

SIMon International System

Technical specification





Created by

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SIMon International System

1. Design goals and feature overview of the SIMon system

Equipment vendor independence

During the development of the SIMon system, the most important design goal was to deliver a measurement system that is capable of uniform, full-scale integration of new measurement devices from independent equipment vendors into the system by implementing a device's drivers based on a common SIMon driver development SDK.

Web-based user interface

We decided that the system's user interface must run in all major Web browsers (Google Chrome, Mozilla Firefox, Microsoft Edge) and should not require other installation on the client-side. To develop the user interface, we chose a commercially supported, professionally maintained JavaScript framework (<u>Sencha Ext JS</u>) that allows the developers to build a browser-independent Web application. The Sencha Ext JS framework accelerates web application development with an enterprise-ready framework, an extensive, pre-built UI component library, and tools built to work together seamlessly.

Because the most important task of the user interface is to support the display and analysis of large (even up to 200 million data points) measurement results, we decided that the integrated Spectrum and Signal Analyzer must use the parallel processing capabilities of the GPU on the client to handle huge amounts of data efficiently. Based on this requirement, we implemented the Spectrum and Signal Analyzer component using the standard <u>WebGL v2.0</u> library. The Web Graphics Library version 2.0 is a JavaScript API for rendering high-performance interactive 3D and 2D graphics within any compatible web browser without the use of plug-ins.

Fixed and mobile stations with offline measurement support

We designed the SIMon system in such a way that it can integrate and supervise a measurement network consisting of fixed and mobile measurement stations with the help of a *Central controller* module and *Station controller* modules.

The *Station controller* module installed on-site at the measurement station guarantees the full use of all integrated measurement devices and controlling devices (like antenna switch/rotator) even if the measurement station is in offline mode (cannot access the central controller software). The *Station controller* module can also be installed in a remote location (for compact measurement stations without a local PC) and provides the same measurement and control capabilities, but it requires an online connection with the measurement station.

Device integration

The integration of new devices (whether coming from a different manufacturer or a new device by an already-supported manufacturer) to the system should not require the modification of the basic system (the *SIMon measurement controller*), only the development of a new driver based on existing drivers and or using the SIMon driver development SDK.

With the help of the SIMon device drivers, the *SIMon measurement controller* can cooperate with the following device families:

- Measuring receivers,
- Antenna switches and antenna rotators,
- Direction-finders,
- Digital broadcasting transmission monitors (e.g., DVB-T/T2),

- GPS devices,
- Devices providing meteorological data.

Currently, we have integrated and developed drivers for the following devices:

- NARDA: SignalShark 3310, 3320, 3330,
- Rohde & Schwarz: DDF-550, DDF-255, EB-500, EM-550, EM-100, ESMB, GB-127, GB-127M, RD-127, ZS-127,
- IZT: R3000 series,
- CRFS: RFeye Node 20-6, 50-8, 100-8, 100-18,
- CommsAudit: Spectra SRDF, CA4909-1,
- STMM: KM44 and KM88 switch, RK3 rotator,
- Compu-Consult: TELE-OPERATOR UTS v.16 DVB-T/T2 Dual LAN monitor,
- Boreas: Weather station.

Measurement modes and data storage

The **SIMon measurement controller** supports the issuing and execution of direct measurement tasks at the integrated measuring stations and measuring devices. In the case of direct measurement, the operator can access the devices and their settings via the user interface and can receive "real-time" feedback on setting changes by the resulting measured data.

The **SIMon measurement controller** also supports the issuing and the execution of automated, scheduled measurement tasks at the integrated measurement stations and measurement devices. The integrated scheduler supports:

- The execution of measurement tasks at the specified time/times based on task definitions devised in advance, without operator interference,
- Parallel task execution,
- Parallel resource usage (if the devices used for the tasks support it),
- Prioritized task execution.

The data generated during measurements is stored in uniform data format, regardless of which manufacturer's device was used for the measurement. The measurement data is stored at the measurement station, but the system also provides the option for on-demand automatic synchronization of the results to the central server.

Real-time measurements

The SIMon system is designed from the ground up to deliver the measurement results from the equipment to the user interface with optimal throughput and minimal latency. This design allows for "real-time" measurements.

During the system development we used the Akka toolkit which allows building highly concurrent, distributed, and resilient message-driven applications. Using the Akka toolkit we can use multiple threads in the driver development, to receive, decode, postprocess the measurement results from the receivers.

We also optimized the connection between the measurement stations and the user interface, to compress the data transmitted (lossless compression) and we are sending multiple packets of data simultaneously to reduce latency.

The user interface is also optimized for fast data processing and display, we use the GPU to parallelly process huge amounts of data.

Based on this design decisions and the optimized implementation we feel confident that our software does can handle the data acquisition speed of modern receivers.

The "real-time" operation is only limited by the used hardware, like switches, routers, network speed and latency...

User workflow

The starting page of the user interface is the integrated map (Google Maps or OpenStreetMap) which displays the integrated measurement stations. The main work processes of the system are initiated from the map:

- All integrated measurement stations are be displayed on the map, colour-coded for current status.
- Measurement locations and licensed and coordinated transmitters are displayable on the map.
- When selecting a measurement station, the system displays a window containing the available antennas and measurement devices, their current connections, and the list of scheduled and direct measurement tasks running on the selected station.

After selecting a measurement station, the user can perform the following task:

- Initiate a new measurement with the selected antenna and measurement device,
- Connect directly to the *Station controller* and configure the Station in a new window,
- View the measurement results.

Configuration

The system provides a uniform, centralized solution for the management of configuration data:

- System parameters,
- Central configuration data:
 - Measurement stations,
 - Places of measurement,
 - Transmitter data,
 - Measurement bands.
- Measurement station configuration data:
 - o Antennas,
 - o Devices,
 - Signal paths (valid antenna and device connections).

User identification and authorization

The system's functions are accessible only to identified users who must be identified with a username and password pair. Users and their authorizations are recorded and managed centrally.

The authorization system is role-based. During development, we define a set of basic rights or entitlements that secure the menu functions of the user interfaces and also the rights for calling functions or editing privileges. These privileges can be grouped into user-configurable roles, and the roles are assigned to the users.

Authentication of users logging in from the user interface and authorization at the start of each subprogram or function call is performed by the *Central- or Station controller* (based on the entitlements, rights derived from the roles assigned to users) depending on whether the user connects to the URL of the *Central controller* or the specified *Station controller*.

For the sake of autonomous (offline) operation, the *Station controller* has a synchronized, encrypted local copy of the central user and authorization records.

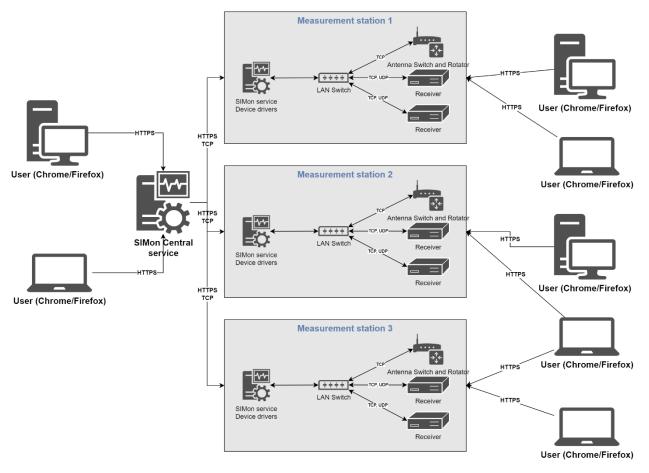
The user authentication in the SIMon system can be integrated with an existing Active Directory (AD) server or other LDAP servers (e.g., Open LDAP).

2. Logical operation model, system architecture

The SIMon system is designed in such a way that it can integrate and supervise a measurement network consisting of fixed and mobile measurement stations with the help of a module acting as a *Central controller*.

The *Central controller* can perform the following tasks with the integrated fixed and mobile measuring stations managed by their own *Station controller*:

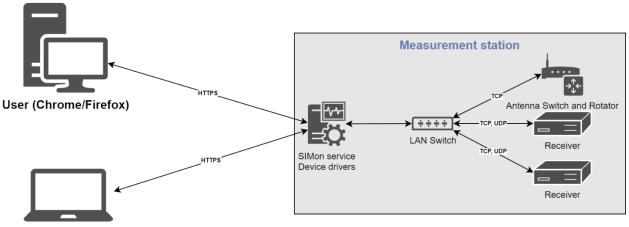
- Automatic registration of the newly installed measuring stations and storage of the configuration of the measuring stations in the Central system.
- Supervision of the measuring stations by scheduled (at least every 3 minutes) status information exchange provides an overview of the status of the stations and measuring devices.
- Synchronization of scheduled measurement tasks and the measured data.



The **Station controller** can:

- Manage and supervise the devices installed at the measuring Station:
 - o Antennas,
 - o Antenna switches and rotators,
 - Monitoring measurement receivers,
 - o Direction finders.
- Connect automatically to the *Central controller* and reconnect in case of an error, and send the current measuring station configuration and status information,
- Support the execution of direct and automated (scheduled) measurements, even if the central Station is not available (is offline),

- Store and process the measurement results even if the central Station is not available (is offline),
- Provide offline map data and services (based on locally stored OpenStreetMap data).



User (Chrome/Firefox)

The *Central controller* and the *Station controllers* running on the measuring stations provide a separate, standalone user interface accessible by a browser, which allows the complete management of the measurement system.

Using the user interface provided by the *Central controller*, all online measuring stations can be fully controlled.

The user interface provided by the *Station controller* supports the following tasks also in offline mode (without connection to the *Central controller*):

- The management of all integrated devices at the Station,
- The execution of direct and scheduled measurements,
- The graphical display and analysis of the measurement results.

3. Features in detail

Internationalization and localization

The user interface elements, the notifications /message texts are translated to English, French, Dutch and Hungarian.

Authorization

The system's user interface pages and functions are accessible only to authenticated users, who have the **basic right** to use the selected user interface or functionality.

Users and their authorizations are recorded and managed centrally.

The authorization system is role-based. During development, we define a set of **basic rights** or **entitlements** that secure the menu functions of the user interfaces and also the rights for calling functions or editing privileges. These privileges can be grouped into user-configurable **roles**, and the **roles** are assigned to the users.

At the start of each subprogram or function call, an authorization check is performed by the *Central- or Station controller* (based on the **basic rights/entitlements** derived from the **roles** assigned to users).

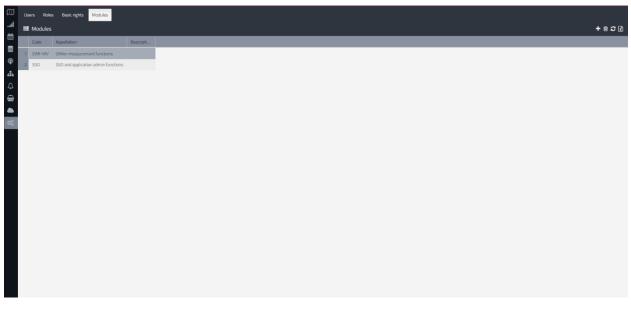
If the user doesn't have the proper **basic rights/entitlements** necessary to access the desired user interface or function, then the function menu/button is greyed out.

Entitlement management

The user interface for the Entitlement management is accessible only to the users with the "SSO and application admin functions - System administrator (SSO)" role.

The entitlement management user interface contains the following tab pages:

Modules



The modules are used to separate the authentication/authorization components from the measurement components.

Basic rights

50	rs Roles Basic rights Mode	les				
	Rights	Entitlement code	Entitlement name	Description	Valid at headquarter	Valid at measurement statio
	SIMon functions	BROADCAST_DATA_IMPORT	Broadcast data import		E	
2	SIMon functions	BROADCAST_DATA_MAINTENANCE	Broadcast data maintenance		0	
	SIMon functions	CODE_MAINT	Code repository maintenance		ĭ.	
4	SIMon functions	CONF_MAINT	Configuration maintenance	Geographical location, station, device.	Ľ	
5	SIMon functions	DATA_REQUEST	Data requirement management		S	
6	SIMon functions	EVENT_MAINT	Event handling		ſ €	8
7	SIMon functions	EVENT_VIEW	Reviewing events and logs			
8	SIMon functions	FREQUENCY_BANDS_MAINTENANCE	Frequency band maintenance		Ľ	
9	SIMon functions	GUI_ACTIVE_BROADCAST_LIST	Transmitter data management		Ľ	
	SIMon functions	GUI_ALERT	Alert management		ſ €	
	SIMon functions	GUI_ALERT_ASSIGNMENT	Alert work basket			
12	SIMon functions	GUI_AUTOMATIC_MEASUREMENT	Automatic measurement management		Ľ	ĭ.
	SIMon functions	GUI_BASE_DATA	Master data management			
14	SIMon functions	GUI_DEVICE_MANAGER	Device management			
15	SIMon functions	GUI_DF_MEASUREMENT	Geolocation		Ľ	
16	SIMon functions	GUI_MAP	Map related functions		Ľ	V
17	SIMon functions	GUI_MEAS_BAND_MAIN	Measurement frequency management			
18	SIMon functions	GUI_MEAS_STATIONS	Measurement system functions		×	⊻
19	SIMon functions	GUI_MEASUREMENT	Measurement functions		Ľ	⊻
	SIMon functions	GUI_MEASUREMENT_DATA	Result management		Ľ	9
	SIMon functions	GUI_NEW_MEASUREMENT	New measurement			⊻
	SIMon functions	GUI_SCHEDULE	Task scheduling			⊻
					~	<i>—</i> •

The basic rights page contains all the rights/entitlements associated with the system functions.

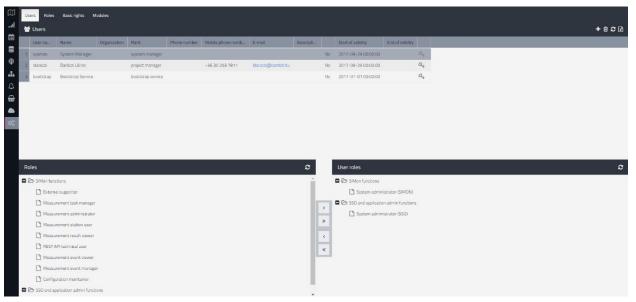
For example, if the user wants to configure the measurement station settings, then he must have access to the **CONF_MAINT** right/entitlement. The **CONF_MAINT** right/entitlement is assigned to the "SIMon measurement functions - System administrator (SIMON)" role.

Roles

Use	rs Roles Basic rights Roles	Modules		
	Module name 1	Role code 🍴	Role name	Description
1	SIMon functions	CONF_ADMIN	Configuration maintainer	The person authorized to maintain configuration data.
2	SIMon functions	EVENT_HANDLER	Measurement event manager	The person authorized to manage measurement events (e.g. person in charge or on duty)
з	SIMon functions	EVENT_VIEWER	Measurement event viewer	The person authorized to view, but not modify, measurement events.
4	SIMon functions	REST_API	REST API technical user	Technical user authorized to use REST API.
5	SIMon functions	RESULT_VIEWER	Measurement result viewer	The person authorized to view, but not modify, measurement results.
6	SIMon functions	STATION_USER	Measurement station user	The person authorized to log onto a measurement station.
7	SIMon functions	SYSTEM_ADMIN	System administrator (SIMON)	The person authorized to use all functions of the SIMon module.
8	SIMon functions	TASK_ADMIN	Measurement administrator	The person authorized to manage measurement tasks and results.
9	SIMon functions	TASK_REQUIRER	Measurement task manager	The person authorized to manage measurement tasks and also to view results.
10	SIMon functions	THIRD_PARTY_OPERATOR	External supporter	The person authorized to use external support functions.
Rig	hts			C Role privileges
				Entitlement reviewing
				Code repository mainter
				Configuration maintena
				Data requirement mana
				Event handling
				< C Reviewing events and lo
				 Alert management
				Master data manageme
				Device management
				Map related functions
				Measurement system for

From the basic rights/entitlements the admin users can create new roles or reconfigure existing roles to create a security policy specific to their organization.

Users



The Users page is used to manage the users who can access the system.

Each user can have multiple roles which determine the users access to the SIMon system functions.

The SIMon system ships with some predefined users and roles, but they can be customized by our customers. The predefined access policies only allow administrators the options to configure the system settings, measurement station configuration, equipment configuration,

Station configuration

A measurement station can be configured by a user with "SIMon measurement functions - System administrator (SIMON)" role.

The station configuration interface supports the following settings:

💿 🖂 🛛 🖉 10.1 °C 💧 0 mm 🛛 📽 💧 Daróczi Lőrinc 🖡 FIX Ê 3 Longitude \$ 47,1381050 17,5638630 **\$** m 200,00 CC-TELE-OPERATOR (ONLINE) Default ige (disk) capacity Å EB500 (ONLINE) \$ ly low free space (GByte) ESMB (ONLINE) \$ NUSIGNALSHARK (ONLINE) Free Space [GByte] -RS-DDF550 (ONLINE) \$ ce quick run out [%/hour] \$ HF902H (ONLINE) HL023A1 (ONLINE) HL040 (ONLINE) RK3 (ONLINE) KM88 (ONLINE) Boreas-BxS06 (ONLINE) Save and restart

Station configuration panel

The station configuration panel contains the general configuration of the station, as seen on the screen above.

Device configuration panel

Receivers

		FIX-MV-02	Config.	General device s	ettings								
.al		topology	Config.	Code	EB500	Enabled							
Ê	Devices		ວ	Charles and	EB500								
	Receivers:			Short name									
(CC-TELE-	OPERATOR (ONLINE)		Name	EB500								
"	EB500 (0	NLINE)		Model		Driver	RS-EB500						
4	ESMB (ON	ILINE)		Serial Number		General device settings							
@	N-SIGNAL	SHARK (ONLINE)			m			Ê					
•	RS-DDF5	50 (ONLINE)		Calibration date		Expiration Date							
¢8	Antennas:												
	HF902H (ONLINE)		Note									
- 1	HF902V (ONLINE)											
- 1	HK309 (0	NLINE)		EB 500 config									
- 1	HL023A1			IP address		127.0.0.1	5555						
_	HL040 (0			Real-time bandwidth m	ust be a real number greater than 0	20	MHz 💌	3.6	GH	-iz 💌			
- 1	Antenna Rota					20	MHz 🔻						
_	RK3 (ONL			Realtime bandwidth		20	NILL -						
_	Antenna Switi												
- 1	KM88 (01												
- 1	Weather Stati												
- 1	Boreas-B	x506 (ONLINE)											
- 1													
	Сору	New Rename	Delete									Save and restart	Cancel

The receivers available on the station can be configured by using the devices panel.

	FIX-MV-02	Config.	General device s	ettings				
	topology	Config.	Code	KM88	Enabled	V		
Devices		ະ	Short name	KM88				
Receivers:								
CC-TELE-	-OPERATOR (ONLINE)		Name	KM88				
EB500 (0	INLINE)		Model		Driver	KM88		
ESMB (OF	NLINE)		Serial Number		General device settings			
N-SIGNA	LSHARK (ONLINE)					m		
RS-DDF5	550 (ONLINE)		Calibration date		Expiration Date			
Antennas:								
HF902H	(ONLINE)		Note					
HF902V ((ONLINE)							
HK309 (C	DNLINE)		KM44 config.					
HL023A1	1 (ONLINE)		IP address	127.0.0.1	42021			
HL040 (0	ONLINE)							
Antenna Rota	ators:							
RK3 (ONL	LINE)							
Antenna Swit	tches:							
KM88 (01	NLINE)							
Weather Stat	tions:							
Boreas-B	3x506 (ONLINE)							
							🖺 Save and r	

Antenna switches and rotators

Antennas

D Station:	FIX-MV-02	Config.	General device	settings						
Topology driver:	topology	Config.	Code	HK309	Enabled		Y			
Devices		0	Short name	HK309						
Receivers:	-OPERATOR (ONLINE)		Name	НКВО9						
	ONLINE)		Model		Driver		ANT-GENERAL			
ESMB (DNLINE)		Serial Number		General device	settings				
N-SIGN	ALSHARK (ONLINE)		Calibration date	Ê	Expiration Date		<u>60</u>			
	550 (ONLINE)						Antenna factor table			√ x
Antennas:	(ONLINE)		Note			_ h				
	(ONLINE)					_	НК309	< 16 G + @ C ☑		•
HK3091	(ONLINE)		Antenna Gener	al config			Frequency [Hz]		35 1	
HL023A	1 (ONLINE)		Frequency range	20	MHz 💌	1.3	1 20 000 000 2 30 000 000	21,0000	30	
HL040 (Rotatable	0	Direction Finder		3 60 000 000	10,0000		
Antenna Ro RK3 (01)			Polarization	N/A 👻		- 11	4 90 000 000	17,0000	25	
Antenna Sw			Azimuth offset	0].	li	5 180 000 000	23,0000	20	
KM88 (0	DNLINE)					- 11	6 200 000 000	27,0000	15-	
Weather Sta	itions:		lcon				7 280 000 000	31,0000	10	
Boreas	B×SO6 (ONLINE)		Icon preview				8 400 000 000 9 550 000 000	32,0000	o topologie sources sources topologie topologie topologie	5 ⁰⁰
						Antenr	10 700 000 000	30,0000	N. N. C. C. L. L. N.	
						L	11 890 000 000	30.0000		
Сору	New Rename	Delete							Save and restart	Cancel

The antenna configuration options allow the configuration of the antennas available on the station with their frequency range and the antenna correction factor table.

Topology configuration panel

General configuration

	Station:	FIX-MV-02	Config.	Tapalogy config	
al		topology	Config.		
m	Devices		3	General device information Signal path definitions Antenna switch	
	Receivers:			NASES *	
Ŷ	CC-TELE-	OPERATOR (ONLINE)		Antenna rotator	
#	EB500 (0	INLINE)		Rig *	
4	ESMB (O	NLINE)		Antenna ardar:	
⊕	N-SIGNA	LSHARK (ONLINE)		HF902H HF902V HK309 HL023A1 HL040	
	RS-DDF:	50 (ONLINE)			1
o;	Antennas:				
0%	HF902H				
	HF902V		_		
	HK309 (0		_		
	HL023A				
	HLO40 (C Antenna Rota				
	RK3 (ON				
	Antenna Swit				
	KM88 (0				
	Weather Stat	ions:			
	Boreas-B	xS06 (ONLINE)			
				😫 Save and restart Carcel	

The general configuration panel allows the configuration of the antenna switch and the display order of antennas and receivers on the signal path selection panel.

Signal path definitions

	topology	Config.	юр	ology config								
Devices	capanogy	3	Gen	eral device informatio	Signal path defin	nitions						
Receivers:			-									
CC-TEL	LE-OPERATOR (ONLINE)			Code	Name		Switch in port	Switch out p		Receiver in port		
EBSOC	(ONLINE)		1	HF902H_EB500	HF902H EB500	HF902H	ANT_6 - Antenna 6.	RX_1 - RX 1.	EB500	X43 - V/UHF 2 (20 MHz - 3.6 GHz)	Correction table	0
ESMB	(ONLINE)		2	HF902H_E5MB	HF902H ESMB	HF902H	ANT_6 - Antenna 6.	RX_3 - RX 3.	ESMB	X13 - V/UHF (20 MHz - 3.0 GHz)	Correction table	0
N-SIG7	NALSHARK (ONLINE)		3	HF902H_DDF550	HF902H_DDF550	HF902H	ANT_6 - Antenna 6.	RX_4 - RX 4.	RS-DDF550	X42 - V/UHF 3 (20 MHz - 3.6 GHz)	Correction table	Û
RS-DD	F550 (ONLINE)		- 4	HF902H_TELE	HF902H_TELE	HF902H	ANT_6 - Antenna 6.	RX_2 - RX 2.	CC-TELE-OPERATOR	INPUT - Input	Correction table	Û
Antennas:			5	HF902V_EB500	HF902V E8500	HF902V	ANT_5 - Antenna 5.	RX_1 - RX 1.	EB500	X43 - V/UHF 2 (20 MHz - 3.6 GHz)	Correction table	0
HF902	eh (online)		6	HF902V_ESMB	HF902V ESMB	HF902V	ANT_5 - Antenna 5.	RX_3 - RX 3.	ESMB	X13 - V/UHF (20 MHz - 3.0 GHz)	Correction table	Û
HF902	V (ONLINE)		7	HK309_DDF550	HK309 DDF550	HK309	ANT_1 - Antenna 1.	Correction table				
HK309	(ONLINE)		8	HK309_EB500	HK309 EB500	HK309	ANT_1 - Antenna 1.			< 10 ∆ + ≅ <i>C</i> 2		
HL023	A1 (ONUNE)		. 9	HK309_NARDA	HK309 NARDA	HK309	ANT_1 - Antenna 1.	HK309 EB500				
HL040	I (ONLINE)		10	HK309_TELE	HK309 TELE	НКЗОЭ	ANT_1 - Antenna 1.	Freques	icy [Hz]			
Antenna R	otators.		11	HL023A1_DDF550	HL023A1 D0F550	HL023A1	ANT_3 - Antenna 3.	- 1	20 000 000	0,4000	0- 5-	
RK3 (C	INLINE)		12	HL023A1_EB500	HL023A1 EB500	HL023A1	ANT_3 - Antenna 3.	2	30 000 000	0.5000	0-	
Antenna Si	witches:		13	HL023A1_ESMB	HL023A1 ESMB	HL023A1	ANT_3 - Antenna 3.	з	50 000 000	0.7000 2	5-	/
KM88	(ONLINE)		34	HL023A1_TELE	HL023A1 TELE	HL023A1	ANT_3 - Antenna 3.	- (4)	80 000 000	0.8000 2	0-	/
Weather Si	tations:		100	HL040_DDF550	HL040 DDF550	HL040	ANT_2 - Antenna 2.	5	100 000 000	0,0000	5-	
Boreas	- BxS06 (ONLINE)			HL040_EB500	HL040 EB500	HL040	ANT_2 - Antenna 2.	6	200 000 000	1,4000	5.	
			and the second second	HLO40 NARDA	HL040 NARDA	HL040	ANT_2 - Antenna 2.	-7	300 000 000	1,7000	0	
				HLO40 TELE	HL040 TELE	HL040	ANT 2 - Antenna 2.	8	500 000 000	2,2000	0 7000000 LOS	5. 900 900 900 900 900 900
			10	HEDHOL TELE	PLUND I CLE	112040	Ann_z - Ancenna z.	9	700 000 000	2,7000	20050 405	South South Strate Strate South Strate
Сору	New Rename	Delete						10	000 000 000	3,4000		
	Rename							11	000 000 000	4,0000 *		

The signal path definitions panel allows the configuration of the connections between the antennas, the signal path switch input and output and the receiver input.

For each signal path it is possible to provide a correction table.

The antenna and the signal path correction tables are taken into account when displaying the spectrum data using the $dB\mu V/m$ measurement unit.

The SIMon system automatically saves the station configuration to the central server, so in case of failure/data loss, during the reinstallation of the software on the station it can be copied back.

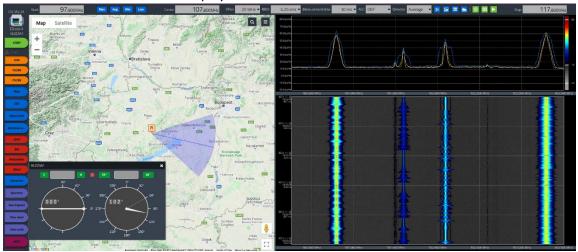
The installation image of the SIMon system contains all the device drivers supported by the system, and it will automatically configure them according to the station configuration files which can be restored manually form the central server.

Measurement execution

The **SIMon measurement controller** provides the following measurement execution modes:

• Direct measurement: when device selection (including the antenna rotator and signal path switch) and measurement configuration take place in "real-time" through the user interface,

and the measured data is also displayed in "real-time."

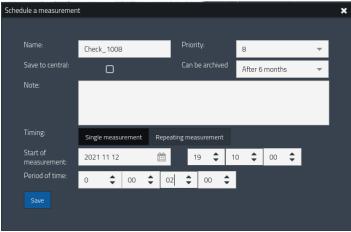


 Automatic and scheduled monitoring measurement: when the execution of a pre-assembled and queued (scheduled) measurement task takes place in the background (without a connected user interface), and the measured data is continuously stored.

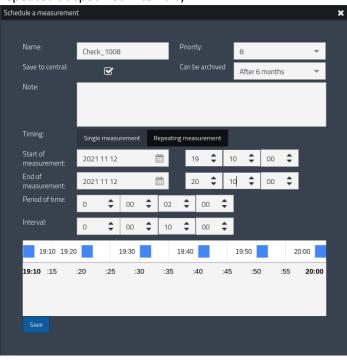
0	Sched	uled and active measurements					
	Туре	Task name	Start †	Finish	State	Period of time	Device †
1	.al	107 800 kHz	2021.11.12 19:08:25		0		DDF255-A HK309
2	0	Check_1008	2021.11.12 19:10:00	2021.11.12 19:12:00	×	00:02:00	EB500-A HL023A1
з	0	Check_1008	2021.11.12 19:20:00	2021.11.12 19:22:00	×	00:02:00	EB500-A HL023A1
4	9	Check_1008	2021.11.12 19:30:00	2021.11.12 19:32:00		00:02:00	EB500-A HL023A1
5	9	Check_1008	2021.11.12 19:40:00	2021.11.12 19:42:00	Ø	00:02:00	EB500-A HL023A1
6	0	Check_1008	2021.11.12 19:50:00	2021.11.12 19:52:00	Ø	00:02:00	EB500-A HL023A1
7	9	Check_1008	2021.11.12 20:00:00	2021.11.12 20:02:00	Ø	00:02:00	EB500-A HL023A1

Automatic measurements can be scheduled like a:

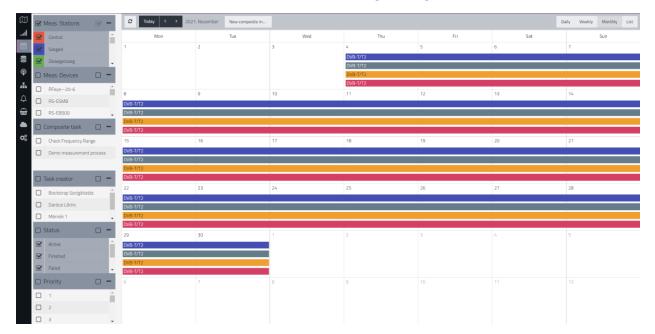
• single measurement (with a specified start time and a specified duration),



 repeating measurement (measured during a specified time range, with a specified duration, repeated at specified intervals).



The scheduled measurement tasks can be viewed and managed using the embedded calendar view:





The scheduled repeating measurements can be viewed and managed using the embedded list view:

1 Task creator - 2021.11.04.1000 2021.11.30 11.00 DVB-7/72 1 ming: Srede measurement: 2021.11.04.1000 2021.11.30 11.00 DVB-7/72 1 ming: Srede measurement: 10 00 00 00 00 1 Memok 1 - - - 11 00 00 0 <th></th> <th></th> <th>Meas. Stations</th> <th>⊴ -</th> <th>2021-11-0</th> <th>2 🛗 - 202</th> <th>1-11-22</th> <th>Ê</th> <th>New compo</th> <th>ite m</th> <th></th> <th>E</th> <th>Daily</th> <th>Weel</th> <th>kly 1</th> <th>fonthly</th> <th>List</th>			Meas. Stations	⊴ -	2021-11-0	2 🛗 - 202	1-11-22	Ê	New compo	ite m																		E	Daily	Weel	kly 1	fonthly	List
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Automated missions

Measurement Wizard

The *SIMon measurement controller* also provides the possibility to schedule the same measurement at the same time on multiple measuring stations, having the same device and antenna configuration.

Start automatic measurement at selected stations - 2 → Meas. Stations 1 Task → 2 Meas. Stations 3 Mode → 4 Timing → 5 Result processing → 6 Details Code Name Station configuration type DDF550+EBS00+EM550 Estoin configuration type DDF550+EBS00+EM550 DDF550+EBS00+EM550 Kisvarda Gosztola DDF550+EBS00+EM550 BS00+KM44 Eisson+EM50 Eisson+EM550 External-Data FIX-MV-02 Eisson+EM50 FIX-MV-02 Eisson+EM-2 Eisson+EM50 FIX-MV-Oroszlany Eisson+EM-2 Eisson+EM50 FIX-MV-Visegradi Eisson+EM-2 Eisson+EM50								
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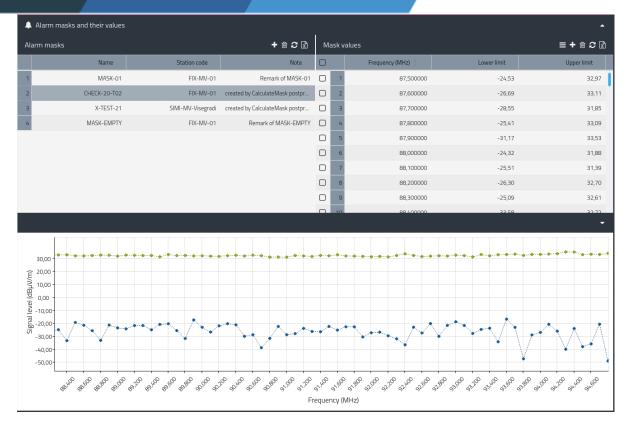
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Mask/List definitions

Masks are named collections of expected values by frequencies/channels.



It currently supports only level range (lower limit and upper limit).

It can be created:

- enter manually (from scratch)
- loading from Excel
- calculating based on a chosen measurement result and the given parameters:



Alerts

A scheduled measurement running on the station can generate alerts based on mask violations.

The station saves the alert and transfer it to the Central controller. The system notifies the users with a bell sign at the top corner of the main window:



The alerts can be shown in the detailed view:

≢ Filters		Ala		wor	k bas	sket								c 🗈
Operator				F	Ur	Operator	Category	Station	Freqfrom, -to	Creation	Start ti	Deadline	Finish t	Note
Daróczi Lörinc	Ŧ		1	1	801	6 Daróczi Lőrinc	Zavarjelenség	FIX-MV-01	107.700 - 107.900MHz	2019.03.14 01:00	2019.0		2019.0	Ez egy megjegyzqqqqq
Category No filtering	~	۵	2	з	809	6 Daróczi Lőrinc	Zauarjelenség	FIX-MV-01	107.700 - 107.900MHz	2019.03.14 01:00			2019.0	Ez egy megjegyzés a riszatáshoz
		0	з	5	109	6 Daróczi Lőrinc	Zauarjelenség	FIX-MV-D1	87.500 - 108.000MHz	2019.04.18 01:12	2019.0	2019.0	2019.0	
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Result management, post-processing

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Торіс		o 📃	Measurement s	tation 1 Meas. Device 1	Antenna	Appellation	Start frequency [Hz]	Stop frequency (Start of measurement 4	End of measurement	Task creator	Task status	Topic	Physical placem
G 🗀 2015		- 18	FDI-MV-01	EB500-A	HL023A1	Check_1008	95 800 000	105 800 000	2021.11.12 19:10:00	2021.11.12 20:10:00	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
2016		2	FIX-MV-01	DDF255-A	HK309	Scan: 97.8 MHz - 117.8 MHz	97 800 000	117 800 000	2021.11.12 19:08:25	2021.11.12 20:05:22	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
2018		3	FDC-MV-01	EB500-A	HL023A1	Scar: 95.8 MHz - 108.3 MHz	95 800 000	108 300 000	2021.11.12 19:00:04	2021.11.12 19:02:03	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
D = 2019		4	FDI-MV-01	EB500-A	HL023Å1	Scan: 102.8 MHz - 112.8 MHz	102 800 000	112 800 000	2021.11.12 18:59:40	2021.11.12 19:00:03	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
2020		5	FIX-MV-01	EB500-A	HL023A1	Scar: 97.8 MHz - 117.8 MHz	97 800 000	117 800 000	2021.11.12 18:59:28	2021.11.12 18:59:40	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
■ (⇒ 2021)		6	FIX-MV-01	EB500-A	HL023A1	Scan: 97.8 MHz - 117.8 MHz	97 800 000	117800000	2021.11.12 18:55:01	2021.11.12 18:56:08	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
		7	FIX-MV-01	DDF255-A	HE010E	test_211101_001_9kHz - 1	9 0 0 0	19 000	2021.11.01.20:20:00	2021.11.01 20:20:20	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
0 10 03		8	FDC-MV-01	DDF255-A	HE010E	Scan: 0.009 MHz - 0.019 MHz	9 000	19 000	2021.11.01 20:03:25	2021.11.01 20:05:35	Idaroczi	FINISHED	2021/11/idaroczi	2021/11/idaroc
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HK309		1 2	SCAN-EB500-A							SCAN			A	
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DDF255-A		-		W-EB500-A0001-p001						SEAN			× -	
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Торіс С	Measurement station	Meas Device	Antenna	Appellation	Start freque	and a second sec	Pay Rdj./em				1100		⊞ C@ !	
	Measurement station	EB500-A	HL023A1	Check_1008	Start freque	95 800 000					1100		⊞ C⊗ II	
Topic 🏾 C	Measurement station FIX-MV-01 FIX-MV-01	EB500-A DDF255-A	HL023A1 HK309	Check_1008 Scan: 97.8 MHz - 117.8 MHz	Start freque	95 800 000	Pay 75.53,010 St.53,010 St.53,010				1100		■ C⊗ I	
Topic C	Measurement station 1 FIX-MV-01 2 FIX-MV-01 3 FIX-MV-01	EB500-A DDF255-A EB500-A	HL023A1 HK309 HL023A1	Check, 1008 Scan: 97.8 MHz - 117.8 MHz Scan: 95.8 MHz - 108.3 MHz		95 800 000 97 800 000 95 800 000	Piny 71.48,/Vm Std8,/Vm Std8,/Vm Vd8,/Vm				±±00		■ C011	
Topic 2	Measurement station 1 FDX-MV-01 2 FDX-MV-01 3 FDX-MV-01 4 FDX-MV-01	EB500-A DDF255-A EB500-A EB500-A	HL023A1 HK309 HL023A1 HL023A1	Check_ 1008 Scar: 97.8 MHz - 117.8 MHz Scar: 95.8 MHz - 108.3 MHz Scar: 102.8 MHz - 112.8 MHz		95 800 000 97 800 000 95 800 000 102 800 000	Pay 75.53,010 St.53,010 St.53,010		Â		1200		■ C o II	
Topic C	Measurement station FIX-MN-01 FIX-MN-01 FIX-MN-01 FIX-MN-01 FIX-MN-01 FIX-MN-01 FIX-MN-01	EBSOD-A DDF255-A EBSOD-A EBSOD-A EBSOD-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1	Check_1008 Scar: 97.8 MHz - 117.8 MHz Scar: 95.8 MHz - 108.3 MHz Scar: 102.8 MHz - 112.8 MHz Scar: 97.8 MHz - 117.8 MHz		95 800 000 97 800 000 95 800 000 102 800 000 97 800 000 97 800 000	Par 755%/VM 655%/VM 655%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM 153%/VM				±±•≎		■ C⊙II	
Topc C	Measurement station 1 FDX-MV-01 2 FDX-MV-01 3 FDX-MV-01 4 FDX-MV-01 5 FDX-MV-01 6 FDX-MV-01	EB500-A DDF255-A EB500-A EB500-A EB500-A EB500-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1	Cherx, 1008 Scar: 97.8 MHz - 117.8 MHz Scar: 95.8 MHz - 108.3 MHz Scar: 102.8 MHz - 112.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz		95 800 000 97 800 000 95 800 000 95 800 000 97 900 000 97 900 000 97 800 000	Pay 75.5%/vm 62.5%/vm 62.5%/vm 92.5%/vm 92.5%/vm				±±•≎			
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Topic 2 □ 2015 □ 2016 □ 2016 □ 2016 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2010 □ 2000	Measurement station 1 RK-MV-01 2 RK-MV-01 3 RK-MV-01 4 RK-MV-01 5 RK-MV-01 6 RK-MV-01 7 RK-MV-01	EB500-A DDF255-A EB500-A EB500-A EB500-A EB500-A DDF255-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1 HE010E	Check, 1008 Scar: 97.8 MHz - 117.8 MHz Scar: 95.8 MHz - 108.3 MHz Scar: 102.8 MHz - 112.8 MHz Scar: 97.8 MHz - 117.8 MHz		95 900 000 97 900 000 95 900 000 102 900 000 97 900 000 97 900 000 9 900 000	Pro- Triduren Editore				<u>a l</u>	ı. A	-1 I.	
Type: 2 2015 2015 2016 2016 2019 2019 2019 2019 2019 2019 2019 2019 2019 2019 2019 2019 2010	Measurement station 1 RK-MV-01 2 RK-MV-01 3 RK-MV-01 4 RK-MV-01 5 RK-MV-01 6 RK-MV-01 7 RK-MV-01	EB500-A DDF255-A EB500-A EB500-A EB500-A EB500-A DDF255-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1 HE010E	Check, 1008 Scar: 97.8 MHz - 117.8 MHz Scar: 95.8 MHz - 108.3 MHz Scar: 102.8 MHz - 112.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz Sert_211101_00T_9Hz - 1		95 900 000 97 900 000 95 900 000 102 900 000 97 900 000 97 900 000 9 900 000	700 - 700 -	1			<u>a l</u>	ı. A	-1 I.	
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Topic 2 □ 2015 □ 2016 □ 2018 □ 2018 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2019 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010 □ 2010	Measurement station 1 RK-MV-01 2 RK-MV-01 3 RK-MV-01 4 RK-MV-01 5 RK-MV-01 6 RK-MV-01 7 RK-MV-01	EB500-A DDF255-A EB500-A EB500-A EB500-A EB500-A DDF255-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1	Check, 1008 Scar: 97.8 MHz - 117.8 MHz Scar: 95.8 MHz - 108.3 MHz Scar: 102.8 MHz - 112.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz Sert_211101_00T_9Hz - 1		95 900 000 97 900 000 95 900 000 102 900 000 97 900 000 97 900 000 9 900 000	700 - 700 -				<u>a l</u>	ı. A	-1 I.	
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Topic 2 □ 2015 □ 2016 □ 2016 □ 2016 □ 2016 □ 2016 □ 2016 □ 2016 □ 2016 □ 2000	Measurement station 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60 17:64:60	EB300-A DDF255-A EB500-A EB500-A EB500-A DDF255-A DDF255-A DDF255-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1	Desc, 1000 Scan 92 AMA - 113 AMA Scan 95 AMA - 113 AMA Scan 95 AMA - 103 AMA Scan 92 AMA - 103 AMA Scan 92 AMA - 113 AMA Scan 92 AMA - 113 AMA Scan 92 AMA - 113 AMA Scan 200 AMA - 101 AMA Scan 200 AMA - 101 AMA		95 900 000 97 900 000 95 900 000 102 900 000 97 900 000 97 900 000 9 900 000	700 - 700 -	1.000			<u>a l</u>	₽.	-1 I.	
Topic 2 0 2015 0 2016 0 2018 0 2018 0 2019	Measurement station IPAR-M03 TRAM-01	EB300-A DDF255-A EB500-A EB500-A EB500-A DDF255-A DDF255-A DDF255-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1	Check, 1008 Scar: 97.8 MHz - 117.8 MHz Scar: 95.8 MHz - 108.3 MHz Scar: 102.8 MHz - 112.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz Scar: 97.8 MHz - 117.8 MHz Sert_211101_00T_9Hz - 1		9900000 9780000 9790000 9790000 9790000 9790000 970000 9000	700 - 700 -				<u>a l</u>	₽.	-1 I.	
Topic 2 □ 2015 □ □ 2016 □ □ 2016 □ □ 2016 □ □ 2016 □ □ 2016 □ □ 2016 □ □ 2016 □ □ 2016 □ □ 2017 □ □ 2019 □ □ 2019 □ □ 2010 □ □ 2019 □ □ 2019 □ □ 2010 □ □ 2010 □ □ 2010 □ □ 2010 □ □ 2010 □ □ 2010 □ □ 2010 □ □ 2010 □ □ 2010 □ □ 2010 □	Measurement Station 10 FXAMU 0 17 FXAMU 0	EB300-A DDF255-A EB500-A EB500-A EB500-A DDF255-A DDF255-A DDF255-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1	Dec; 1000 Sian 92 AMR - 113 AMR Sian 93 AMR - 103 AMR Sian 93 AMR - 103 AMR Sian 92 AMR - 103 AMR Sian 92 AMR - 113 AMR Sian 0.004 Me - 0.019049			700 - 700 -				<u>a l</u>	₽.	-1 I.	
Topic 2 2015 2016 2016 2016 2018 2016 2019 2016 2019 2016 2019 2016 2019 2016 2019 2016 2019 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2010 2016 2011 1 2011 1 2011 1 2011 1 2011 1 2011 1 2011 1 2011 1 2011 1 2011 1 2011 1	Measurement Station 1704Abc0	EB300-A DDF255-A EB500-A EB500-A EB500-A DDF255-A DDF255-A DDF255-A	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1	Внех, 1002 Sam 92 AMA - 113 AMA Sam 95 AMA - 113 AMA Sam 95 AMA - 113 AMA Sam 93 AMA - 112 AMA Sam 93 AMA Sam 93 AMA - 112 AMA Sam 93 AMA Sam			700 - 700 -				<u>a l</u>	₽.	-1 I.	
Topic 2 0 2015 0 2016 0 2018 0 2019 0 2019 0 2019 0 2019 0 2019 0 2019 0 2019 0 2019 0 2010	Mazaument station IPAM-03 TRAM-03 TRAM-04 TRAM-04 TRAM-05 TRAM-05 TRAM-01	EBSOD-Å DDF255-A EBSOD-Å EBSOD-Å EBSOD-Å EBSOD-Å DDF255-Å DDF255-Å DDF255-Å	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1	Dec; 1000 Sian 92 AMR - 113 AMR Sian 93 AMR - 103 AMR Sian 93 AMR - 103 AMR Sian 92 AMR - 103 AMR Sian 92 AMR - 113 AMR Sian 0.004 Me - 0.019049							<u>a l</u>	₽.	-1 I.	
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Topic 2 0 2015 0 2016 0 2018 0 2019 0 2019 0 2019 0 2019 0 2019 0 2019 0 2019 0 2019 0 2010	Mazaument station IPAM-03 TRAM-03 TRAM-04 TRAM-04 TRAM-05 TRAM-05 TRAM-01	EBSOD-Å DDF255-A EBSOD-Å EBSOD-Å EBSOD-Å EBSOD-Å DDF255-Å DDF255-Å DDF255-Å	HL023A1 HK309 HL023A1 HL023A1 HL023A1 HL023A1 HL023A1	Внех, 1002 Sam 92 AMA - 113 AMA Sam 95 AMA - 113 AMA Sam 95 AMA - 113 AMA Sam 93 AMA - 112 AMA Sam 93 AMA Sam 93 AMA - 112 AMA Sam 93 AMA Sam										

The measured data is stored in a uniform data format, regardless of which manufacturer's device was used for the measurement. This way, it can be ensured that data measured by different devices can be compared and processed with uniform algorithms. The system manages the following data types:

- Spectrum data (signal level data measured in the specified frequency range, at the specified time range),
- Audio data,
- Direction finding data,
- DVB-T/T2 data,

- I/Q data,
- Weather data.

The system supports the automated uploading of measurement results stored at the measuring stations to the *Central controller*. The following use cases are supported:

- The automated upload to the central storage can be requested at the time of the measurement task creation,
- The automated upload to the central storage can be requested after the execution of the measurement task,
- Manual upload to the central storage, with the help of a USB drive, in the case of offline measuring stations.

"Real-time" processing of measurement data

• channel occupation %

Post-processing of measurement results is supported with the following features:

- Spectrum data:
 - o Deleting rows between given signal level and/or frequency interval,
 - Saving rows between given time interval,
 - o Saving rows between given time and frequency interval,
 - o Deleting rows between given time intervals,
 - Statistical compression of data (maximum, average, minimum), for the given time interval, with the given compression interval,
 - o Occupancy calculation based on a given noise level,
 - Export of data in CSV (Comma-Separated Values) format.
- Audio data:
 - Conversion to WAV (Waveform Audio File) format.

Measurement station	Meas. Device	Antenna	Appellation	Start frequency [Hz]	Stop frequency [Start	of measurement 👃	End of measurement	Task creator	Task status	Торіс	Physical pla
FIX-MV-01	EB500-A	102204	Charle 1000	05.000.000	105,000,000		11.12 19:10:00	2021.11.12 20:10:00	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/ld
FIX-MV-01	DDF255-A	Process	- [EB500-A] Check_100	08 ⇒ SCAN-EB500-A		×	1.12 19:08:25	2021.11.12 20:05:22	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/k
FIX-MV-01	EB500-A	Delete	rows containing data in f	the given interval		+	1.12 19:00:04	2021.11.12 19:02:03	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/
FIX-MV-01	EB500-A			0			1.12 18:59:40	2021.11.12 19:00:03	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/
FIX-MV-01	EB500-A	Save ro	ws between a given tim	e interval		+	1.12 18:59:28	2021.11.12 18:59:40	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/
FIX-MV-01	EB500-A	Delete	rows between a given ti	me interval		+	1.12 18:55:01	2021.11.12 18:56:08	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/
FIX-MV-01	DDF255-A		0				1.01 20:20:00	2021.11.01 20:20:20	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/
FIX-MV-01	DDF255-A	Compre	ess data			+	1.01 20:03:25	2021.11.01 20:05:36	Idaroczi	FINISHED	2021/11/Idaroczi	2021/11/
		Filter (to) Compres Calculatio	: ision interval: *	00 \$ 00 \$ 10	\$	*						
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SCAN-EB500-A		Calcula	te occupation			+		SCAN				⊞
K Nightly calculationOVEF												
OVERVIEW_SCAN-EB500)-A0001-p001					ocess		SCAN				

It runs on the server as a background process:

	📤 Ba	ckground processes				c	x
		Enroll	Claimant	Task	State	Process	
6	3 1	11/12/2021, 9:33:39 PM	Idaroczi	Calculate AVG values	Finished 🗸	Loading 100% (60387 / 60387 lines)	

The output of the processing is stored as the part of the result:

🖽 Data content - (1) Check_1008				<i>ដ</i> t	• •
ID †	Name	Түре			
1 AUDIO-EB500-A		AUDIO	•	4	
2 SCAN-EB500-A		SCAN	-		1
Kightly calculationOVERVIEW					
3 OVERVIEW_SCAN-EB500-A0001-p001		SCAN	-		a
Post processingFIX-MV-01					
4 scan-avg-hold0001		SCAN	-		1

Archiving

The system also supports archiving old measurement data. Measurement results can be categorized in the following archival categories:

- test data (no need to keep, can be deleted at any time),
- can be archived after 3 months,
- can be archived after 6 months,
- can be archived after 1 year,
- can be archived after 2 years,
- can be archived after 5 years.

At the start of the archiving process, the system prepares the list of measurement results to be archived based on the archival categories. After the user's consent, it stores them compressed in the archive folder, which can be moved to an external drive. The restoration of individual archived measurement results is supported (simply by decompression and copying it back to the results folder).

	ult archiving									ວ
Archiv	ve status:	Select results	New	v Execute	Break off	Save				
Create	e a suggestion list:	2021-11-12 19:35		Collection Idaroczi started by:	1	07 piece 11 25	6 008 883 byte			
Select	results					9 piece 545	0 158 242 byte			
Perfor	rm archiving:			Started by:		0 db	0 byte	0 byte ZIP		
Archiv	ve folder:	/srv/development/git/SIMI_MV	/_Charlie/simi-m	nv/testenv/DEV/FIX-MV-01/	/archived/results/results-2	0211112-183517-76	6f1f8e-4247-40f1-97cf-f0a70e	1a628e-archive	d	
Sele	ect measurement re	esults for archiving								*
	Measurement station	Name	Owner	Start of measurement	End of measurement	Can be archived	Can be archived	State	Size [byte]	ZIP [MB
	Measurement station FIX-MV-01	Name	Owner sysman	Start of measurement 2019.12.14 17:54	End of measurement 2019.12.14 17:54	Can be archived	Can be archived 2020-12-13T16:54:38.891Z	State Marked •	Size [byte] 4 507 646	ZIP [MB
-		Name								
S	FIX-MV-01	Name	sysman	2019.12.14 17:54	2019.12.14 17:54	After 1 year	2020-12-13T16:54:38.891Z	Marked 	4 507 646	0
2	FIX-MV-01 FIX-MV-01	Name	sysman sysman	2019.12.14 17:54 2019.08.21 19:03	2019.12.14 17:54 2019.08.21 19:05	After 1 year After 1 year	2020-12-13T16:54:38.891Z 2020-08-20T17:05:06.424Z	Marked 🔶	4 507 646 700	0
2	FIX-MV-01 FIX-MV-01 FIX-MV-01		sysman sysman Idaroczi	2019.12.14 17:54 2019.08.21 19:03 2020.10.19 16:28	2019.12.14 17:54 2019.08.21 19:05 2020.10.19 16:29	After 1 year After 1 year After 3 months	2020-12-13T16:54:38.891Z 2020-08-20T17:05:06.424Z 2021-01-17T14:29:06.413Z	Marked Marked Marked Marked	4 507 646 700 338 682	0
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	FIX-MV-01 FIX-MV-01 FIX-MV-01 FIX-MV-01 FIX-MV-01		sysman sysman Idaroczi Idaroczi sysman	2019.12.14 17:54 2019.08.21 19:03 2020.10.19 16:28 2020.11.05 16:27 2020.01.10 21:30	2019.12.14 17:54 2019.08.21 19:05 2020.10.19 16:29 2020.11.05 16:27 2020.01.10 21:31	After 1 year After 1 year After 3 months After 1 year After 1 year	2020-12-13T16:54:38.891Z 2020-08-20T17:05:06.424Z 2021-01-17T14:29:06.413Z 2021-11-05T15:27:15Z 2021-01-09T20:31:24.832Z	Marked • Marked • Marked • Proposed • Marked •	4 507 646 700 338 682 422 662 159 109	0 0 0 0

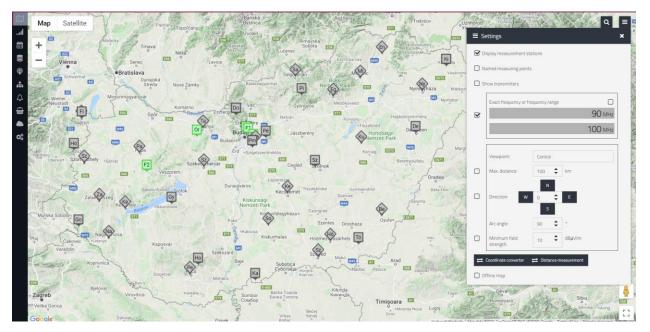
Map

The central element of the user interface is the map, which functions as a starting point for everyday activities, like initiating measurements, displaying the transmitters, etc.

The map-based home screen provides a comprehensive picture of the measuring stations integrated into the system. It displays them at their current location and shows their current status (offline, online, free to use, executing a measurement, or in an error state if a device is malfunctioning).

The map-based home screen supports the following technology types, between which the user can switch freely:

Google Maps,



• OpenStreetMap-based offline data.

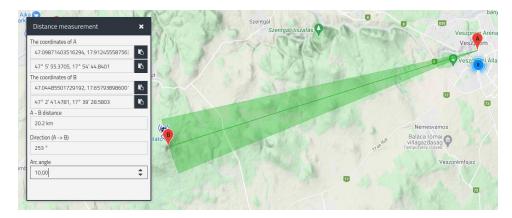


The default map display is based on Google Maps and supports its special functions (like terrain display, satellite view, street view, search based on address).

Map display based on the data from OpenStreetMap plays a role in offline scenarios when the Google Map service is not accessible, e.g., at a remote location with a mobile station. The necessary infrastructure to support offline maps is part of the system.



The integrated mapping services support the calculation of distance and direction between two arbitrarily selected points.



On the map, the following data is displayed in a filterable way:

and KA		ettings	and the second					
2	☑ Display measurement stations							
Veszprém-Kádárta 🕥 bányató, Kádártai 🔍	Named measuring points							
reszprém Aréna	🗹 S	how transmitters						
Veszprém E66		Exact frequency or f	frequency rang	•				
Veszprzeni Állatkert				89, 500MHz				
Szentkirálys Repülé		108						
3		Viewpoint:	Központ					
Szentkirály		Max. distance:	100	: km				
TA VII			N					
mfajsz		Direction: w	0	E				
1/12/200			s					
73		Arc angle:	90	•				
Felsőörs		Minimum field strength:	10	: dBµV/m				
ilátó Somlyó-hegyi kilátó 🍣	1	Coordinate converter	≓ Distance	measurement				
Lovas)ffline map						

- Measuring stations,
- The named measuring points (which are frequent sites for on-field measurements with mobile stations),
- The transmitters from the licensing database, with filtering option relative to the selected measurement station, based on:
 - o maximum distance,
 - o direction and arc angle



• minimum field strength calculated by free space attenuation, and frequency range. For the selected (clicked) transmitter on the map, the system can display the detailed transmitter.

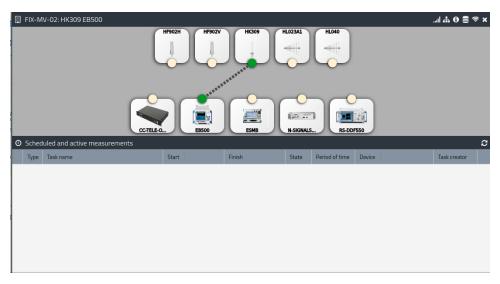
Ajkai Bányászati 💿 Múzeum	93.9, 100.5, 102.3, 105, 107.2 Petőfi Rádió 🗙										
Muzeum	Frequency	Broadcast na	Station	ERP	Pol	Broadcast ti	Legal status	Legal validity	Legal validity	Lice	
the Alight	93,9 MHz	Petőfi Rádió	5199	48.8	н	0-24	Granted	2017.07.13	2022.08.01	149	0
1 - Martin	100,5 MHz	RETRO Rádió	5199	48.9	Н	0-24	Granted	2018.06.15	2025.05.26	146	
Sárcsikút 🍄	102,3 MHz	Dankó Rádió	0044	37.3	Н	0-24	Granted	2017.07.12	2022.08.01	157	
	105 MHz	Bartók Rádió	5200	49.2	Н	0-24	Granted	2017.07.11	2022.08.01	141	
	107,2 MHz	Kossuth Rádió	5199	49.2	Н	0-24	Granted	2017.07.24	2022.08.01	180 _{nfajsz}	
14 5 3 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -											

For the selected (clicked) Station on the map, the system displays its detailed data, including:

- antenna types and measurement limits,
- measuring device types and measurement limits,
- the data from the ongoing measurements (who started it and when, on which devices, etc.).

Direct- and scheduled measurements can be started by selecting a station on the map.

An intuitive graphical interface supports the selection of the signal path to be used during the measurement (the user connects the desired antenna and measurement receiver using the mouse).



Measurement control interface

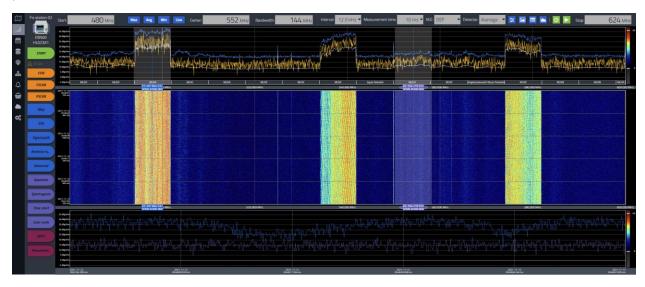
The measurement control interface is designed with the following features:

- The configuration options of the selected device are displayed (frequencies, bandwidth, measurement time, detector etc.) according to the device type,
- During the configuration, the UI validates the settings and also checks the correlations between the configuration options.
- For a directional antenna, the UI displays a graphical antenna rotation control screen which allows the user to select the desired antenna direction and polarity and provides continuous, real-time feedback on the current position of the antenna.

- For a given measurement, the UI provides an integrated map panel, which displays:
 - o the environment of the given measuring station (with the Station in the middle),
 - based on the measured frequency/frequency range, the relevant transmitters from the licensing database,
 - for a directional antenna, the current direction of the antenna and its direction cone is based on the arc angle.
- This integrated map panel also provides all the features of the home screen map (e.g., switch between Google Map with satellite, street view and offline map, distance measuring, filtering the transmitters).



The measurement control screen is designed in such a way that the spectrum analysis interface is given the most possible space so that the graphic display of the measurement data can be as detailed as possible.



Spectrum and Signal Analyzer

The Spectrum and Signal Analyzer interface displays the scan (IF panorama, panorama scan, frequency scan) measurement data on three interconnected types of diagrams:

- Spectrum diagram:
 - X-axis: frequency

• Y-axis: field strength

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		fall diagram):						
0	X-axis: frequ	ency						
0	Y-axis: time							
-12 (10)								

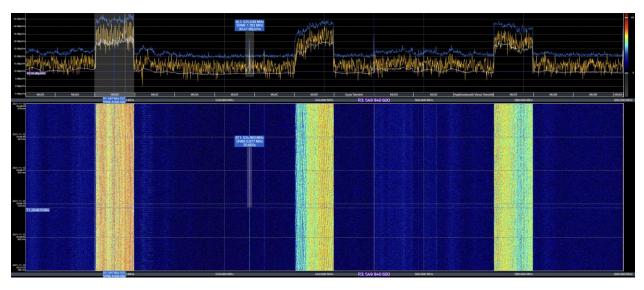
- Time-field strength diagram:
 - X-axis: time
 - Y-axis: field strength

The diagrams are resizable, and their display can be turned on and off.

In the spectrum diagram, the minimum, average, maximum values are calculated by the GPU, and the live (last) measured values can be displayed. The display of the minimum, average, maximum, and live values can be turned on and off.

On the waterfall diagram, the measured values can be displayed coloured according to the measured signal level. If necessary, multiple values can be compressed during zoom operation according to the chosen minimum, maximum or average value compression mode. By default, two colour schemes are used for colouring, a grey colour scheme for values below the noise level and a coloured transition for values above the noise level. The (bi-graded) colour scheme used for colouring is also displayed on the screen.

The spectrum analyser supports the placement of markers to allow the reading of exact measurement values and selecting relevant, significant data regions. The following markers are supported:



- Line markers:
 - o frequency marker

Ⅲ R3	× ×
centerFreq:"	549,940600
fixCenter:	
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higherFreq:"	549,940600
bandwidth:*	0,000
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- Area markers marking a rectangle area on a given diagram:

frequency - signal level range, 0 🔳 AL1 × ▲ lowerFreq: 524,147757 525,929760 higherFreq: bandwidthMhz: 1,782003 higherLevel: 36,87 lowerLevel: 6,40 evelDifference: 30,47 П active: $\mathbf{\nabla}$ visible: 19 opacity: #FFFFFF areaColor: color: #0063CF frequency - time range. 0 AT1 524,504155 lowerFreq: higherFreq: 525,480951 bandwidthMhz: 0,976797 2021-11-12 20:48:36.017 higherTimestamp: lowerTimestamp: 2021-11-12 20:48:15.352 timeDifference: 00:00:20.665 П active: $\mathbf{\nabla}$ visible: 19 opacity: #FFFFFF areaColor: color: #0063CF

The Time–field strength diagram displays the change in signal levels over time for the frequencies selected by the frequency markers.

The frequency marker provides a "peak search" function that allows moving the marker to the previous/next "peak" value according to a set threshold.

All three diagrams provide synchronized zoom functions accessible by the mouse scroll wheel:

- Zoom-in: enlargement can be increased up to the measured elemental data,
- Zoom-out: the measured values are displayed compressed. This way, the total amount of measurement data (in the buffer) can be displayed on a single screen.

The diagrams are created, and the data in them is processed and displayed in the browser using WebGL 2.0 technology, taking advantage of the graphics card's power on the client computer. During measurement, the measured values are displayed continuously and can reach an image refresh rate of 60 FPS (depending on the GPU of the computer).

The analyser was designed with the goal to ensure that as many data rows as possible can be reviewed on the waterfall diagram by buffering the incoming data rows.

For example, the spectrum analyser can:

- display data of at least a 120-minute time period, in case of measurement with start=87.5 MHz, stop=107.5 MHz, step=6.25 kHz, measurement time=100 ms,
- display data of at least a 12-minute time period, in case of measurement with start=87.5 MHz, stop=107.5 MHz, step=6.25 kHz, measurement time =10 ms,

Measurements with high column numbers (containing many frequencies) must also be displayed. For example:

- in case of a start=20 MHz, stop=3.6 GHz, step=250 Hz measurement, 14.320.000 frequencies
- in case of a start=20 MHz, stop=6.0 GHz, step=250 Hz measurement, 23.920.000 frequencies

The spectrum analyser can help the identification of the measured signals by the switchable display of possible transmitters on the spectrum diagram, based on the licensing database. On click, it should display the details of the relevant entries from the licensing database.

In a switchable mode, it can also display the national and international frequency allocation ranges on the spectrum diagram. On click, it should provide information for the given range (service, usage guidelines, and recommendations).

Direction finding and geolocation

The *SIMon measurement controller* provides support for integrating direction finders based on Angle of Arrival (AoA) technology.

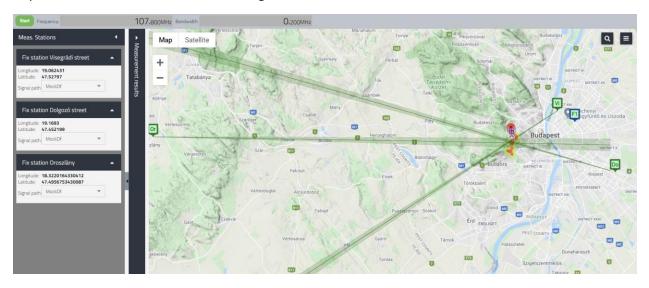
We have implemented drivers for equipment which supports AoA direction finding measurements. The following drivers support this feature:

- Rohde & Schwarz: DDF-550, DDF-255,
- NARDA: SignalShark 3320, 3330,
- CRFS: RFeye Node,
- **CommsAudit**: Spectra SRDF, CA4909-1.

These drivers provide the measurement results in a unified data format which includes:

- Timestamp,
- Location of the receiver,
- Signal level,
- Azimuth,
- Azimuth confidence,
- Elevation,
- Elevation confidence.

Based on this data the user interface can display the measurement results on the map, using a direction cone, where the aperture of the cone represents the confidence in the results provided by measurement equipment. The system aggregates the previous N direction finding results to also provide statistics about the number of directions from which the signal is received. This allows for detecting peer to peer communication or interference signals.



By using a unified data format for handling the direction-finding results, the system also allows for using this data to calculate the location of a transmitter using multiple sites. The measurement results from multiple locations are corelated using the timestamp. The correlated results are used by our geolocation algorithm which takes in account the azimuth and the azimuth confidence, to calculate the possible location of the transmitter. During the calculation based on the azimuth confidence data, the algorithm also calculates a probable location ellipse centred around the most probable location.

Frequency:		107,800MHz	Bandwidth		0,200MHz					
Measurement results						6	101	Map Satellite	Dudince 2 4	
	Re	sult				S	tations 📫	Surany	Zeliezovce Sativ Balassagyar	
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2021-11-12T19:05:43.620Z	47.4893774	18.9790136	2021-11-12T19:05:44.419Z	237.044769	0.77793320	2021-11-12T19:05:44.440Z	287.2	AL LAND	Duna-Ipoly Nemzeti Park	
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2021-11-12T19:05:42:5332	47.4995626	18.9797297	2021-11-12T19:05:43.326Z	238.088507	0.76505743	2021-11-12T19:05:43:346Z	286.23	Acs CI	Dorog Szentendrei-sziget	
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2021-11-12T19:05:40.557Z	47.4968132	18.9872338	2021-11-12T19:05:41.131Z	236.075097	0.75670614	2021-11-12T19.05:41.153Z	287.91	Kisbèr Oroszlány	Bicske Biddues Do	
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The accuracy of the results depends on the equipment and the DF antennas used.

4. Hardware requirements

- Measurement stations (recommended configuration):
 - CPU: minimum 6 core, 12 thread, minimum 3 GHz,
 - o RAM: 32 GB,
 - o SSD: NVMe, PCI-E Gen 3, 1 TB
 - Storage (for measurement data): minimum 2 TB,
 - GPU: Nvidia GeForce GTX 1050 4GB RAM,
 - OS: Custom Linux to support the drivers,
- Central server (recommended configuration):
 - CPU: minimum 8 core, 16 thread, minimum 3 GHz,
 - RAM: 64 GB,
 - SSD: NVMe, PCI-E Gen 3, 1 TB,
 - Storage (for measurement data): minimum 8 TB,
 - o OS: Ubuntu 20.04 x64,
- Client PC-s or Laptops (recommended configuration):
 - CPU: minimum 4 core, 8 thread, minimum 3 GHz,
 - RAM: 16 GB,
 - o GPU: Nvidia GeForce GTX 1050 4GB RAM,
 - Operating system: Windows 10 x64,
 - Browser: Google Chrome 64-bit v95.0, Mozilla Firefox 64-bit v94.0, Microsoft Edge 64bit v95.0.

5. Network requirements

Connection types supported:

- Wired (Copper, Fibre optic),
- Wireless (3G HSPA+, 4G LTE, 5G, P2P microwave).

Security:

• Secure VPN connection between the Central server, the Stations and Client PC-s or Laptops.

Connection Speed for a station:

- Minimum: ~1 Mbit/s download and upload speed (in this case the "real-time" measurement options are severely limited),
- Typical: 30 Mbit/s download and upload speed,
- Recommended: 80 Mbit/s download and upload speed.

The upload speed is the more important, because the station uploads the measurement results to the central server or the client in "real-time".

The upload speed should be even higher if the upload in "real-time" of I-Q data or DVB transport streams is required.