Product presentation 2024

Who we are

Enhancell is a software company creating new and innovative tools for wireless network testing needs.

Our team of mobile network experts and creative software designers are striving to simplify network testing.

Our headquarters is in Oulu, Finland, and we have an office in Miami, FL. We are a trusted partner of several major cellular operator and network manufacturers.

Enhancell was founded in 2014 by CEO Pasi Niemi, CTO Jukka Juvonen, and General Manager Joni Pajala.

Markets: global

Enhancell Echo product family 1/2

- **Echo One** and **Echo Lite** handheld tools for measurement
- **Echo Plus** tablet tool for control and measurement
- **Echo Studio** control and analysis tool
- **Echo Analyzer** a versatile network testing post-processing tool
- **Echo Cloud** online service
- **Echo Verify** a site-commissioning tool
- **Echo Trek I** a custom-designed solution for drive and walk surveys
- **Echo Trek II** a custom-designed solution for drive and walk surveys, a next generation backpack

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Enhancell Echo product family 2/2

- **Echo Probe** a solution for unattended non-stop service quality monitoring in fixed locations
- **Echo Connect cube** for installing Echo One application without rooting on an Android device
- **Echo Scanbox** an ultra-lightweight scanner, designed to be the most compact scanner on the market
- **Echo Scanbox Pro** a chipset-based 5G NR/LTE/WCDMA/GSM multi-technology scanner
- **Echo ScanMaster** an SDR-based drive-test scanner reaches high speeds and includes new WRC bands up to 8,5GHz

References 1/2

Telefónica (Germany)

Vodafone (Germany)

Nokia Networks (Finland)

Police (UK)

LMT (Latvia)

Bitė (Latvia)

Bundesnetzagentur (BnetzA) (Germany)

UPS (USA)

Cisco (USA)

Disney (USA)

Eltel (Finland)

Techmahindra / Verizon (USA)

References 2/2

O2 (Czech)

O2 (Slovakia)

Cetin (Czech)

Triopt (Germany)

Comcross (Germany)

Rejlers (Finland)

CRC Regulator (Bulgaria)

Network Projectum (Sweden)

Motorola (Israel)

Viavi (Italy)

Anritsu (Japan)

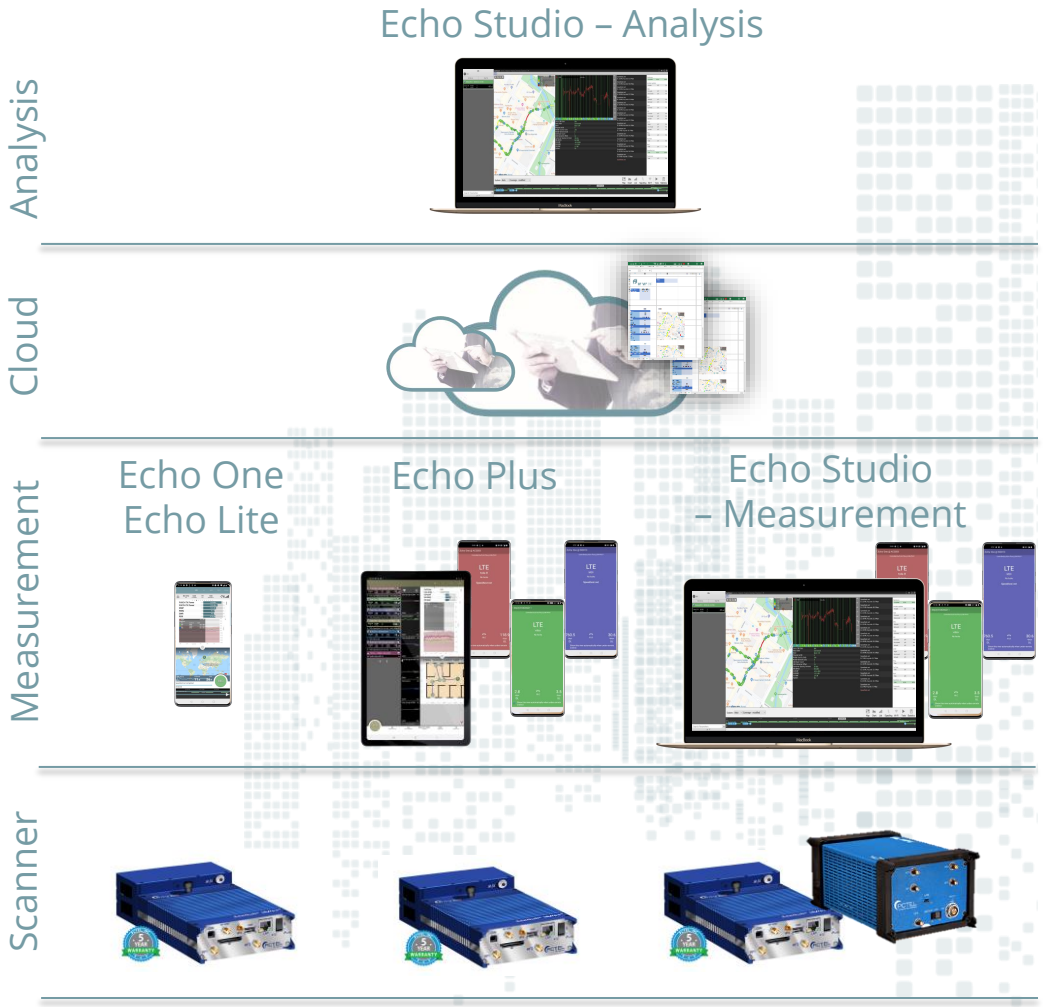
Advanced mobile network measurement solution

Enhancell Echo mobile network measuring tools run directly on your handset. They are designed for PC-less drive and walk survey.

With Echo, you do not need custom test devices and firmware. This means that you can be assured to see the network exactly as your customers see it.

Having Echo run on commercial phones not only saves you from spending on expensive custom hardware but also allows you to easily transfer licenses from one phone to another.

Automatic software updates guarantee that you are always running the latest software.



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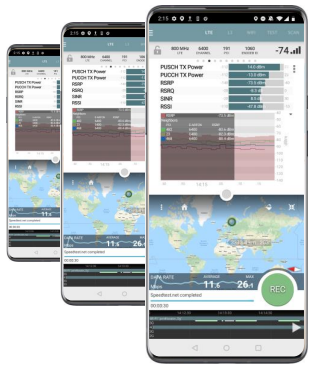
Echo product line

Echo One
Echo Lite



Standalone / autonomous

Echo Plus

Tablet controlled walk / drive test and benchmarking

Echo Studio

Control and analysis

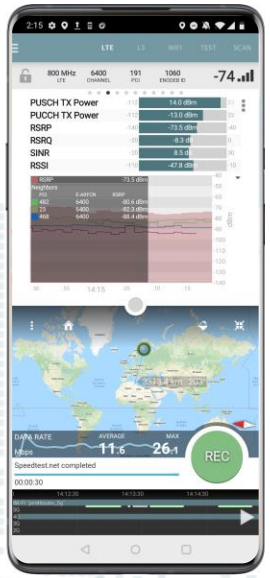
Echo One and Echo Lite

Echo One and Lite are extremely versatile hand-held cellular protocol measurement tools.

- Echo One and Lite can operate on several commercial Android and Harmony OS handsets*.
- Echo One and Lite allow the User to perform the most thorough hand-held measurements in the industry.

Echo One

Echo Lite



*Capabilities vary between various phone models, please contact Enhancell sales for more information

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Echo Plus

Echo Plus introduces new methods of enabling Users to conduct surveys and optimize equipment.

It enables the User to control several different Echo devices simultaneously in real time.

Only one set of measurement configurations is needed which adds to the efficiency of performing measurements.

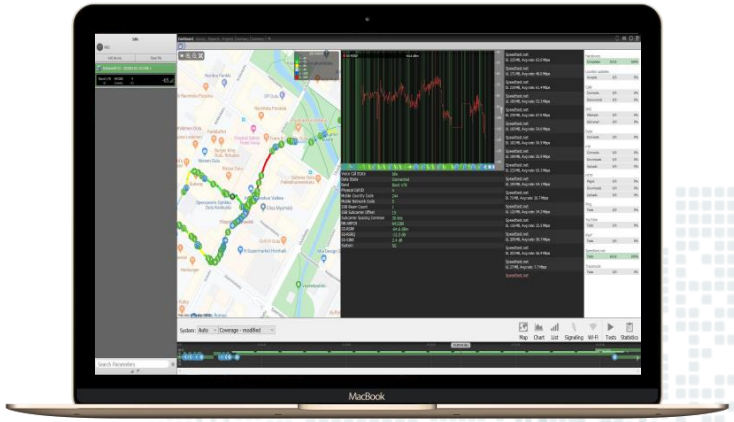
Echo Plus includes features such as Remote Start and Logging, Location Ping, Cloud based logging, and Transferable Licensing.

Echo Studio

Echo Studio is a measurement and analyzing tool which offers quick and easy way to produce reports and visualizations of the measurement test results.

Synchronization to Cloud enables instantaneous report production of measurements performed remotely with other Echo devices.

Echo devices can also be remotely controlled with Studio.

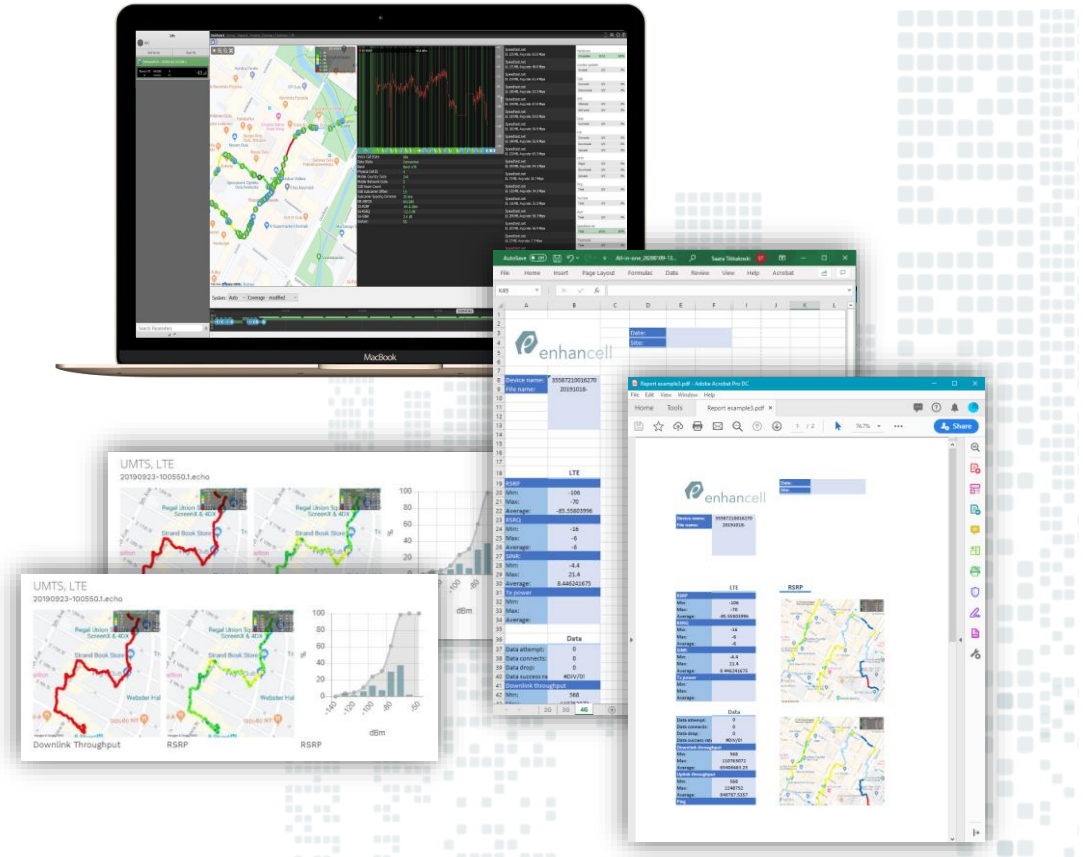


Windows 10

Linux

Echo Studio analysis (post-processing)

- Easy post-processing for log files directly from Cloud.
- Quick Plots: a unique and very easy plotting of measurements.
- Fully customizable reports powered by Echo reporting engine.
- All reports and plots are synchronized to Cloud.



Echo Cloud

Echo Cloud is a perfect companion to your Echo network measurement tools. You can take full advantage of your Echo fleet with Echo Cloud.

Echo Cloud not only gives your Echo fleet a fully automated data storage for all the drive test file but also a way to control and configure your fleet remotely.

License management tool in Echo Cloud makes your asset management a breeze. With total control on your purchased licenses, you can for example

- easily transfer licenses to new phones
- pull licenses from phones you no longer use.

Echo Connect

Game changer:

- Plug it in to a 100% commercial phone and it will enable Echo One in the phone.
- No root or special firmware required anymore.
- Pass through charging allowing the phone to charge while operating Echo Connect.

Key benefits

Truly unique cloud concept

Echo Cloud synchronizes log files and test scripts, phone and scanner configurations, and maps and cell files, and provides full remote control for drive test devices. Comes free of charge as part of the tools by default.

Transfer of all licenses

This is an advantage of approximately 30-50% pricewise compared to fixed licenses.

Rental concept by default

Get licenses for short-term project demands.

The same license for different chipsets

No “handler” required which means there are no double investments.

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Key benefits

Community root, no custom ROM

Immediate support of new phones and phone FW/OS updates at no additional cost. In addition, support of new phone features in Enhancell log files immediately.

Support of >180 phones

Almost all commercial off-the-shelf phones with compatible chipset are supported. Any Qualcomm-based devices are supported.

Full remote control

Includes phones, probes, entire benchmark setups including scanner setups. Connectivity via internet (Wi-Fi, mobile broadband) or BlueTooth.

Real standalone drive tests with phones

Measurement phones do not require connection to PCs or tablets. The system is completely free of connecting cables.

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Key benefits

Echo One and Plus Timeline

15 min “flight-recorder” to detect and analyze issues in the past. Highly convenient and easy to use during or after measurement.

ViSQOL and POLQA 3.0 support

From mobile to mobile and from mobile to fixed line.

Smart recovery of log file

Automatic function to avoid re-measuring in the unlikely event of issues with phones.

GPS master

Selects the strongest signal out of several GPS receivers and makes it master for all log files.

Cell estimation

Have cell files calculated during postprocessing, from both phone or a scanner 2G to 5G log files.

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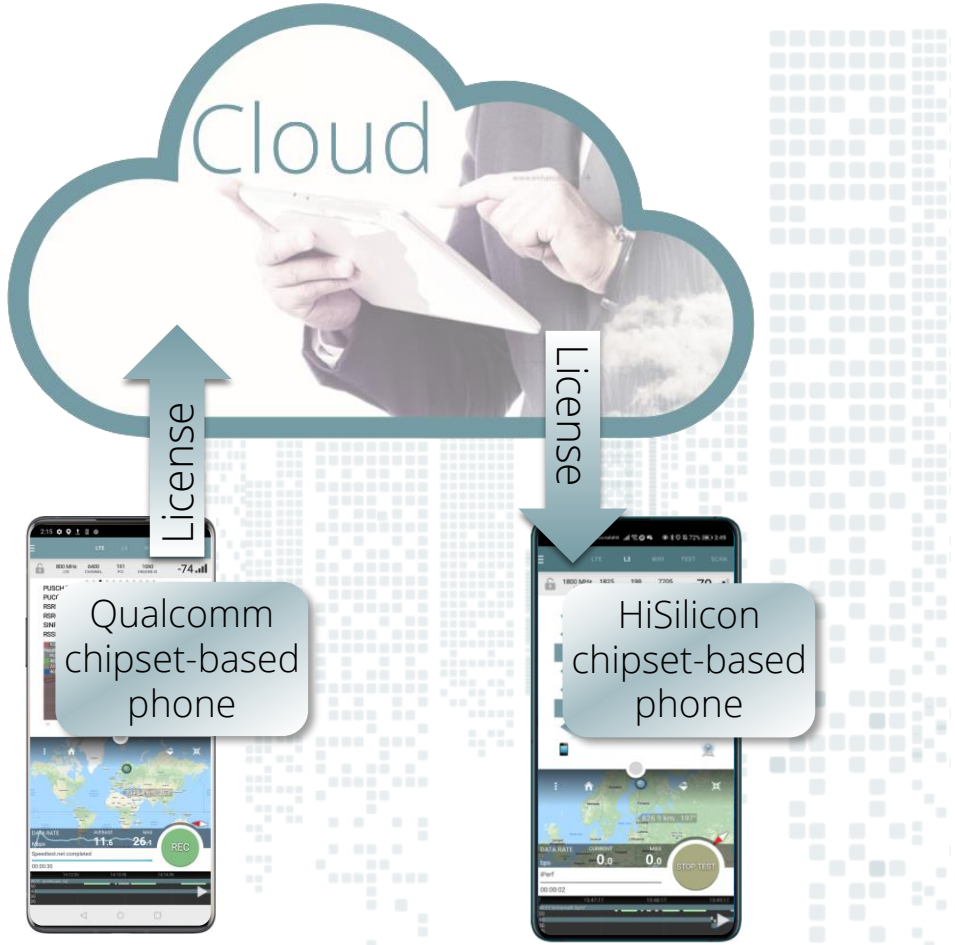
Universal licenses (chipset support)

Enhancell officially supports Qualcomm and HiSilicon (Huawei) chipsets with one universal license.

Feel free to choose your test device from more than 190 commercial phones.

All supported chipsets are covered by one universal license that can be allocated to any commercial phone daily; make drive tests with a Sony phone today and a Huawei phone tomorrow at no additional cost!



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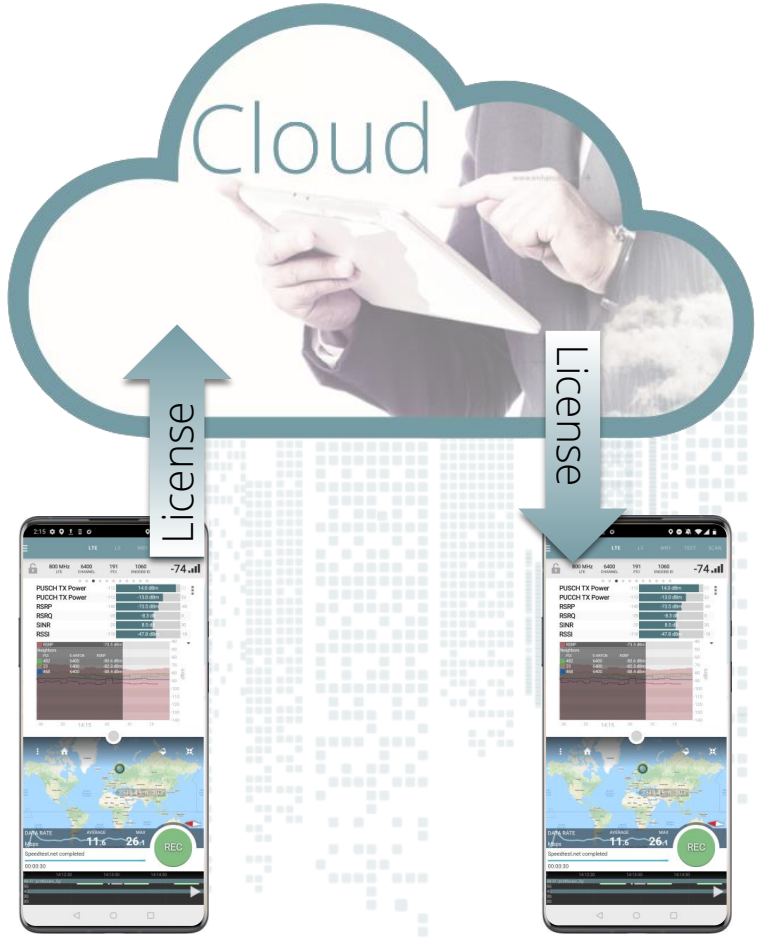
Unparalleled flexibility on license

Echo offers unparalleled flexibility and cost-effectiveness with licenses:

- all technology functions are included by default
- the license transfer is standard from handset to handset.

Echo's Cloud-based licensing guarantees the User full control over license transfers, and a real-time view of license usage.

- Both perpetual and rental licenses are available to add to the flexibility.



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5G support

In addition to 4G and other established technologies, Echo product line is 5G ready and introduces various new features making your Echo product more powerful than ever.

- 4G licenses are upgradeable to a 5G license making it convenient and cost-effective for existing customers.
- New customers can enjoy the 5G license benefits regardless of the devices and post-processing tools they use.

The latest Qualcomm chipset support

Echo supports always the latest Qualcomm chipset-based phones.

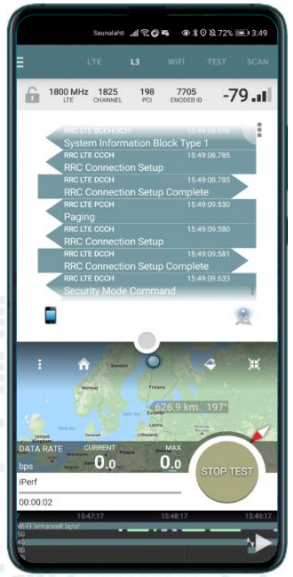
Echo tools have been verified to work with for example the latest OnePlus models which expands the selection of Echo supported commercial phones even further.

In addition to latest Qualcomm modem features, Enhancell supports phones with various new bands/CA-combos for 5G (NSA, SA, DSS).

HiSilicon-based (Huawei) phone support

Enhancell legally supports HiSilicon chipset-based phones.

Take advantage of Huawei's leading position on the 5G phones!



Scanner support

Echo supports scanner measurement with

- PCTel IBflex® and HBflex® scanners
- DRT scanner
- RF Explorer
- Echo scanners

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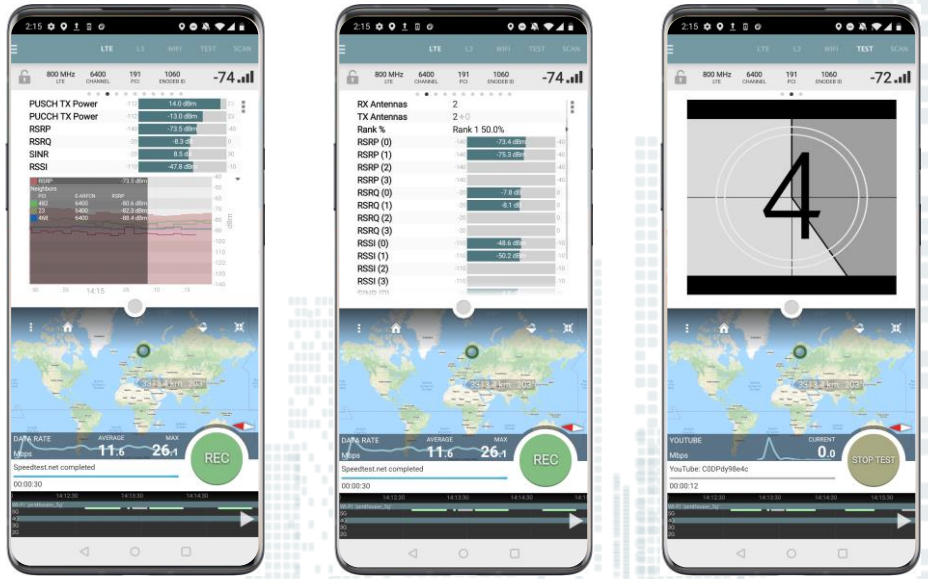
Highly sophisticated measurement system

- Use of commercial Android phones with any Qualcomm-based device.
- No custom ROM concept!
- Full Cloud support.
- Extremely fast time to market due to the availability of latest phone features as soon as they are supported by the phone.
- Support of existing post-processing solutions.
- Build-in report tool to produce reports within seconds.

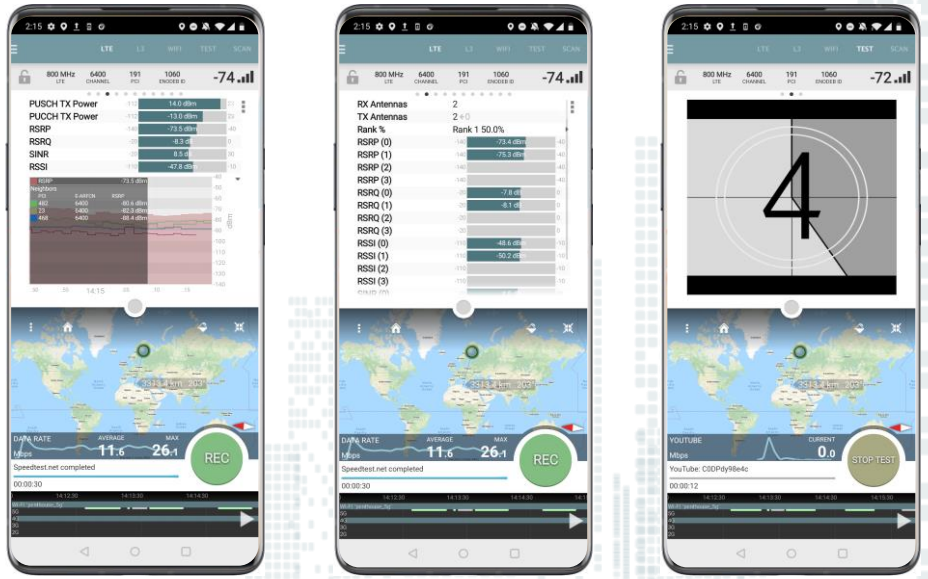
Echo features (1/4)

- Idle and active testing using manual or scripted mode for
  - voice call
  - voice quality (POLQA / ViSQOL)
  - SFTP, FTP and HTTP data transfers
  - iPerf
  - HTML browsing
  - YouTube video streaming testing
  - SMS testing
  - ping and TW ping testing.
- Built-in script editor in Echo tools and in Cloud enables the creation and editing of manual and scripted tests (automatic synchronization).



Echo features (2/4)

- Support for POLQA 3.0 and ViSQOL voice quality testing real-time MOS calculation (optional).
- System lock, band lock, LTE cell lock, and carrier lock (UMTS) (device-dependent feature).
- Remote control via Cloud for automated or remote test execution.
- Scripts can be created and modified with built-in script editor.
- Real-time statistics view for monitoring test progress.
- OTT application testing: Echo supports several built-in application testing options. Echo enables the user to test a wide range of application individually or with scripts.



Echo features (3/4)

- Signaling decoder for L3 and RRC signaling messages which allows signaling decode in real time and supports the following view types:
  - line, bar and gauge graphs
  - text view.
- User-defined views allow parameter display in the following view types:
  - line and bar graphs
  - text view.
- Support for indoor and outdoor mapping. including offline mode map data caching for outdoor maps.
- Indoor floor plans with markers and geodetic coordinates.
  - Support for e.g. iBwave format.
  - Enables geocoding indoor plans on top of Google Maps.

Echo features (4/4)

- Support for both internal GPS and external GSP via BlueTooth.
- Instant report after data collection allowing easy sharing of report in PDF format.
- Support for PCTel IBflex®, PCTel HBflex®, DRT 4311B, EPIQ scanners and RF Explorer.
    - Scanners can be connected via BlueTooth (RF Explorer via USB OTG cable)

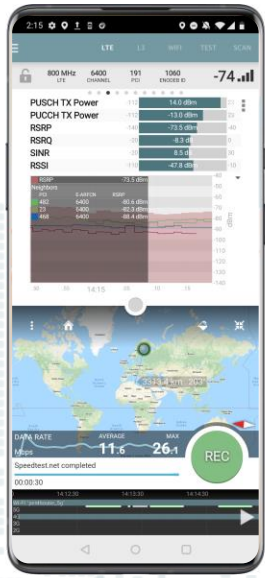
Use case: stand-alone phone

Echo One
- Full trace diagnostic support
- Qualcomm chipset
- HiSilicon (Huawei) chipset
- 5G support

Echo Lite
- Android API
- Limited parameter set (Google API)
- Any Android chipset
- 5G support

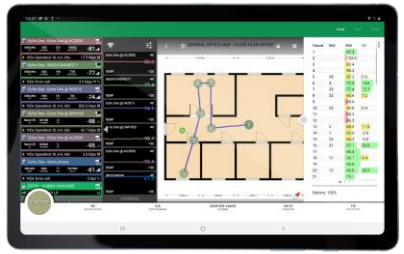
Echo One

Echo Lite



Use case: master tablet controlling up to 6 phones and a scanner

Use case: Tablet or PC/Mac controlling up to 15 phones via Echo hub and USB hubs



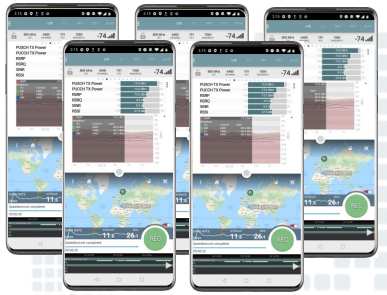
Echo Plus or Echo Studio
is connected to Echo Hub
wirelessly via BlueTooth or Wi-Fi

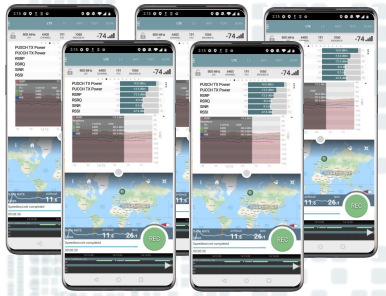
Echo Hub is cable-connected to
USB hubs which are connected
to phones via USB 3.0 cable

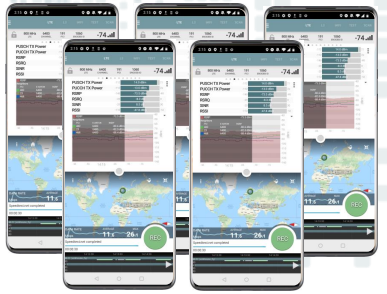
USB hub

USB hub

USB hub







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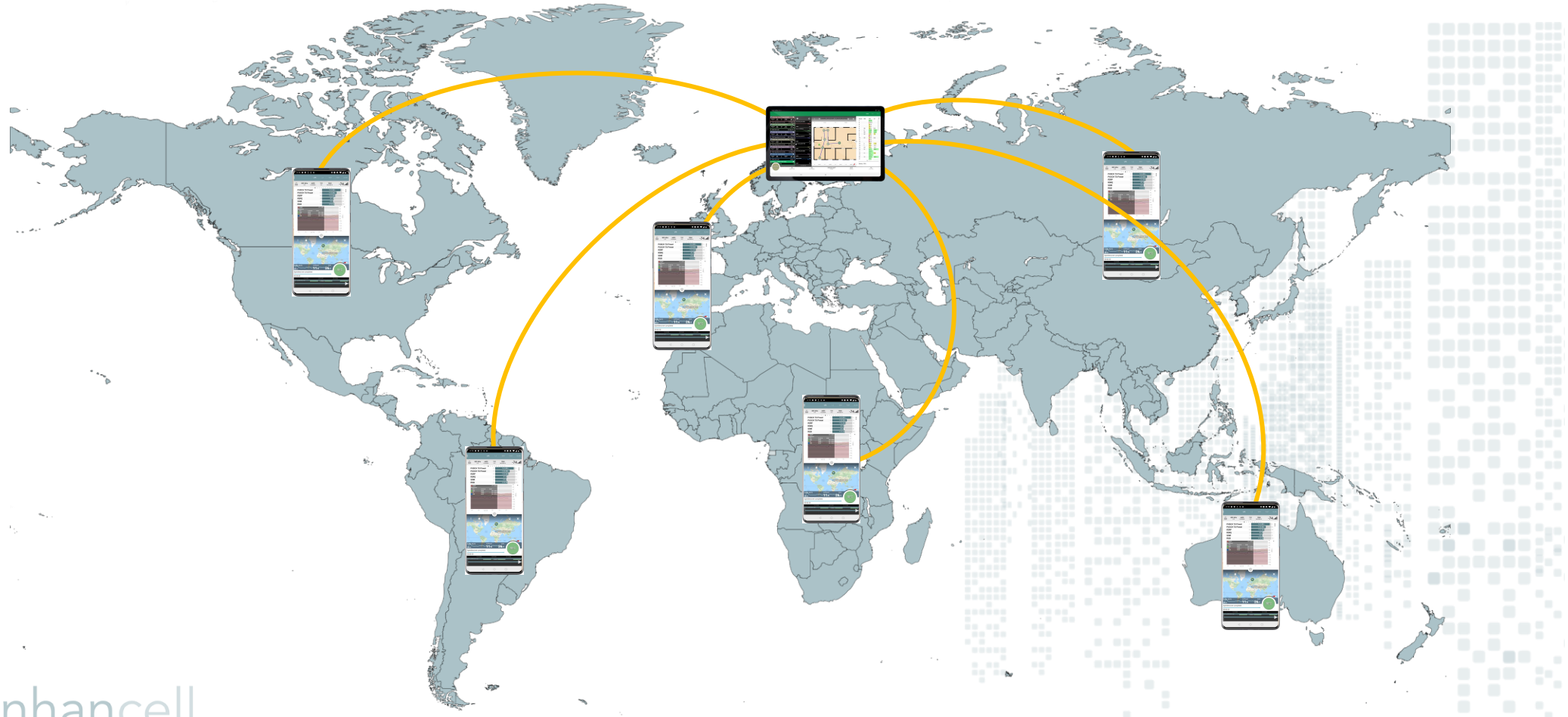
Use case: control devices in any location



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Use case: customized backpack

A typical backpack with a PCTel scanner and two Echo One handsets controlled with a tablet.

This setup was customized by the customer.

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Use case: Echo Trek backpack indoor/outdoor 1/2

Example configuration 4G/5G

- Phones: 6 x phones
- 4 x power bank 20.000 mAh
  (2 phones per power bank)
- Scanner: 2 hot changeable batteries
  (operation time 2 x 4h)
- Tablet: Samsung Android

Use case: Echo Trek backpack indoor/outdoor 2/2

- Operation time > 8h
- Dimensions: 54 x 41/51 (side pockets) x 18 cm
- Weight:
  - 2.85 kg without devices
  - Approx. 7.5 kg (backpack, belt pack, device frame, charger, USB cables, ventilation fans, six phones, a scanner, scanner antenna, scanner battery, and four standard batteries.)

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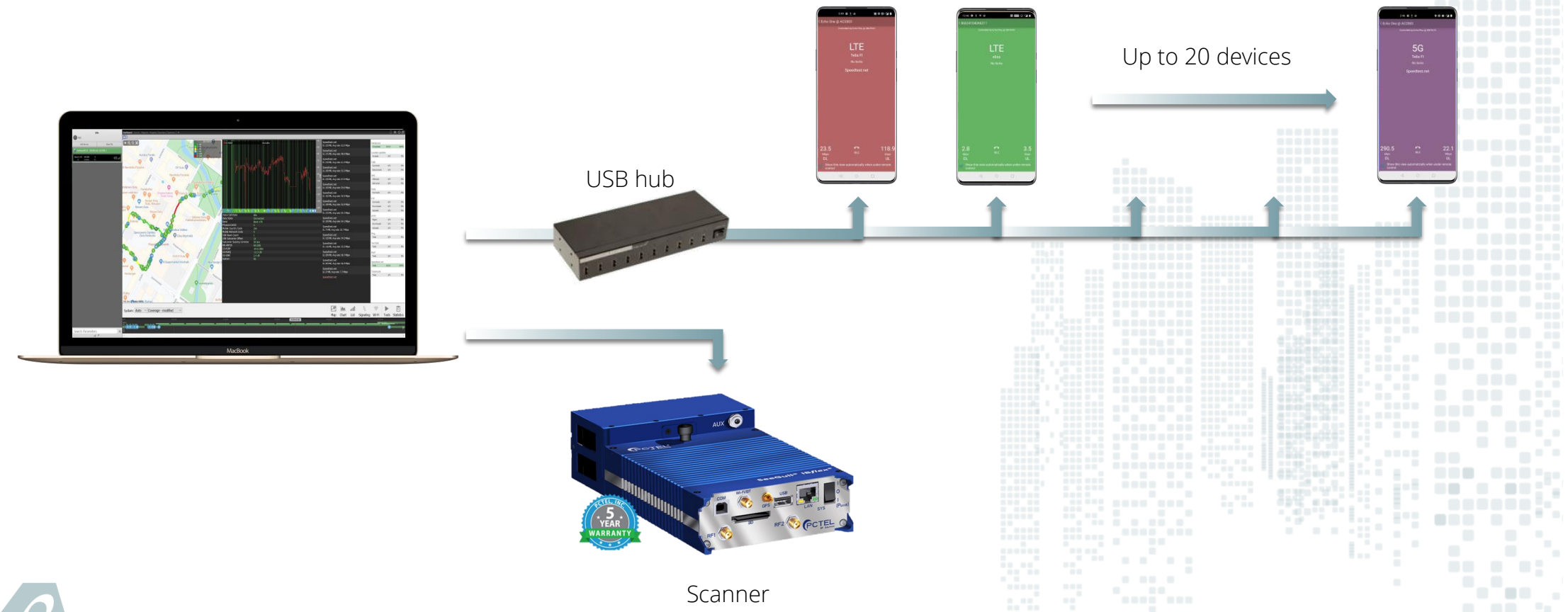
Use case: PC controlling up to 20 phones and a scanner



Use cases: autonomous probes, mobile and/or stationary

Configurations

Measurements

Use case: indoor measurement

- iBwave, customer floor plans or floor pictures can be used as indoor maps.
- Indoor maps are synchronized with Cloud.
- Full iBwave support.

Use case summary

- Network optimization
- Indoor/Outdoor testing
- Benchmarking with Master PC and benchmarking of operators
- Quality of Experience test for regulators
- Statistical benchmarking with multiple (>100) devices
- Fleet control of multiple (>100) devices
- Fixed probes
- Automated Reports
- Nonstop monitoring

5G scanner parameters

- PCI
- RSPBCH-QR [dB]
- PSS-RP [dBm]
- RSPBCH-CINR [dB]
- SSS-RP [dBm]
- SSB-RP [dBm]
- PSS-RQ [dB]
- SSB-RQ [dB]
- SSS-RQ [dB]
- SSB-CINR [dB]
- SS-CINR [dB]
- SSB-idx
- SSS-CINR [dB]
- SSB-RSSI
- RSPBCH-RP [dBm]
- SSS-Delay-Spread
- Time Offset

5G-SA/NSA solution & supported functions

- Support of available commercial terminals.
- Full support of Qualcomm and HiSilicon traces.
- Other chipsets to follow.
- Supported functions depending on phone functions.
- Upgrade path for existing customers (5G upgrade).
- No phone charges, only license cost.
- No SW charge for new functions/features within one technology

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Scanner: PCTel iBflex®

Bands	Technologies	Features
• 5G: 3GPP FR1 • All existing 2G, 3G, and 4G • CBRS • Public safety • Wi-Fi (2.4 and 5 GHz) • Other bands currently deployed around the world.	• 5G NR • CDMA • LTE FDD • EV-DO • TD-LTE • TD-SCDMA • NB-IoT • Wi-Fi • eMBMS • LAA • UMTS • P25 • GSM Custom Channel Power measurements for additional technologies (TETRA, etc.)	• 2x2 and 4x2 LTE MIMO measurements • Hot-swap battery system • Windows laptop and Android tablet support • Connect with BlueTooth or USB • Blind Scan for automatic channel detection

Operational Savings

	Operational Savings
Resources	Less engineers required in the field as all control & administration takes place in Cloud (at the office). Engineers can focus on troubleshooting at the office without spending time in the field configuring handsets etc.
Drive Testers	Unexperienced drivers are suitable too, keeping the costs lower. Gojek, Grab, Ola, Loca & other e-hailing drivers can be employed to increase the amount of data collected. Company staff can also be employed as drive testers.
Static Testing	Devices can be kept in strategic locations such as airports, public transport, MRTs, taxis, cafes, offices, Tsel service centers. All tests and scripts can be sent, and devices remotely controlled via Cloud – no need for human interaction.
Timeline	Increased no. of licenses allows quicker timeline to complete benchmarking or test activities. More cities can be covered with higher no. of licenses due to low per license price. Less DT teams are required due to the higher no. of licenses allowing more tests / operators benchmark. Increase in license utilization 100% (no need logistic/Transportation cost or time.)
Customer Profiling	Easily done without interrupting the user. All tests and scripts can be sent via Cloud – no need for human interaction.

Echo Plus TETRA measurement option

TETRA measurement option allows connection of Airbus/EADS commercial TETRA terminal to Echo Plus via USB UTG cable.

Measured parameters:

- System, MNC, MCC
- Serving channel, LAC and RSSI
- Neighbor channels, LAC and RSSI
- Call statistics

Echo Plus TETRA measurement option

- Detailed serving system information.
- Coverage measurements of serving and neighbor base stations.
- Call generation and statistics.
- Fully user-configurable displays for showing real time measurements.
- All parameters can be displayed with graphical or textual display.

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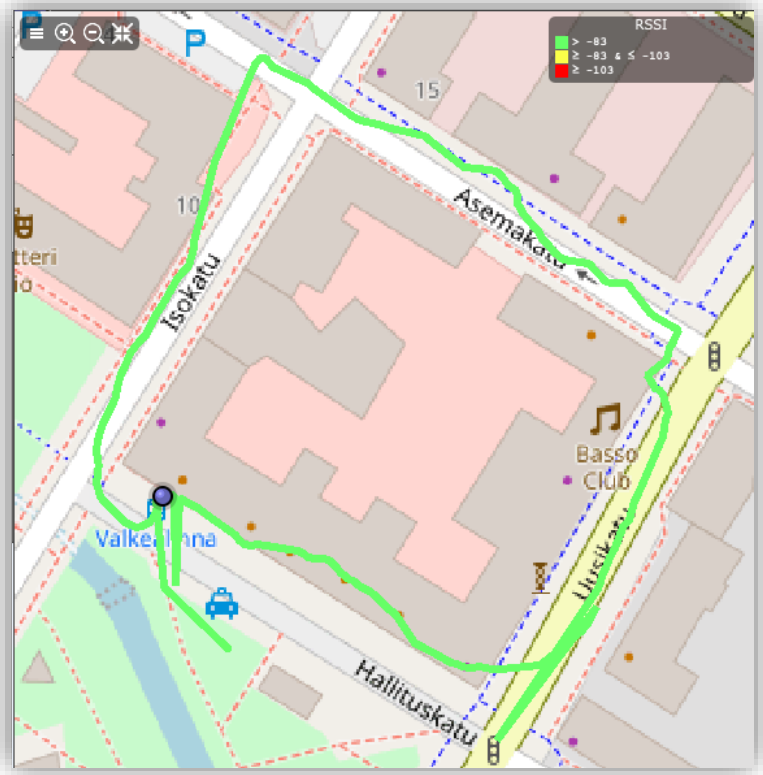
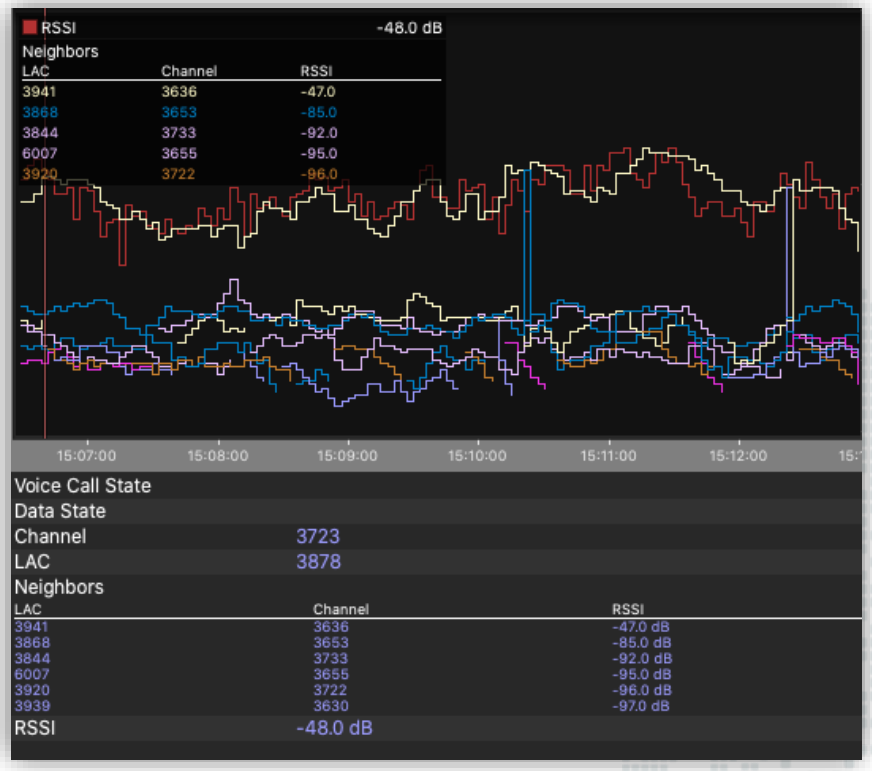
TETRA Analysis Examples





Handovers		
Completes	0/0	0%
Location updates		
Accepts	0/0	0%
Calls		
Connects	3/3	100%
Disconnects	2/3	66%
SMS		
Attempts	0/0	0%
Delivered	0/0	0%

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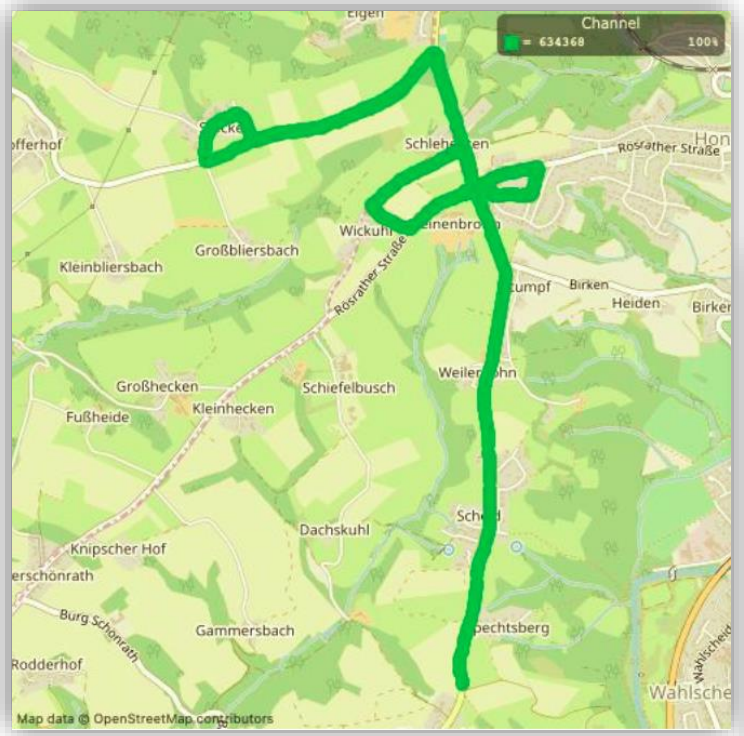
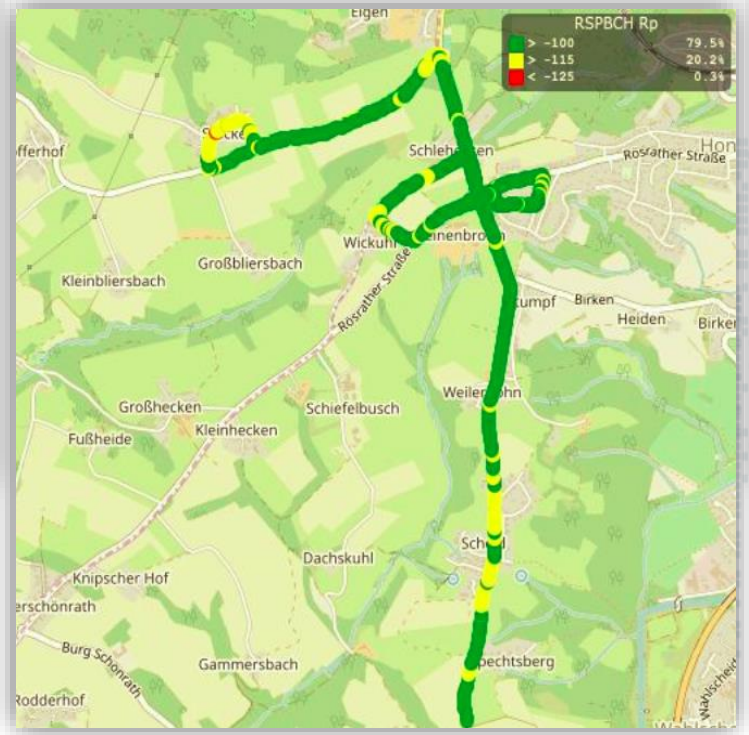
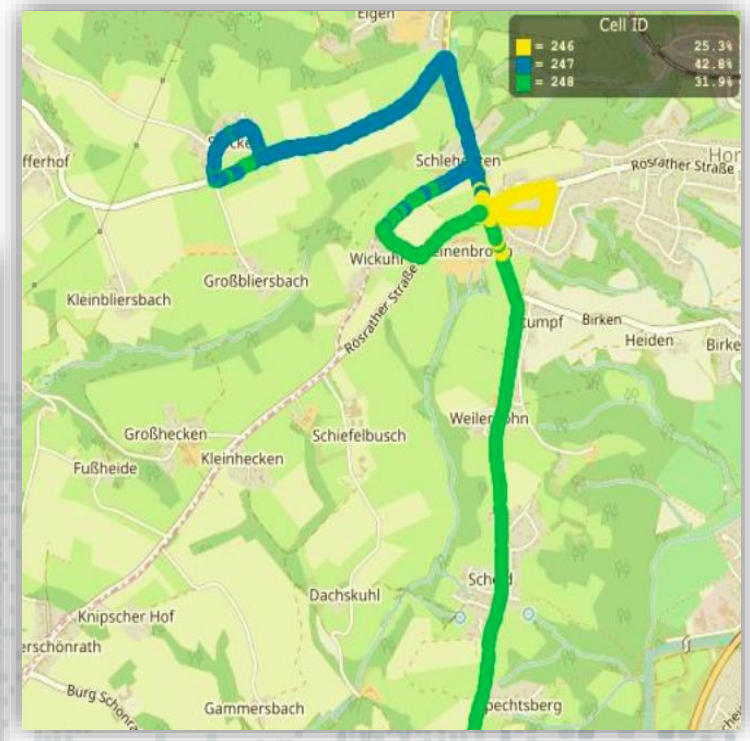
Report example 5G phone: Quick Plot

Report example 5G scanner: Quick Plot



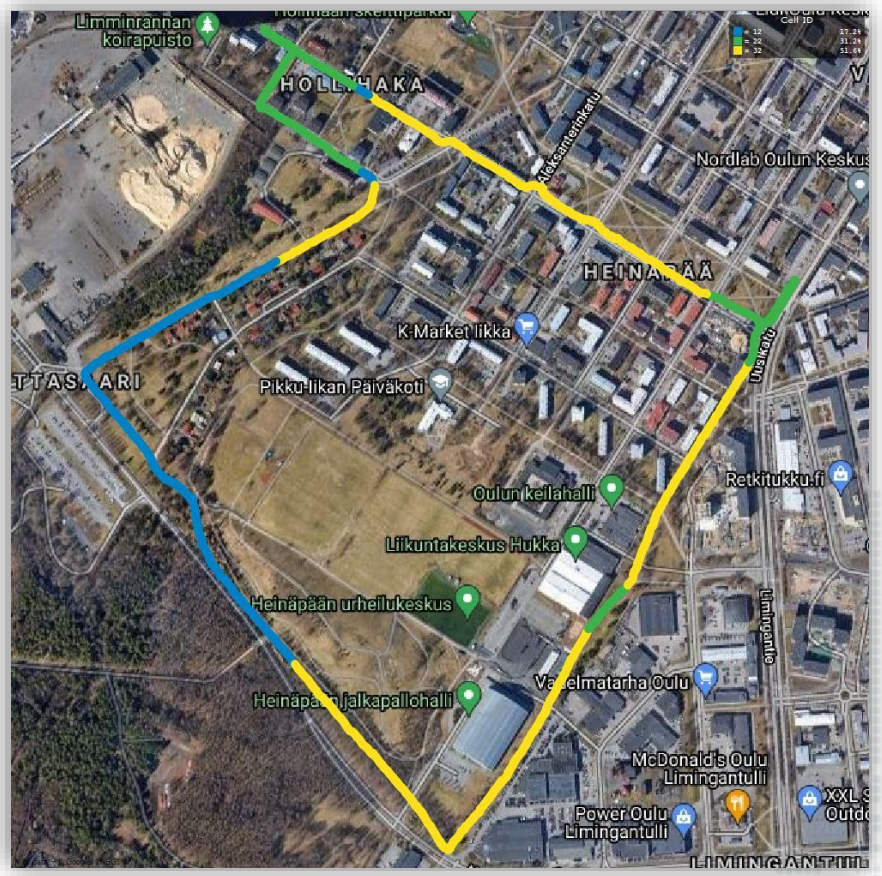




Customized reports, example 1:

Cell ID

- = 12
- = 22
- = 32



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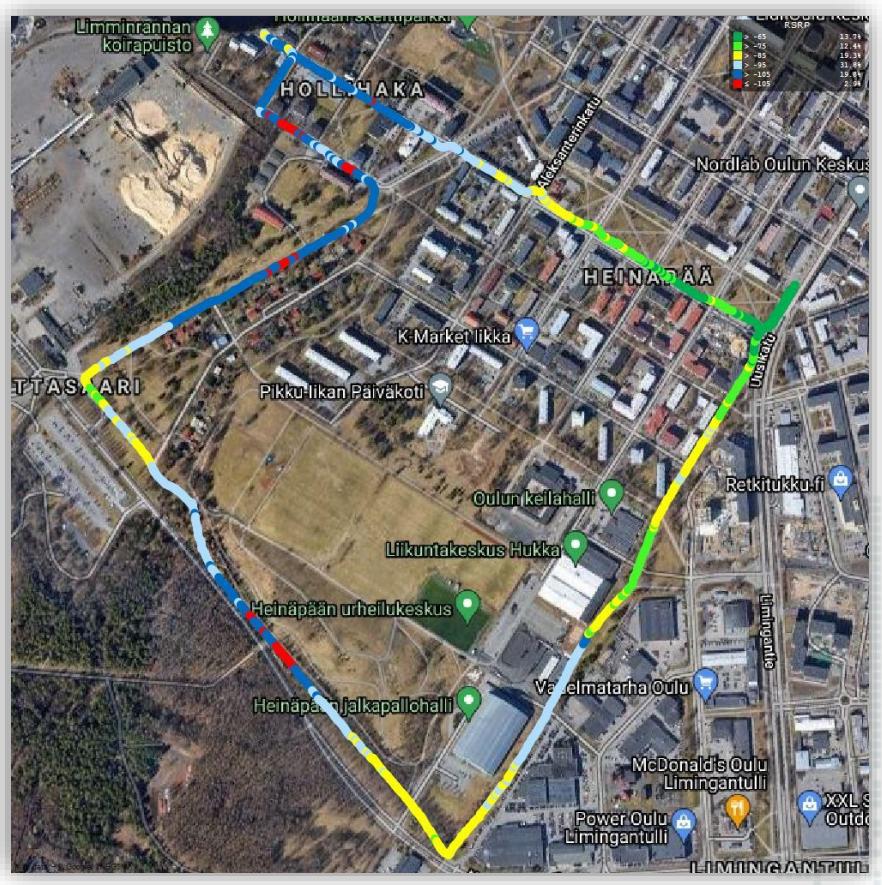
Customized reports, example 2:

RSRP

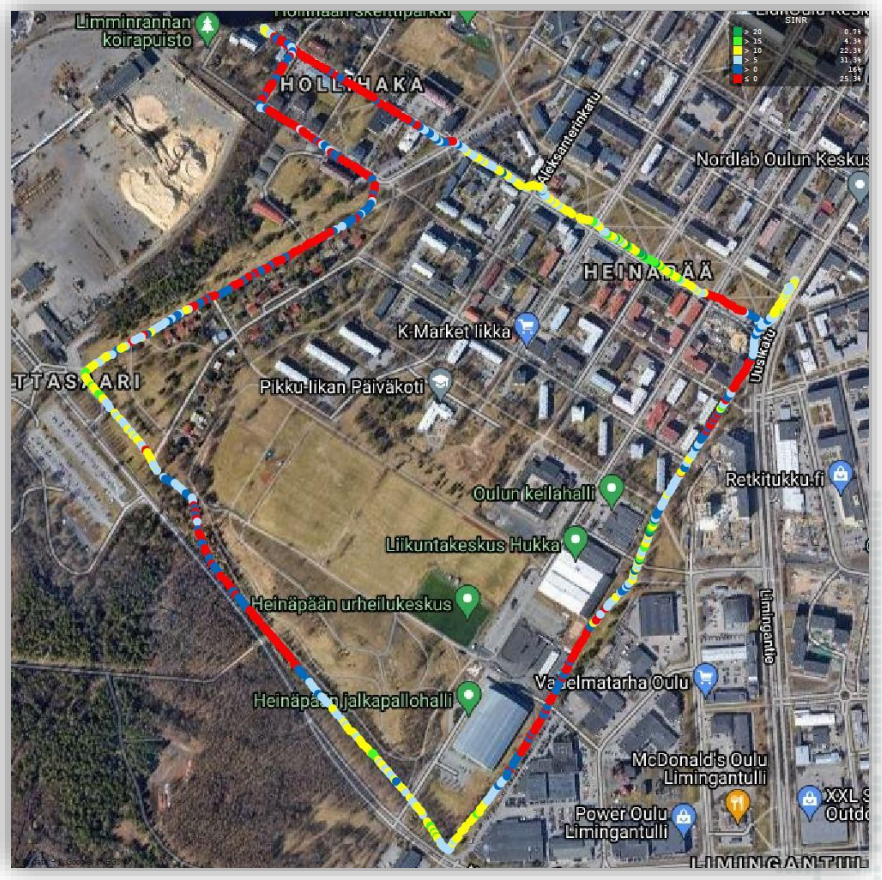
- > -65 dBm
- > -75 dBm
- > -85 dBm
- > -95 dBm
- > -105 dBm
- ≤ -105 dBm



Customized reports, example 3:

SINR

- > 20 dB
- > 15 dB
- > 10 dB
- > 5 dB
- > 0 dB
- ≤ 0 dB



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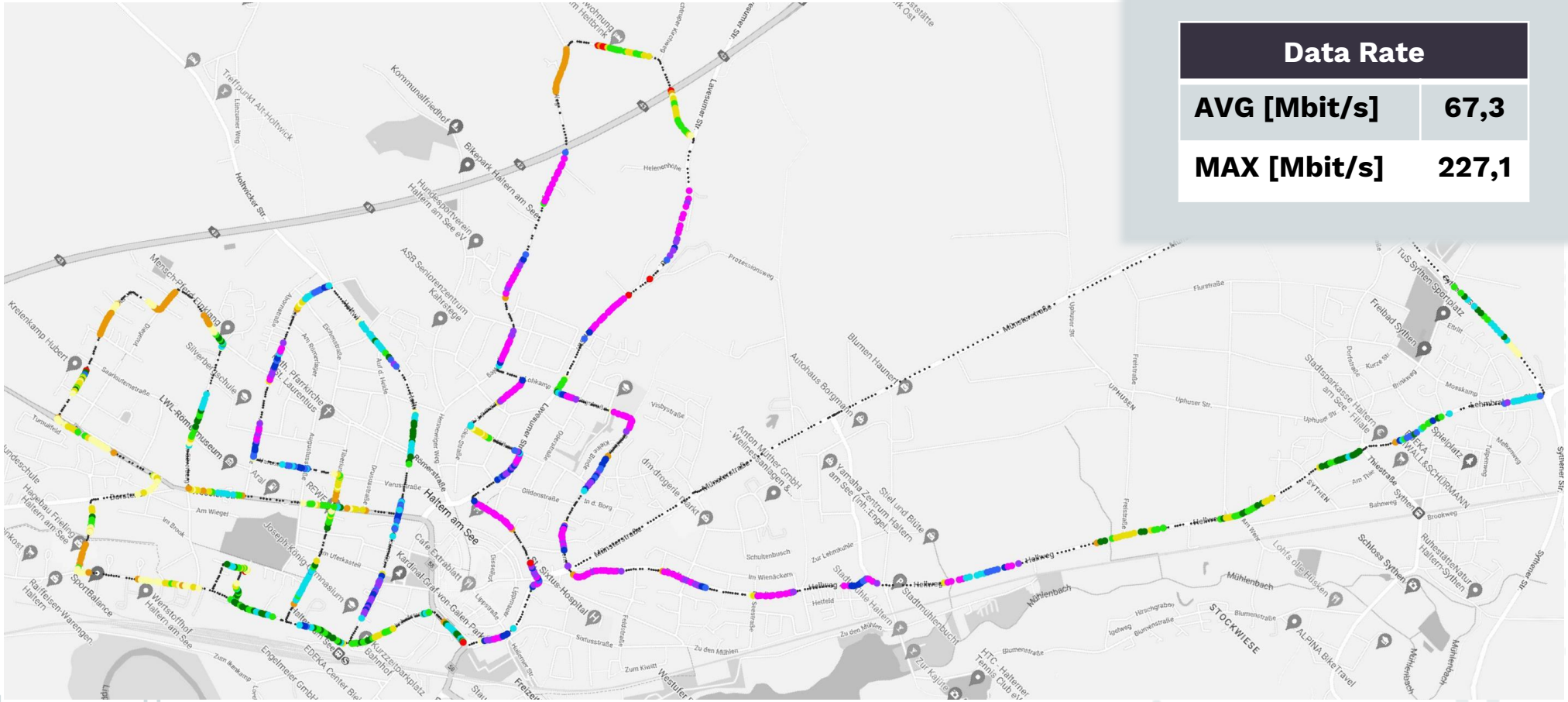
Customized reports, example 4: UE – Data rate Speedtest.net Download

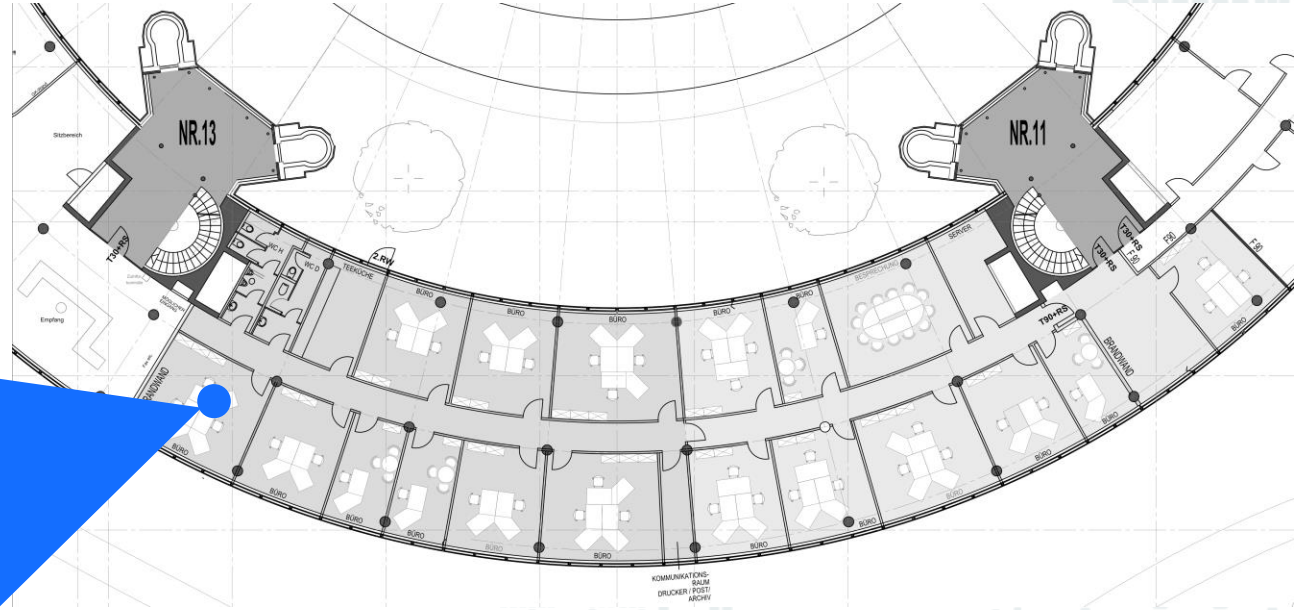
- ≥ 150000 kBit/s
- ≥ 125000 kBit/s
- ≥ 100000 kBit/s
- ≥ 75000 kBit/s
- ≥ 50000 kBit/s
- ≥ 40000 kBit/s
- ≥ 30000 kBit/s
- ≥ 20000 kBit/s
- ≥ 10000 kBit/s
- ≥ 1000 kBit/s
- < 1000 kBit/s



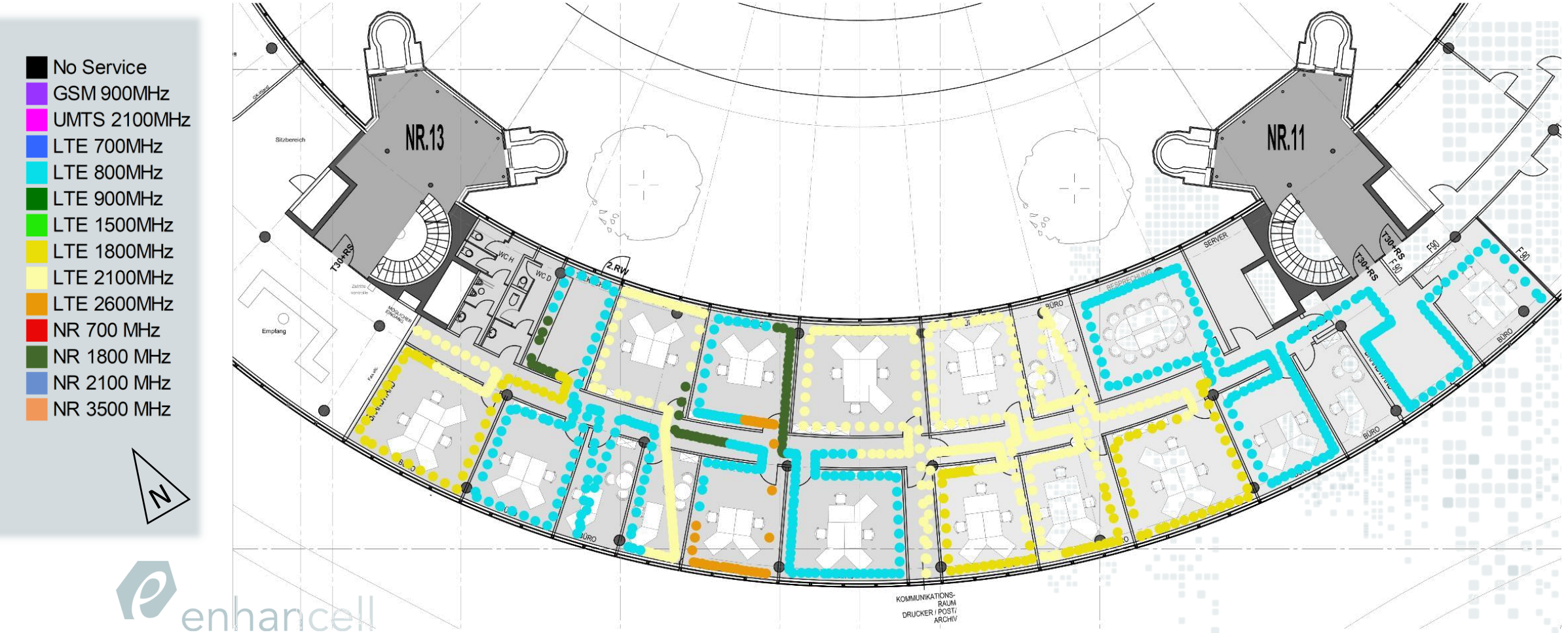
Data Rate	
AVG [Mbit/s]	67,3
MAX [Mbit/s]	227,1

Customized reports, example 5: A single measurement in a meeting room

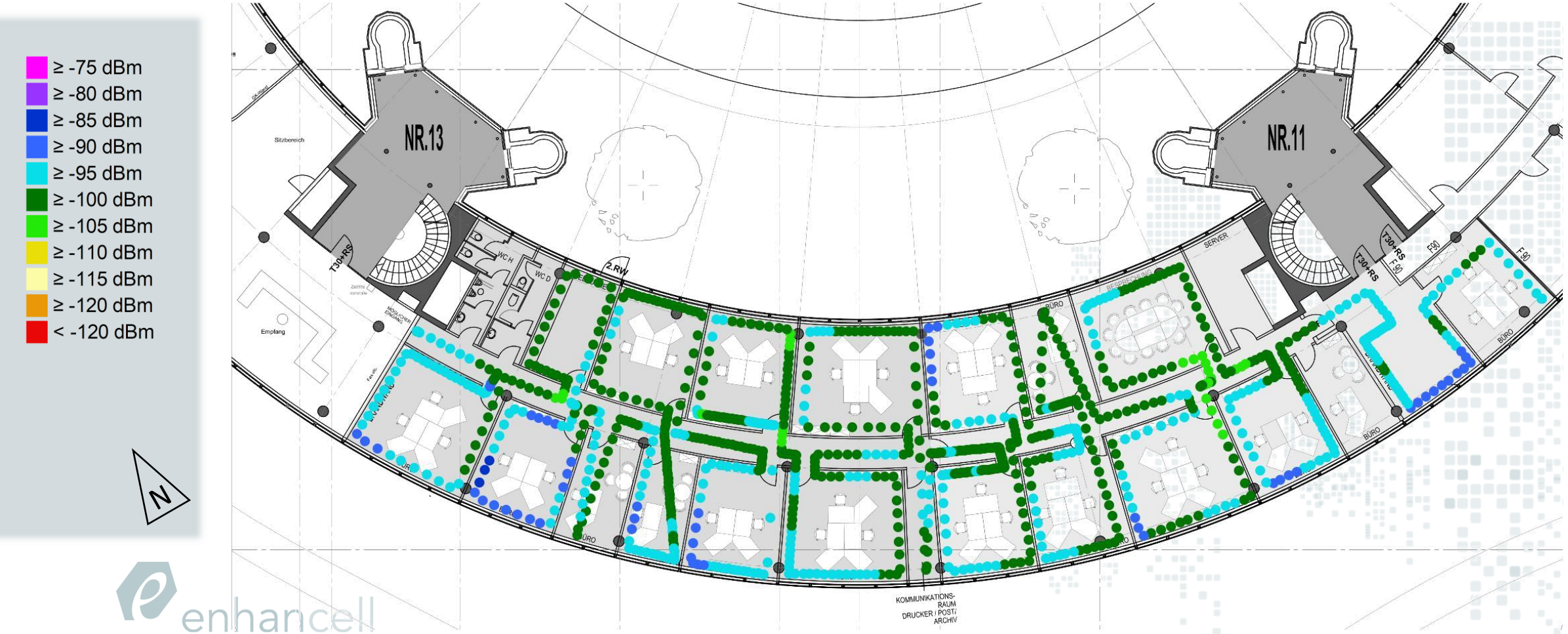
UE Type (UE1)		Type	SM-G781B
		Echo Version	3.2.4
Time per Technology		GSM [%]	0%
		UMTS [%]	0%
		LTE [%]	100%
		NR [%]	0%
		No Service [%]	0%
Tech-nology	GSM	RX Level Sub [dBm]	
		RX Quality Sub [0…7]	
	UMTS	RSCP [dBm]	
		EcNo [dB]	
	LTE	RSRP [dBm]	-93,82
		SINR [dB]	19,89
	NR	SS-RSRP [dBm]	
		SS-SINR [dB]	
Data	Download	Average [MBit/s]	53,21
		Minimum [MBit/s]	10,68
		Maximum [MBit/s]	72,73
	Upload	Average [MBit/s]	4,45
		Minimum [MBit/s]	0,15
		Maximum [MBit/s]	8,40



Customized reports, example 6: UE1 – Technology



Customized reports, example 7: RSRP Best server (LTE 800 MHz)



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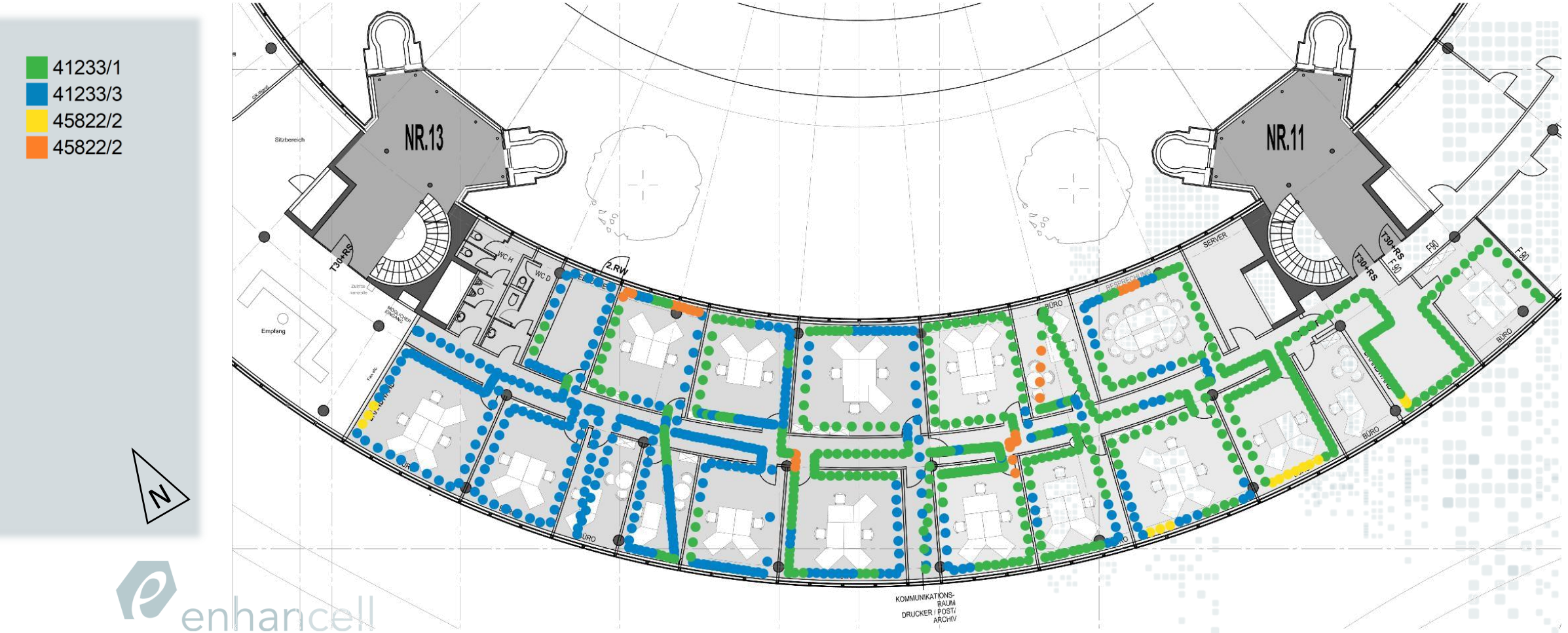
Customized reports, example 8: CI Best server (LTE 800MHz)



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Thank you!