of performed measurement records opens, which can be filtered, searched, renamed and deleted:

- You can analyze and play the specific measurement by double-clicking on it:

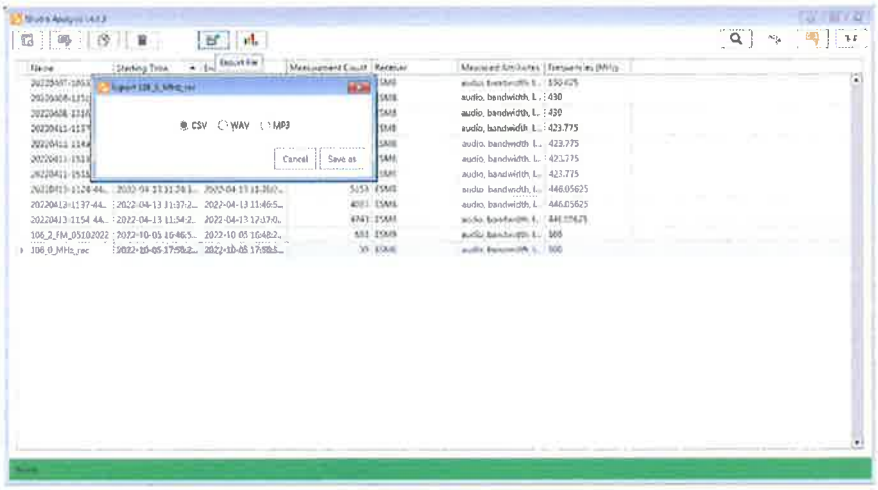


Taken At	Level	Offset	Frequency (MHz)
2022-10-06 16:26:44.679	78	-972	107.2
2022-10-06 16:26:44.884	78.1	-561	107.2
2022-10-06 16:26:45.088	78	-808	107.2
2022-10-06 16:26:45.293	78	-902	107.2
2022-10-06 16:26:45.498	78.1	-818	107.2
2022-10-06 16:26:45.703	78	-1438	107.2
2022-10-06 16:26:45.908	78.1	-588	107.2

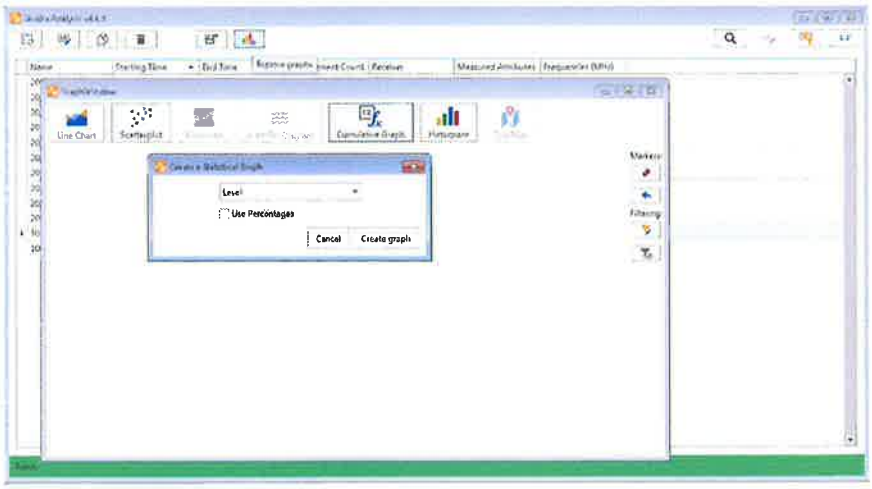
- Double-clicking on a measurement unit displays its detail and spectrum. With the blue vertical arrows you can switch between measurement units:



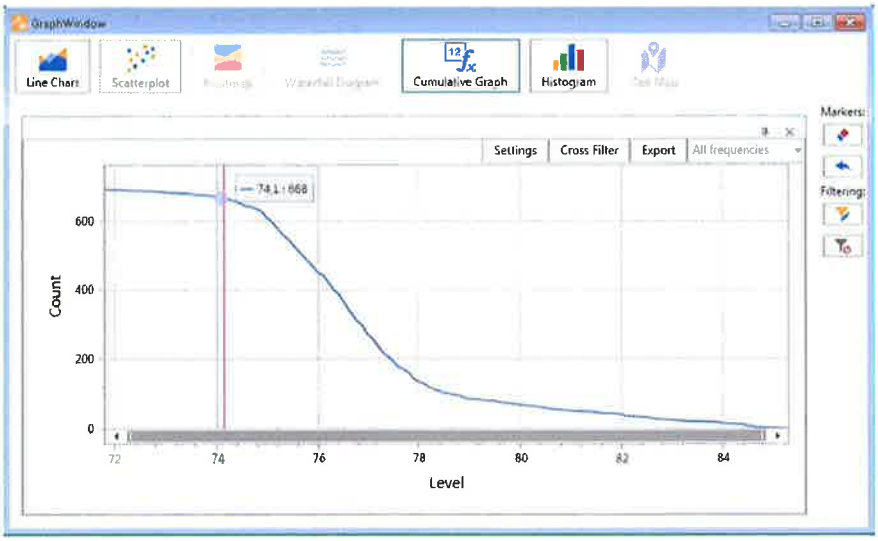
- Measurement data can be exported in various formats (CSV, WAV and MP3):



- Measurement records can be displayed graphically using the " Explore " button graphs ' options:



- An example of a graphical representation:



5 DIRECTION FINDING (DF, LEVELING)

- You must select the bearing mode - " Bearing "

- Then the basic settings related to the direction finder are visible:

Measurement Functions

DF Quality ☑

DF Bearing ☑

DF Quality - bearing quality;

DF Bearing - bearing azimuth.

- Pelengator additional settings menu:

Bearing Measurements

DF Polarization	Vertic	
Measurement time	100	ms
CBW resolution	150	kHz
DF Squelch	10	dB
DF Mode	Norma	
DF quality	0	%

DF Polarization - Direction finding antenna polarization selection;

Measurement time - measurement time of the measurement;

CBW resolution - The width of the measuring band, limited by the width of the spectrum displayed by the receiver (Frequency span). To apply a higher CBW resolution , you need to increase the Frequency span in receiver settings:

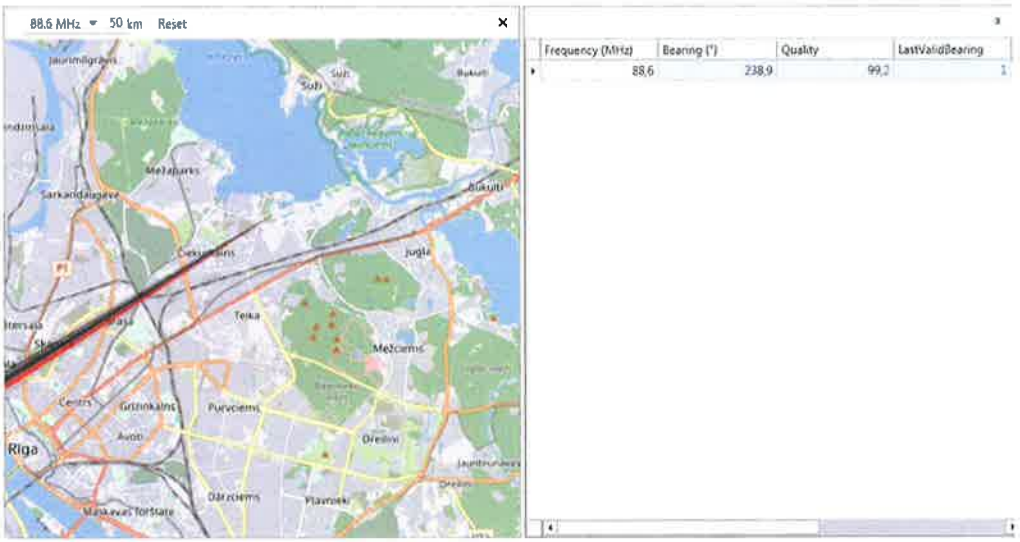
DF Squelch - Threshold of the squelch signal above which measurements are captured;

DF Mode - Mode of dialing;

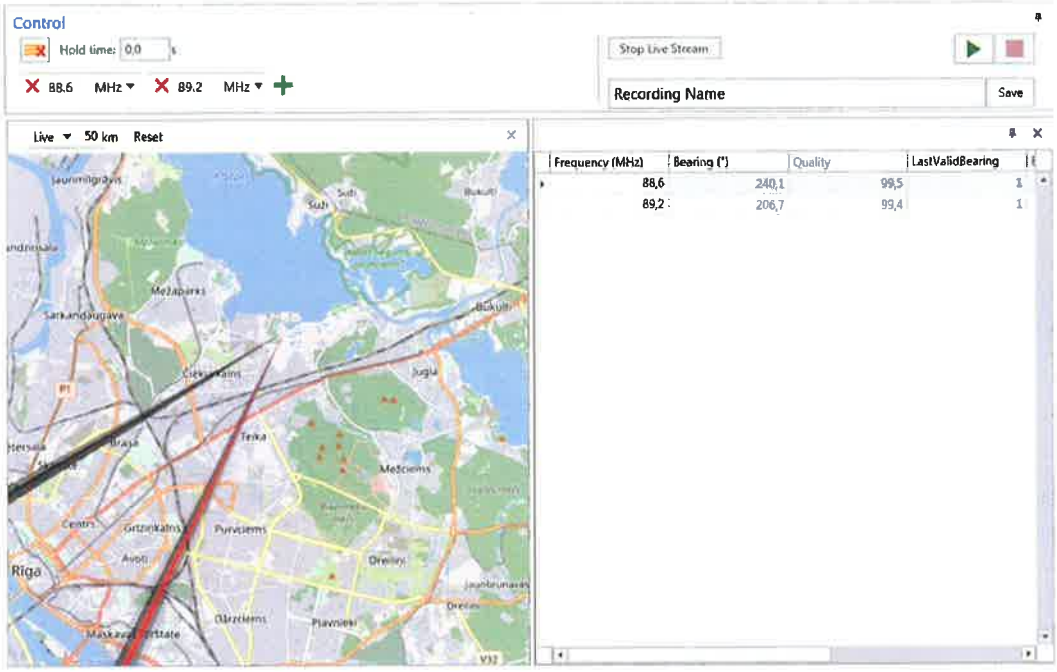
DF quality - Threshold of scaling quality in percentage.

- To see the display of the direction on the map, press the button " Add folder ":

- The numerical values of the surveying results can be seen in the table, while visually the surveying direction can be seen on the map as a beam:



- It is possible to scan several frequencies at the same time:



- The length of the displayed ray on the map can be changed:
  88.6 MHz ▾ 50 km
- If a recording is made, then in surveying mode, the results of direction determination measurements are also recorded.