

# Anite



## NEMO INVEX<sup>®</sup> PRODUCT DESCRIPTION

**NEMO**

**Nemo Invex®** has an established position as a pioneer and leader in drive test measurement and optimization solutions for perfecting the air interface of wireless networks. It collects measurement results and geographical coordinates, and these measurement results further provide valuable information for **network planning, roll-out, tuning, verification, optimization, maintenance, and benchmarking purposes**. Nemo Invex currently supports measurements on all major network technologies, including GSM, CDMA2000, EVDO, TD-SCDMA, WCDMA, HSDPA, HSUPA, HSPA+, WiMAX and LTE.

Nemo Invex system combines powerful intuitive software and scalable military grade hardware design to create superior drive-test systems for wireless networks. Quick and easy to deploy, Nemo Invex provides critical quality-of-service (QoS) measurements and a wide variety of quality-of-experience (QoE) service testing, including the latest voice and video quality measurement algorithms.

Nemo Invex is a centralized solution built on a single, powerful platform. Its expandable, modular structure supports not only **drive testing**, but also **QoS** and **benchmarking** measurements on every standard network technology and on **multiple simultaneous data connections**. Through its diverse set of options, Nemo Invex can be tailored to the specific needs of the customer. This empowers the operators to reach both optimal network performance and **time- and cost-effectiveness**.



*Evolutionary chassis-based benchmarking solution.*

Through our close cooperation with several mobile and scanner manufacturers we ensure that our customers always get to select amongst the latest test equipment. Currently Nemo Invex supports more than **200 test terminals and scanning receivers**, a figure which is constantly on the increase to meet the rapidly changing customer needs for optimal satisfaction.

## PLATFORM

### NEMO INVEX 6.X

Including:

- Measurement
- Voice phones 1 license
- Basic data (HTTP, HTTP browsing, FTP, SFTP, ping, ping trace route, iPerf for UDP/TCP, SMS)
- E-mail testing
- MMS testing
- WAP testing
- GPS handler
- SIP-based VoIP calls

### HANDLERS

- Terminal handler for 2G terminals (GSM/GPRS/EDGE/CDMA)
- Terminal handler for 3G terminals (GSM/GPRS/EDGE/CDMA/EVDO/WCDMA/HSPA/HSPA+ DC)
- Terminal handler for 4G terminals (GSM/GPRS/EDGE/CDMA/EVDO/WCDMA/HSPA/HSPA+ DC/LTE)
- Terminal handler for Motorola iDEN terminals (iDEN)
- Terminal handler for TETRA terminals (TETRA)
- Terminal handler for TD-SCDMA terminals (TD-SCDMA/HSDPA)
- Terminal handler for WiMAX modems (WiMAX)
- Nemo application tester handler
- Nemo FSR1 multi-band, multi-technology scanner
- PCTEL LX series
- PCTEL EX series
- PCTEL PCT series
- PCTEL MX series
- Anritsu scanners
- Anritsu MS2721B + DVB-H analyzer
- Anritsu MS2721B spectrum analyzer
- Rohde & Schwarz TSMQ scanner
- Rohde & Schwarz TSML-C, CDMA scanner
- Rohde & Schwarz TSML-G, GSM scanner
- Rohde & Schwarz TSML-W, WCDMA scanner
- Rohde & Schwarz TSML-GW, GSM/WCDMA scanner
- Rohde & Schwarz TSMW scanner

## **OTHER SUPPORTED FEATURES**

- Video streaming quality
- Voice quality (up to 20 VQ connections)
- Indoor
- Nemo Invex playback including the Indoor option
- Carrying case for Nemo Invex chassis
- PCTEL C/I single band
- PCTEL C/I dual band
- PCTEL GSM BCCH decoding (dual band)
- PCTEL GSM BCCH decoding (single band)
- PCTEL spectrum analyzer
- Layer 3 decoding GSM/WCDMA
- Layer 3 decoding WCDMA
- Anritsu, GSM measurement software and antenna option (900 MHz/1800 MHz for vehicle installation)
- Anritsu and antenna (900 MHz/1800 MHz for vehicle installation)
- Anritsu, two carrier measurement
- Measurement software N80 in Chinese
- Measurement software N95 in Chinese

## **NEMO INVEX SUPPORTED VENDORS AND CHIPSETS**

- Anite
- Anritsu (GSM/WCDMA scanners, DVB-H analyzer)
- Beceem
- Digital Receiver Technology (Wimax scanner)
- EADS
- LG
- Motorola
- Nokia
- PCTEL LX/EX/MX/PCT series
- Qualcomm
- Rohde & Schwarz
- RunCom

## TERMINALS AND SCANNERS IN NEMO INVEX 6.00

### TERMINALS

#### TETRA

*EADS* THR880, THR880i, TMR880  
*Nokia* THR850

#### iDEN

*Motorola* i886

#### GSM

*Nokia* N85 GSM

#### EDGE

*Nokia* 3500

#### WCDMA 2100

*Anritsu* ML8720B  
*Merlin* U530  
*Motorola* V3X  
*Nokia* 6630, 6680, N80  
*Qualcomm* TM6200, TM6250  
*Samsung* ZV10, Z105, Z107, Z140, Z500, SGH-T639 terminal (T-Mobile)  
*Vodafone* 3G

#### CDMA2000 1xEVDO Rel 0

*LG* KX206, VX8000, VX8100, VX8300, VX8350, C270, C676, C680, LHD 200E  
*Motorola* V3C  
*Zapp* Telemodem Z020

#### CDMA2000 1xEVDO Rev A

*Kyocera* KPC650  
*Pantech* PX-500  
*UTStarcom* Audiovox PC5740, PC5750  
*Novatel* Ovation MC727, MC760  
*Huawei* C7600  
*Sierra Wireless* Compass 597  
*Huawei* EC367

#### DVB-H

*LG* U900, KU950  
*Samsung* P920, P940

#### HSDPA

*Huawei* E169, E220  
*LG* KF700, TU550  
*Merlin* U740, U870, X950 D, Express  
*Motorola* RAZR V9, V9US  
*Nokia* 6120, 6121, N85, N85 US, N95, N95US, N96, N96US, N97, N97US  
*Option* GlobeTrotter 3G+, Express 7.2, GT MAX E, GT MAX 7.2 Ready, HSDPA 7.2 Ready,  
*GlobeSurfer* iCON 7.2  
*Qualcomm* TM6275, TM6280  
*Samsung* Omnia 7, ZX20, Z560, Z720, A707, G800, SGH-U900 Soul  
*Sierra Wireless* Aircard 850, 860

#### HSUPA

*Huawei* E180, E270, E870 Express  
*Nokia* C5-03, C7, E7, C5-03 NAM, C5-04 AWS, 6720, 6720US  
*Option* GlobeTrotter HSUPA, iCON 401, iCON452  
*Qualcomm* MSM7200 TM  
*Sierra Wireless* Aircard 880, 881, 885 Compass

#### HSPA+

*Bandrich* Bandlux C320  
*Huawei* E182E, E270+, E1820  
*Novatel* Ovation MC996D, MC545  
*Qualcomm* MDM8220 TM

Sierra Wireless 306, 307, 308, 309, 310U, 312U, 319U

**TD-SCDMA,  
GSM/TD-SCDMA**

*Datang* DTM 8101, DTM 8120  
*Leadcore* LC 8130E

**WiMAX**

*Beceem* BCS200  
*Beceem* BCSM250  
*ZTE* TU25  
*DRT* 4301A+  
*Motorola* PCCW200  
*Motorola* USBw 25100  
*Zyxel* MAX-100

**LTE**

*Huawei* E398  
*LG* L1000, G7, G13, G17, VL600  
*Pantech* UML290  
*Qualcomm* MDM9200, 9600  
*Sierra Wireless* 313U, 320U

**Application testing**

Any voice and data-capable terminal

**Voice Quality  
testing (PESQ)**

*Nokia* 6120, 6121, 6720, 6720US, C5, N85, N85US, N95, N95US, N96, N96US, N97, N97US  
*LG* C676, C680, KX206, VX 8350, VX8360  
*Datang* DTM 8120, *Leadcore* LC 8130E  
*Samsung* SGH-U800

**SCANNERS**

**Anritsu**

*ML8720B* WCDMA 2100  
*ML8720C* WCDMA 2100, GSM 900/1800  
*ML8740A* WCDMA 2100, GSM 900/1800  
*ML8740B* WCDMA 2100, GSM 900/1800

**DRT**

*4301A+* WiMAX 2300-2360, 2496-2690, 3300-3800, 5150-5825 MHz

**Nemo FSR1**

GSM 850/900/1800/1900MHz  
WCDMA 850/900/1900/2100/2100AWS  
CDMA/EVDO 850/1900  
LTE 700- A/ B/ C/ D/ E, 850, 900, 1800, 1900, 2100, 2100 AWS and 2600 (E-UTRA bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 38)  
Spectrum analyzer  
Band scan

**PCTEL**

*EX* LTE Single Band Upper 700C  
LTE Dual Band Upper 700-C/AWS 2100 Mini  
LTE Dual Band Lower 700-B/C/AWS 2100 Mini  
LTE Single Band Lower 700-A/B/C Mini  
LTE Tri-Band Scanner, Lower 700-A/B/C / Upper 700-C / 2100 AWS  
LTE Single Band 1600 (E-UTRA band 24)  
LTE Dual band 1800/2600  
LTE Single Band 2100  
LTE Single Band Scanner, 2100 AWS Mini  
LTE Dual Band 2100/2600  
LTE Single Band E800 Mini  
LTE Dual Band E800/2600  
LTE Single Band 2600 Mini  
GSM 900/1800 TD-SCDMA 2000

	WiMAX 2.496-2.69 GHz
	WCDMA 850/1900, GSM 850/1900
	WCDMA 2100 AWS, GSM 850/1900
	WCDMA 900/2100, GSM 900/1800
	WCDMA 2100 AWS, GSM 1900
	WCDMA 2100/GSM 900/1800
	CDMA/EV-DO 850/1900
<i>EX Mini 06110</i>	WCDMA 2100
<i>EX Mini 06111</i>	WCDMA 900/2100
<i>EX Mini 06112</i>	WCDMA 850/1900
<i>EX Mini 06113</i>	WCDMA AWS
<i>EX Mini 06116</i>	WCDMA 850
<i>MX</i>	E-UTRA bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 21
	WCDMA 850/900/1800/1900/2100/2100 (AWS), GSM 850/900/1800/1900
	CDMA/EVDO 850/1900
	Spectrum analyzer
<i>LX</i>	All GSM frequencies
	WCDMA 850
	WCDMA 900
	WCDMA 1900
	WCDMA 2100
	WCDMA/GSM 850/1900
	WCDMA 850/1900/2100/2100 (AWS)
	WCDMA 2100, GSM 900/1800
	1xEVDO 450
	1xEVDO 850
	1xEVDO 1900
	CDMA 850/1900, EV-DO 850/1900
	CDMA/EVDO 850
<i>PCT-505</i>	WCDMA 850/900/1800/1900/2100
<i>PCT-510</i>	GSM 850/900/1800/1900
<i>PCT-520</i>	WCDMA 2100, GSM 900/1800
<b>Rohde &amp; Schwarz</b>	
<i>TSML-C</i>	CDMA/EV-DO, spectrum analyzer, CW scanning
<i>TSML-G</i>	GSM, spectrum analyzer, CW scanning
<i>TSML-W</i>	UMTS, spectrum analyzer, CW scanning
<i>TSML-GW</i>	UMTS 850/900/1900/2100/2100 AWS, spectrum analyzer, CW scanning,
	GSM-E/-R 850/900/1800/1900
<i>TSMQ</i>	GSM 850/900/1800/1900,
	WCDMA 850/900/1900/2100/2100AWS
	CDMA/EVDO 450/800/1900
	Spectrum analyzer, CW scanning
<i>TSMW</i>	GSM-E/-R, GSM 850/900/1800/1900
	WCDMA 850/900/1800/1900/2100/2100 AWS
	CDMA2000/1xEVDO 450/800/1900
	LTE FDD bands 700, E800, 850, 900, 1400, 1500, 1800, 1900, 2100, 2100 AWS and 2600 (E-UTRA bands 1- 5, 7- 24)
	LTE TDD bands (1900-1920MHz), (2010-2025MHz), (1850-1910MHz), (1930-1990MHz), (1910-1930MHz), (2570-2620MHz), (1880-1920MHz), (2300-2400MHz), (2496- 2690MHz), (3400-3600MHz) and (3600- 3800MHz) (E-UTRA bands 33- 43)
	Spectrum analyzer
<b>ZTE</b>	
<i>TU25</i>	WiMAX 2.496-2.690 GHz

## DEVICES COMPATIBLE WITH INVEX ISOLATION MODULES

The table below displays a list of devices that can be connected to the Nemo Invex measurement system using the modem isolation modules or the handset isolation modules. The table also tells if the device can be used for voice quality measurements. The devices below are certified to the Standard<sup>1</sup> level of functionality.

Brand	Model	Technology	Modem Iso	Handset Iso	Voice Quality
Huawei	UMG1831	HSPA+	Yes	No	No
LG	LX 570	CDMA 1x EVDO	No	Yes	Yes
LG	LX 8350	CDMA 1x EVDO	No	Yes	Yes
LG	UX 565	CDMA	No	Yes	Yes
LG	LG VL600	LTE / EVDO Rev A	Yes	No	No
Motorola	i265	IDEN	No	Yes	Yes
Nokia	C7, C5	HSPA+	No	Yes	Yes
Novatel	MC547	HSPA+	Yes	No	No
Samsung	A847	HSPA	No	Yes	Yes
Samsung	A867	HSPA	No	Yes	Yes
Samsung	R430	CDMA 1xEVDO	No	Yes	Yes
Samsung	T639	WCDMA / HSPA	No	Yes	Yes
Samsung	T659	WCDMA / HSPA	No	Yes	Yes
Sierra Wireless	SW 308	HSPA+	Yes	No	No
Sierra Wireless	SW 312	HSPA+	Yes	No	No
Sierra Wireless	SW 320	HSPA+	Yes	No	No
Sierra Wireless	SW 598U	EVDO	Yes	No	No
Ubee Interactive	Ubee 1900	Wimax	Yes	No	No
UTStarcomm	UM100C	CDMA 1xEVDO	Yes	No	No
UTStarcomm	UM175C	EVDO Rev A	Yes	No	No
ZTE	MF683	HSPA+ DC	Yes	No	No

<sup>1</sup>Standard level certification ensures proper operation of the following protocols: voice, voice quality, FTP, HTTP and ping.



## NEMO INVEX KEY FEATURES

- Rugged military grade design to ensure uninterrupted operation in harsh field conditions (MIL-STD-810E).
- Integrated mounting and connections for scanners.
- Power consumption and high speed performance balanced to allow high device count and mobile operation.
- Support for measurements on all major network technologies, including HSPA+ Dual Cell and LTE.
- Support for the latest voice and video quality measurement algorithms (PESQ and POLQA).
- Support for more than 200 test devices.
- Measurements can be carried out on multiple networks and even on multiple technologies simultaneously for ultimate network performance.
- Voice quality, video quality, video call quality and Psytechnics PVI video streaming quality measurements are supported.
- Multiple devices can conveniently be added to the system in user-defined order using automatic device detection.
- With the optional VoIP module, a user is able to perform IP telephony measurements on the IP networks based on the established VoIP sessions. The gathered measurement information includes call statistics and IP related parameters, such as the number of lost or discarded packets, transfer delay, and jitter.
- Channel/scrambling code locking, band locking, handover control, timeslot testing and cell barring are available in Nemo Invex.

## SYSTEM OVERVIEW

- Nemo Invex software user interface and device handlers
- Measurement platform holds up to ten universal interface controller (UIC) modules
- Each UIC supports two test devices (one high speed data and one voice or two voice)
- Integrated power supply with internal battery backup (UPS)
- UICs are connected via a Gigabit Ethernet connection
- Integrated mounting, power and GPS for Nemo FSR1 scanner
- Can be used either as a fixed or a mobile unit
- Twelve slots in total
  - Ten active slots (for UIC modules)
  - Two passive slots (for isolation modules only)
- UIC modules and modem isolation modules each occupy a one-slot space
- Handset isolation modules each occupy a two-slot space
- System Interface (SI) module
- Active backplane provides power to attached modules
- Intelligent power supply prevents the unit from affecting normal vehicle operation

## HARDWARE CONFIGURATION EXAMPLES

- Ten UIC modules and two modem isolation modules
- Three UIC modules, three modem isolation modules and three handset isolation modules
- Six UIC modules and six modem isolation modules
- And various other combinations (note that isolation modules are not required)



### UNIVERSAL INTERFACE CONTROLLER MODULE (UIC MODULE)

- Provides dedicated resources to interface to handsets and data sticks
- Supports > 100 Mbps data transfers
- Industrial PC running Windows 7 OS
- 2GB RAM, 16 GB solid state hard drive
  - No rotating media
- 2 USB ports support 2 devices per card
  - 2 power ports for isolation modules
- 1 PCIe port for future expansion
- Ability to shut off USB port power to hard reset locked up devices
- Separate supervisory processor
- Single card slot width



### SYSTEM INTERFACE MODULE (SI MODULE)

- 2 Gigabit Ethernet ports
  - Interface to controlling laptop
  - Interface to scanners
  - Interface to second Nemo Invex chassis
- Contains a GPS module
  - u-blox 6 chipset
  - 50 channel, 2 million correlators
  - -160 dBm sensitivity
- GPS signal is distributed to each UIC over the backplane
- Onboard active GPS RF splitter provides signal for scanners

### MODEM ISOLATION MODULE

- Shielded enclosure for USB data sticks
- Provides secure mounting for device in chassis
- Passive, does not connect to chassis backplane
- USB cable connection to UIC
- Internal device to SMA RF cables
- External SMA connectors for antennas
- Single slot width



### HANDSET ISOLATION MODULE

- Shielded enclosure for handsets (~50 dB)
- Supports all modes of testing (voice & data)
- Contains soundcard for audio testing
- Handsets are fitted with custom battery eliminator modules
- Supports continuous driving
- Power provided by UIC
- Ability to hard reset devices in case of handset lock up
- No connection to chassis backplane
- USB cable connection to UIC
- Separate power connection to UIC module
- Internal device to SMA RF cable(s)
- SMA antenna connector(s)
- Double slot width



## WORKING WITH NEMO INVEX

Nemo Invex® system combines powerful intuitive software and scalable military grade hardware design to create superior drive-test systems for wireless networks.

Quick and easy to deploy, Nemo Invex provides critical quality-of-service (QoS) measurements and a wide variety of quality-of-experience (QoE) service testing, including the latest voice and video quality measurement algorithms. Nemo Invex is flexible and scalable, capable of evolving as the network evolves providing the lowest effective total cost of ownership available.

The Nemo Invex software application that runs on the Nemo Invex 4G chassis for benchmarking is also widely known as a tool for network optimization. With other benchmarking tools, QoS statistics can be collected but no actual reasons for possible issues, i.e., low data rates can be seen without a cause identified. Often the network issue is interference and other benchmarking tools are collecting quality parameters but no real time analysis is performed. The Nemo solutions allow the user to activate different interference analysis measurements such as WCDMA pilot pollution, GSM co-channel/ adjacent channel interference and GSM/ WCDMA missing neighbor detection. These enhanced capabilities, help to save time and money and provide additional value added information also to benchmarking campaigns. Furthermore, significant cost savings can be realized by bundling the data collection solution with post processing solution as Anite has a comprehensive post processing solution in Nemo Analyze.

The Nemo Invex chassis IP can be set. Individual UICs are automatically assigned incremental IP addresses.

<b>Temp rise (full system)</b>	+10 ° C
<b>Shock and vibration</b>	MIL-810
<b>Certification</b>	CE approval – FCC part 15
<b>Architecture</b>	Modular, field expandable
<b>Connectors</b>	All I/O on front, except power connection (on rear)
<b>Power switch</b>	Rear
<b>Module capacity</b>	10 active + 2 passive for 12 total
<b>Scanners</b>	Includes optional brackets and connections for attaching scanners to the top of the chassis
<b>Mechanical configurations</b>	Front exposed
<b>Width</b>	40.18 cm (15.82 in)
<b>Height</b>	17.55 cm (6.91 in)
<b>Depth</b>	45.34 cm (17.85 in)
<b>Power requirements</b>	12 VDC or 120/240 VAC 50/60 Hz with external power supply

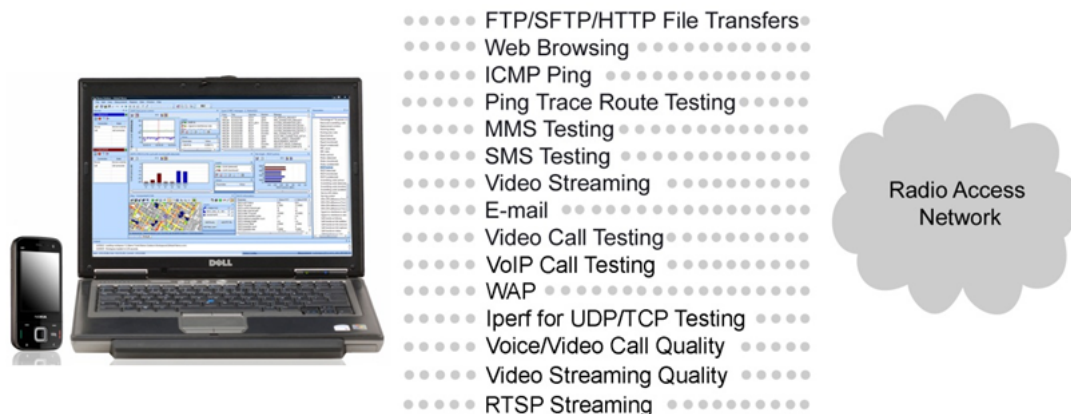
## HARDWARE AND SOFTWARE REQUIREMENTS FOR THE NEMO INVEX LAPTOP

- PC (Lenovo or Dell recommended) with Windows® XP (32- bit) Professional or Windows 7® Professional (32/64- bit).
- Pentium III processor, minimum 1GHz, preferably 1.7 GHz for single mobile measurements
- For multi data measurements Intel® Core Duo processor T2500 2.00GHz or higher required
- For voice quality measurements with up to four channels with USB sound card Intel® Core Duo processor T2500 2.00GHz or higher required
- For up to six channel voice quality measurements with USB sound card Intel® Quad Core processor Q9100 2.26GHz or higher required
- 512MB RAM minimum, 1GB RAM recommended
- For multi data measurements with HSPA+ devices Intel® Quad Core processor Q9100 2.26GHz or higher required
- 100 MB of free hard disk space for installation and use; 1 GB recommended
- One USB port for copy protection module
- Depending on the scanner used, one serial port, RJ45 or FireWire port per scanner
- Display resolution 1024 x 768 with 256 colors, 1280 x 1024 recommended
- Internet Explorer 4.0 or higher for viewing the help file

## APPLICATION TESTING

Nemo Invex enables network operators to test their network using *the same application protocols as their customers and, therefore, provides results that correspond with the end-user experience.*

Nemo Invex supports e-mail, SMS, MMS, WAP, Iperf for UDP/TCP testing, ping trace route testing, FTP, SFTP and HTTP file transfers, HTTP browsing, RTSP streaming, video streaming, video streaming quality, VoIP call, video call, video call quality, voice quality (ITU-T P.862.1, WB-AMR, P862.2), ICMP ping, measurements. The information provided by Nemo Invex assists in the verification and troubleshooting of new services reducing the time-to-market.



Application tests can be performed either manually or automatically by taking advantage of user-definable scripts. For all protocols, key performance indicators, such as data throughput, access time and success rate can be recorded simultaneously with the full radio network information.

All services are supported in a single product, Nemo Invex, providing an easy-to-use, consistent interface for configuring the different applications. Different applications, such as voice, SMS and packet-switched data can be launched in one measurement session to simulate end-user behavior.

Nemo Invex supports single and multi (parallel) SFTP transfers and single, multi (parallel) and multi-threaded FTP transfers. In single SFTP/FTP transfer, one file is either sent or received. In multi SFTP/FTP transfer, one or more files are either sent or received or both simultaneously. In multi-threaded FTP transfer, the transferred file is split into smaller fragments. The number of threads can be defined by the user. Each thread creates a new FTP session and transfers a fragment of the file. Multi-threaded FTP transfer mode is supported in receive direction.

MMS testing allows you to monitor how multimedia messages are transferred in the network. MMS messages can be sent manually and with scripts. In addition to successfully sent/received MMS messages, also sending/receiving attempts and sending/receiving failures are recorded enabling statistical success rate calculations. Nemo Invex measures total MMS sending delay. Also separate delays from attach, PDP context activation, logging to MMSC, and message sending/receiving are recorded.

The *end-to-end SMS and MMS application testing* in Nemo Invex adds to the extensive testing portfolio. Nemo Invex attaches a unique identifier to the messages, which enables the Nemo post-processing tool Nemo Analyze to recognize each individual message, and to calculate the time it took for the message to reach its destination from the time of sending.

## BENCHMARKING

Nemo Invex benchmarking measurements can be performed on *any combination of networks and system technologies* ranging from GSM, WCDMA, 1XEV-DO, and TD-SCDMA to HSPA+, WiMAX and LTE. Nemo Invex allows *10 simultaneous voice measurements* and *up to 10 concurrent data measurements to be performed simultaneously*. In addition, it is possible to perform *up to 20 concurrent voice quality measurements*. The network, system technology and measurement mode options also present endless possibilities for combination.

As many as *20 test devices can be connected with Nemo Invex at once*, including Nokia, Motorola, and Qualcomm-based terminals, as well as scanning receivers from Anite, Anritsu, PCTEL, DRT and Rohde & Schwarz. What is more, they are all conveniently connected to the same Nemo Invex platform running on a *single laptop*. Furthermore, combined with Nemo Server, it is also possible to carry out *long-term network performance measurements*.



*Nemo Invex with Nemo FSR1 scanner*

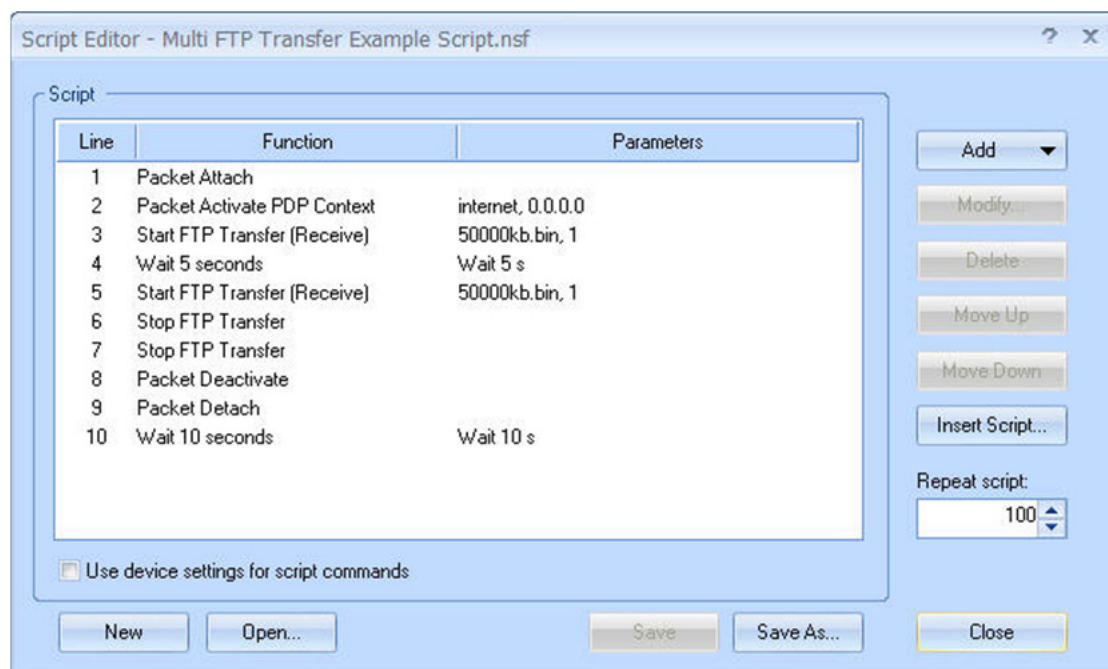


## SCRIPTS AND MEASUREMENT LISTS

In Nemo Invex measurement **automation** is enhanced through scripting. By creating and editing script files with the built-in script editor, Nemo Invex makes voice and video calls, HTTP/FTP packet data uploads/downloads, HTML/WAP browsing, SMS/MMS messages, emails, and ping measurements according to the user's needs and for their purposes.

The more advanced scripting features include loops, conditions and waits. The Condition script command can be used, for instance, to create scripts where the type of the detected packet technology determines how the script proceeds. The Loop script command enables scripts where a portion of the script is repeated a number of times before proceeding with the rest of the script. With the Wait script command, the user can create scripts that are not activated before a certain system or bandwidth is active.

The **script group functionality** enables the user to synchronize script files and/or certain lines in the script file for specific devices. Both synchronization methods can be used together or separately depending on the needs of the user.

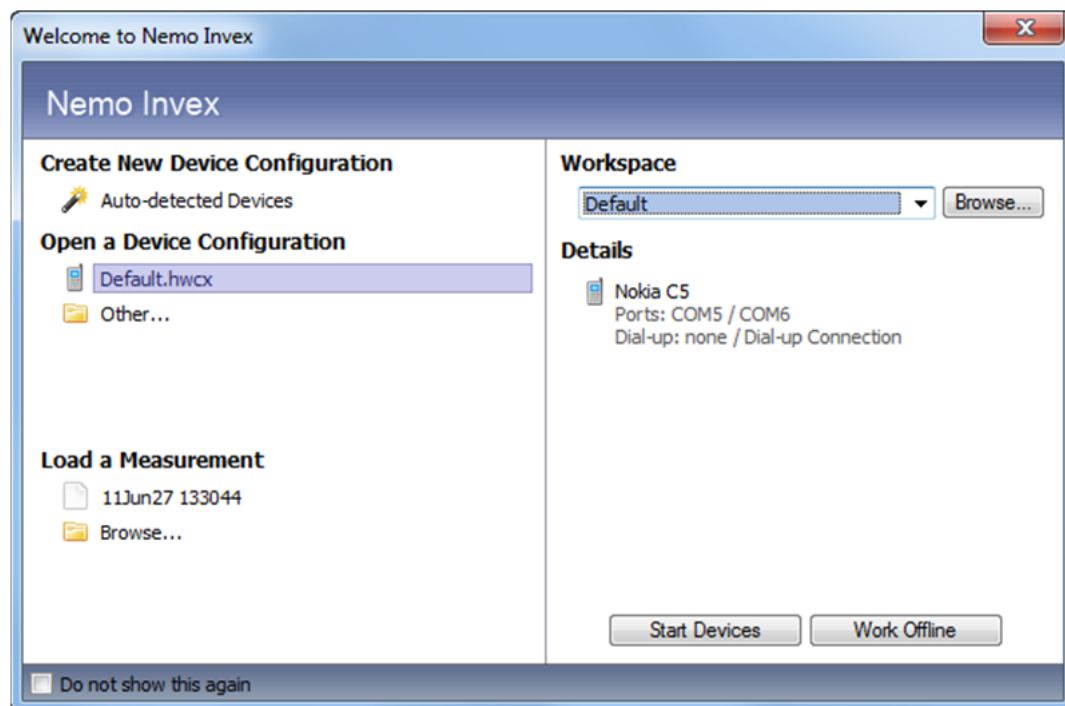


*Nemo Invex comes with several script examples*

**Measurement lists** are one level higher individual scripts, enabling even larger-scale measurement campaigns for increasing measurement automatization. Measurement lists, which can be loaded and saved, Measurement lists enable you to run automated measurements with several devices combining multiple scripts. What is more, you can use measurement lists with just one device to run several scripts one after another. However, each measurement is recorded in a separate file. You are also able use measurement lists without scripts.

## AUTOMATIC DEVICE DETECTION

Nemo Invox has a flexible and user-friendly user interface which allows users from different levels of experience to have an *easy and smooth access to the system*. The automatic device detection functionality, accessed both through the Welcome page and the menu bar, automatically detects devices connected to the Invox chassis and assigns the appropriate, previously created COM port and dial-up information to them. For example, when trying to add a Qualcomm device, the application adds the device and recognizes the necessary ports of the device automatically, which is very user convenient. The order of added devices can also be determined by the user, and the user can set the devices to start automatically upon setup. The benefits of this function include, for example, that the reassignment of COM ports to the devices will no longer cause confusion for the user. In addition, the user does not need to spend time on manually going through the procedure, saving valuable time and optimizing the experience of the easy and intuitive Nemo Invox UI.

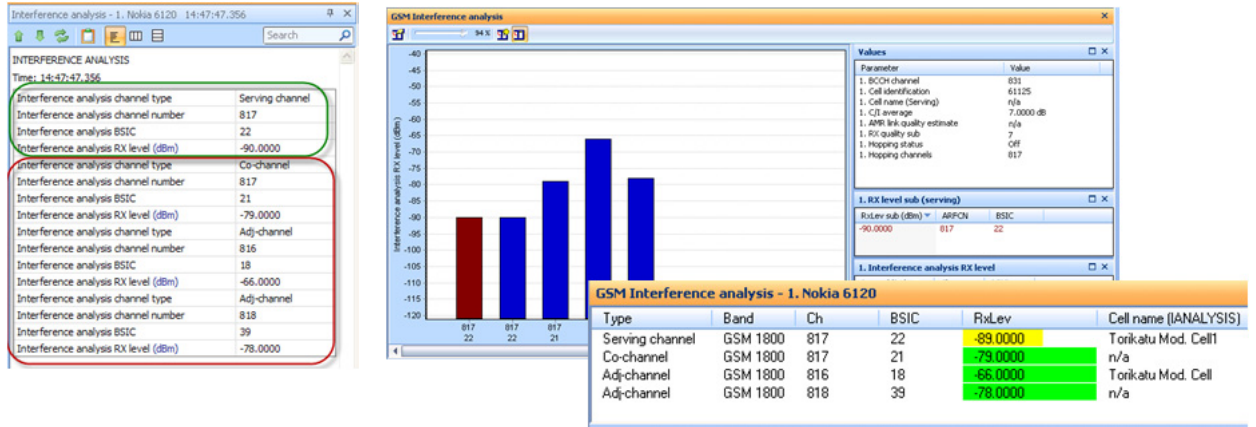


*The automatic device detection functionality makes Nemo Invox easy to set up and use*

# TROUBLESHOOTING

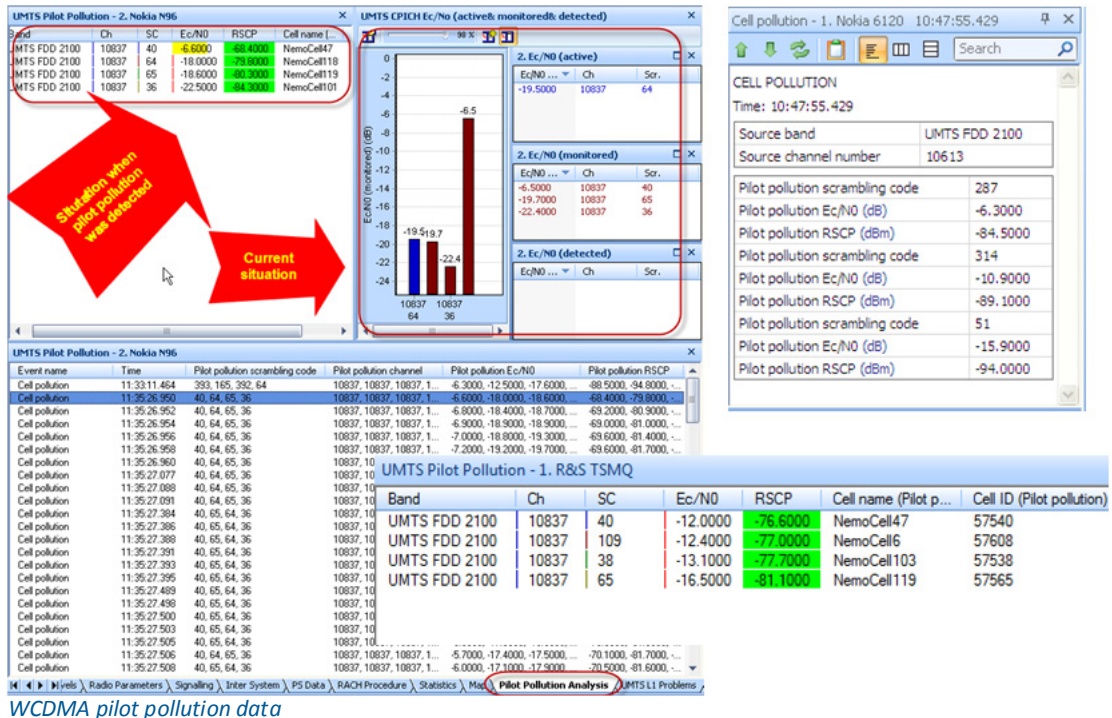
## GSM INTERFERENCE ANALYSIS

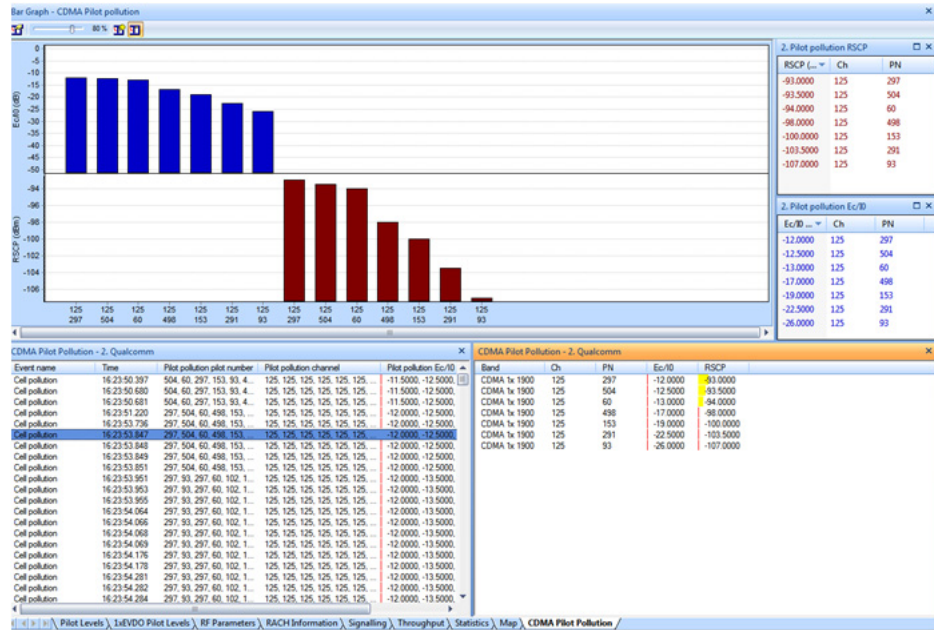
In GSM mobile communication networks, system capacity is often limited by co-channel interference. This is because of the surrounding cells using the same carrier frequency, or adjacent channel interference when surrounding cells use a channel too close to the serving cell used by a terminal. GSM co-channel and adjacent channel analysis is done in real time during a measurement and playback with Nemo Invex. Interference detection is done based on GSM terminal and GSM scanner measurements and these measurements are combined together.



## PILOT POLLUTION ANALYSIS

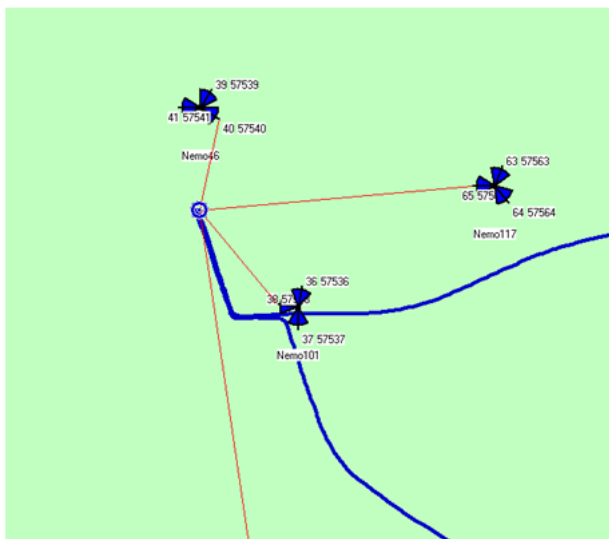
Available for WCDMA and CDMA networks, Pilot Pollution Analysis measurements can be performed in real time with Nemo Invex by using test terminals or a scanning receiver. In a pilot pollution situation there are more active/monitored pilots than a handset can measure, or there is no clear dominance for any pilots in the area. The pilot signal is used to distinguish cells in the network from one another. Pilot pollution analysis is done based on CELL MEASUREMENT events, and analysis is always active. The user can define thresholds for pilot pollution analysis via the Nemo Invex user interface.





CDMA pilot pollution data

Pilot pollution situations detected with WCDMA scanners and terminals and GSM co-channel/ adjacent channel interferer situations can be displayed on a map. A line from the current location is drawn to interfering cell(s). A BTS file with WCDMA scanners and terminals can be used to display cell names for cells causing pilot pollution. Cell names can be displayed in different views.



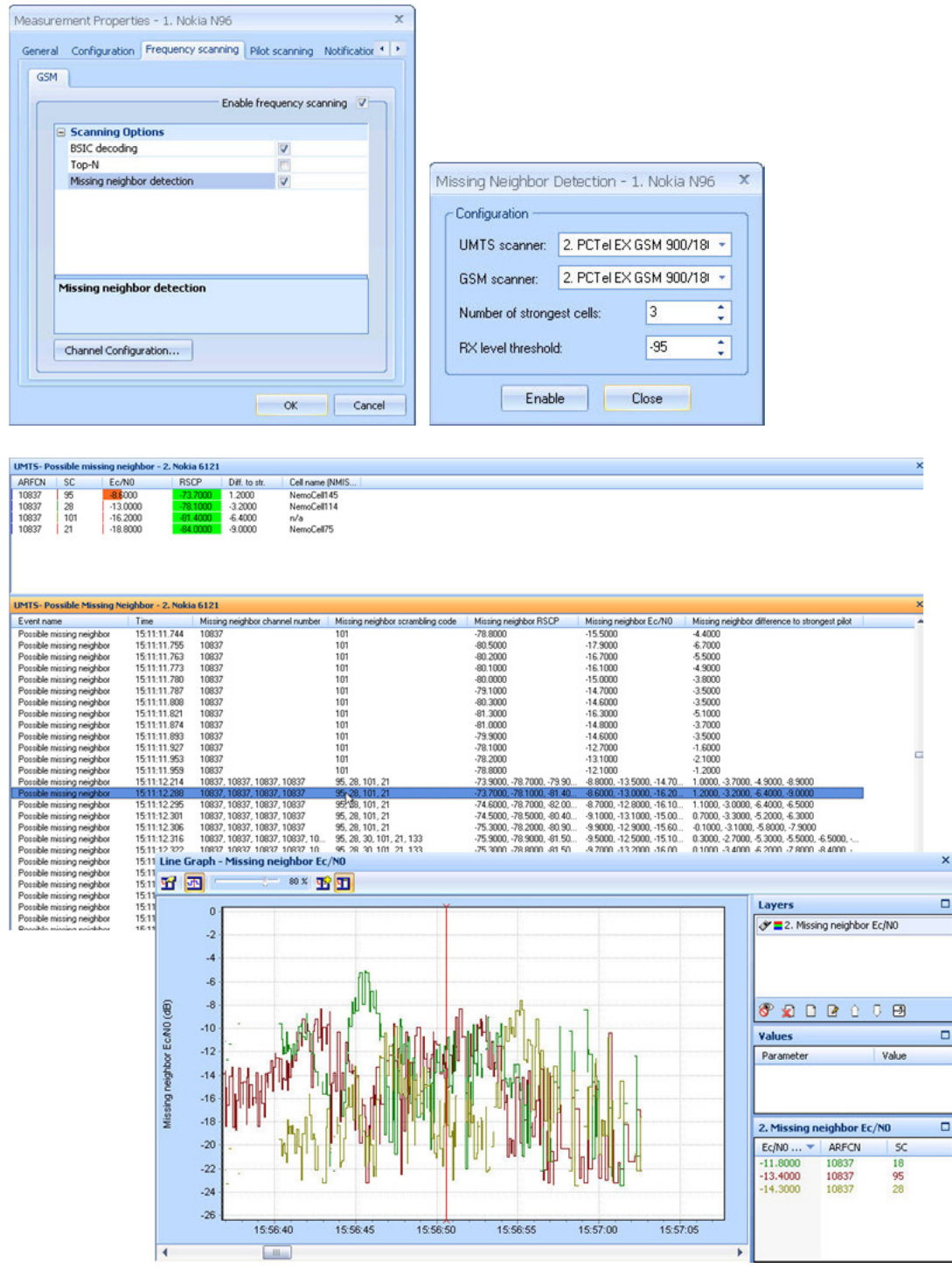
Map view with lines drawn to interfering cells

### MISSING NEIGHBOR DETECTION

With Nemo Invox you can perform real-time missing neighbor detection. You have three options in which to perform missing neighbor detection:

- with a mobile terminal supporting missing neighbor detection,
- a GSM/UMTS scanner, or
- GSM/UMTS scanner and a GSM/UMTS mobile.

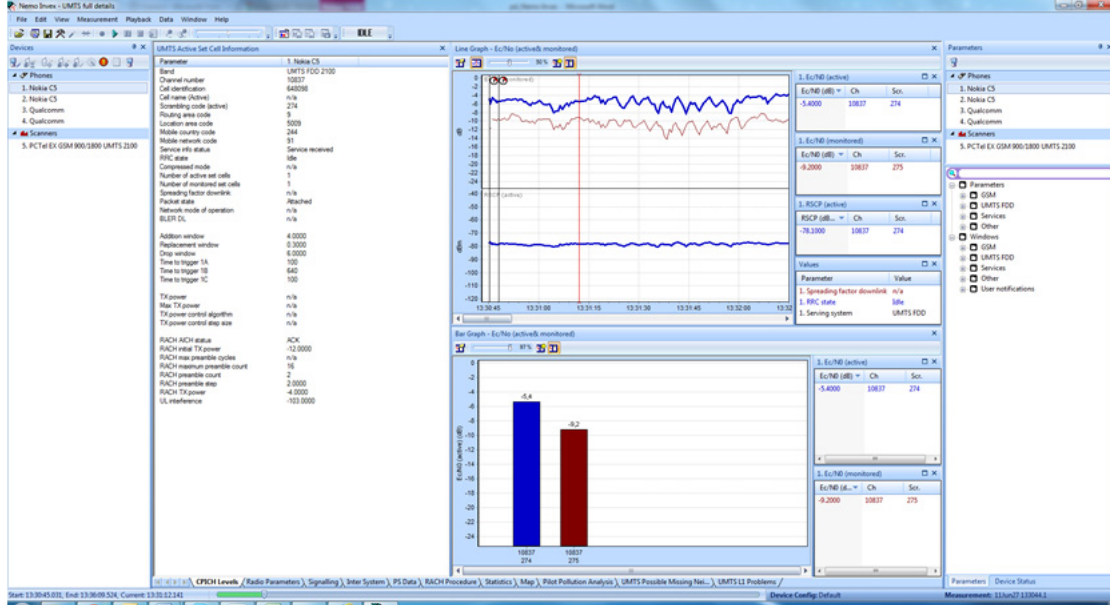
Each cell has list of neighboring intra-frequency, inter-frequency, and inter-system cells. A terminal sees/measures only cells in the neighbor list, whereas a scanner measures all available cells. Missing neighbor detection is based on comparing scanner measurements with the neighbor list of the mobile. Hence, a possible missing neighbor refers to a cell that is not in the neighbor list of the mobile at a given time, but is detected/measured by the scanner. Missing neighbor detection can also be done using only Nokia test terminals that include the scanning functionality.



Missing neighbor detection data

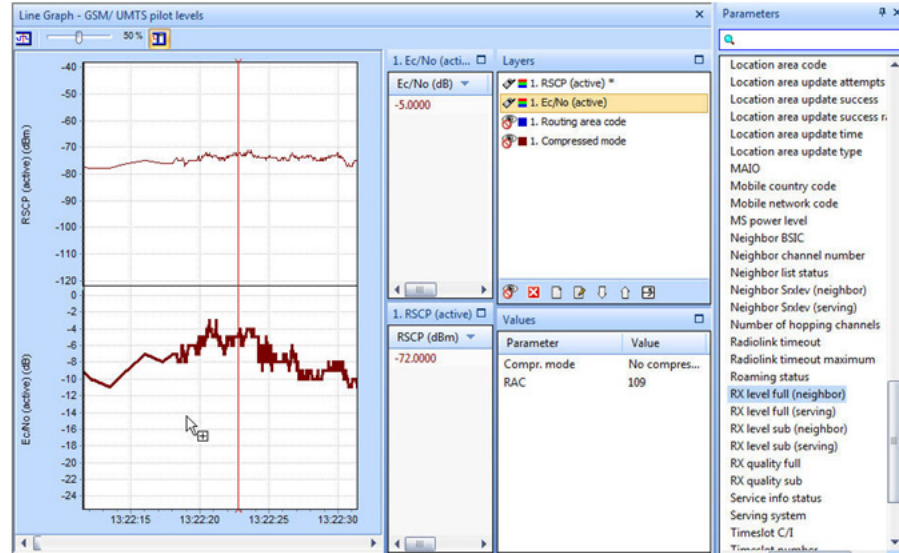
## DATA VIEWS AND USER INTERFACE

Nemo Invox's flexibility is best displayed and experienced through its class-leading user interface. It is arranged into control and data windows which can further be arranged and adjusted depending on the user's needs.



*Nemo Invox user interface is extremely flexible*

The drag and drop functionality in Nemo Invox is one example of convenient organization possibilities in the user interface.



*You can drag and drop parameters in graphs, grids, and maps*

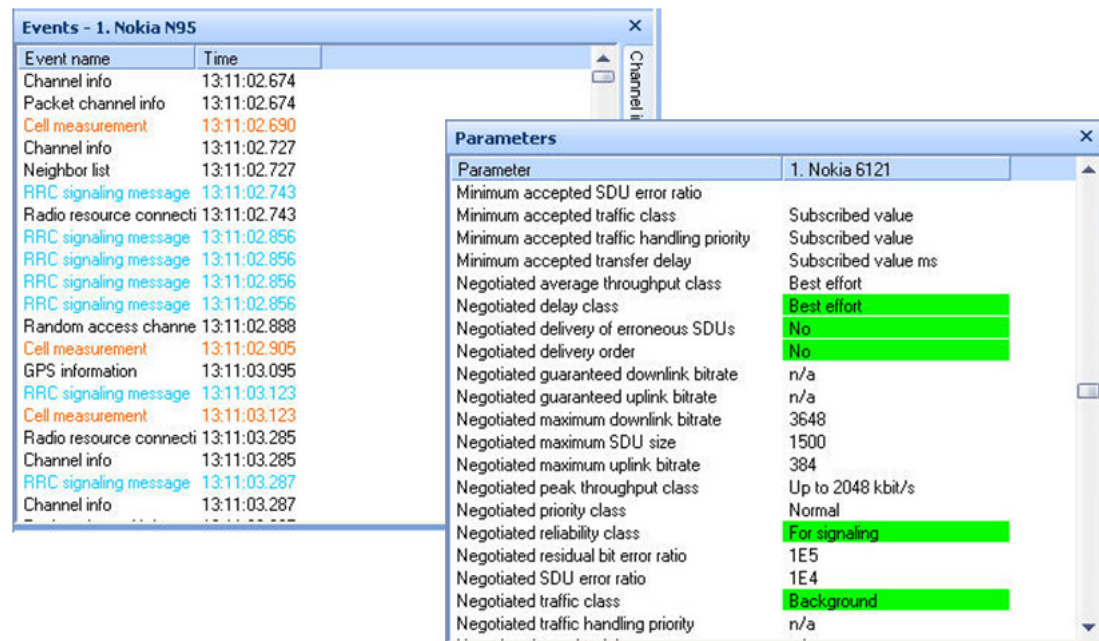
The Nemo InveX user interface is compatible with common Windows® standards. During measurement, users can easily monitor the results and the progress of the measurement process. Through the main window users will easily access all relevant functions. After the initial device setups and configurations the user can save all device-related settings to a hardware configuration file and load the same configuration later on. The Nemo InveX user interface is first and foremost flexible and organizable to suit each user's specific needs. *Measurement windows* display useful information during the measurement process and during playback. *View groups* allow the organization of measurement windows into different tabs for easier viewing. This is especially useful when there are several graphs and maps open at once in the main window.

Nemo InveX offers several methods for viewing measurement results. With graphs the user is able to view any parameter, and the multi-layer capability makes it possible to view multiple results in a single graph. However, line graphs are best suited for viewing parameters for which historical (past) values need to be seen, such as serving cell RSSI value. Vertical and horizontal bar graphs work especially well with multiple parameters which need to be compared with each other, e.g., RSSI levels for neighboring cells. You can also configure graph colors based on the parameter value, or using fixed or algorithmic color sets.



Different graph types in Nemo InveX

**Grids** offer more detailed information on the measurement data. **Events grids** list, by default, all measurement events and messages, but the user can configure the view so that only events that are of special interest are displayed. **Parameters grids** display selected network parameters. **Table grids** provide an easy way of simultaneously displaying the same parameter values for multiple instances. For example, the neighbor list of a serving cell can be displayed in a table grid so that each row represents one neighbor and each column represents a parameter value (e.g., system, carrier, scrambling code, etc.). **Packet decoder grids** enable you to view and decode packet capture information on data transfers in playback mode.



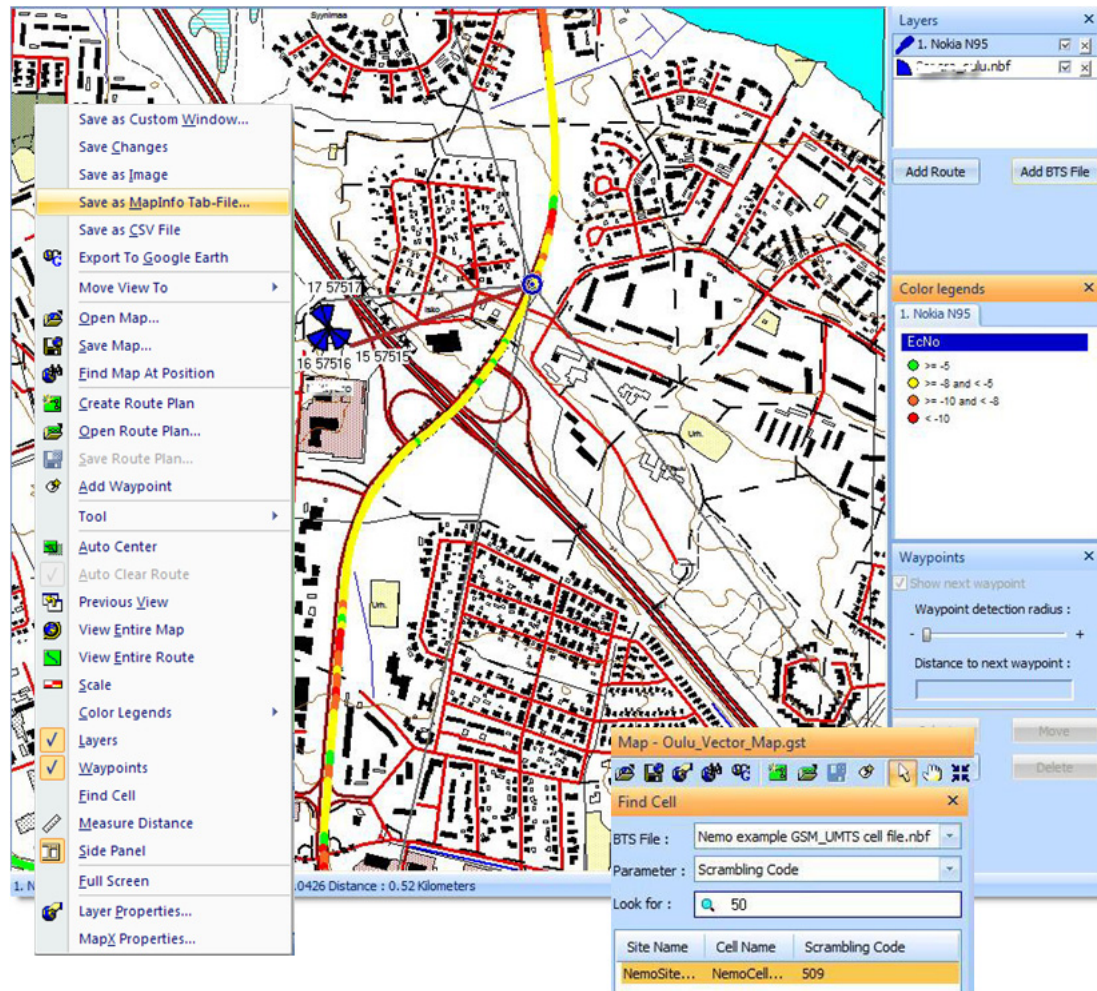
Furthermore, it is possible to copy grid data, such as signaling messages, and export (paste) the data to MS Excel, MS Word, etc. for further analysis. Signaling data can be copied in non-decoded or in decoded format. You can also save the event grid as an image or text file, or export event grid data into CSV and MapInfo .tab format, and export and import user parameters that are decoded from signaling messages.

The **User Parameters** function offers more options for advanced users. Any user-defined string can be searched from decoded messages. The function retrieves the value following the searched string and displays it in the info view and in the graph side panel. To avoid losing these user-defined parameters when updating Nemo InVex, it is possible to save them in an .xml configuration file, *Parameters.xml*.

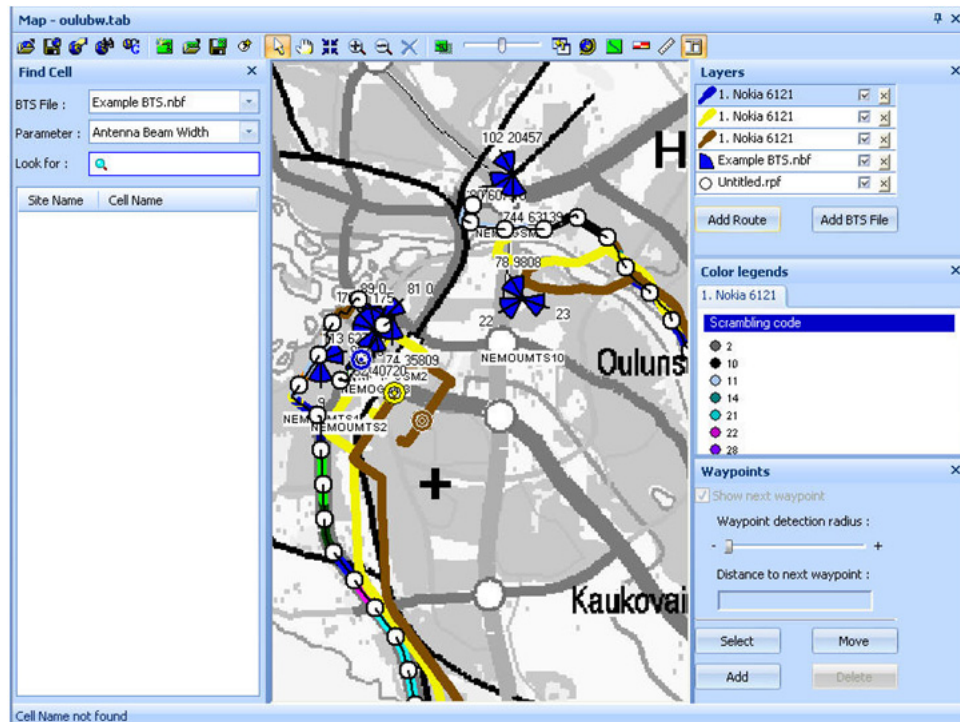
**Maps** provide the user with a better understanding of the measurement route and results through visualization. When Nemo InVex is used with a GPS receiver and positioning coordinates are collected, the measurement route is drawn on a map and the user can easily correlate events to location coordinates. Most of the time drive testing is performed using regular GPS receivers that give exact coordinate information in normal situations. Once the GPS fix is lost, coordinates cannot be updated correctly anymore. Especially in areas where there are a lot of tunnels or other obstacles causing the loss of GPS signal, it can be problematic to post-process data correctly. With Nemo InVex it is possible to modify GPS coordinates during playback. With the Modify Route tool users can correct measurement route drawing, for example, when the route is missing because the test vehicle drove through a tunnel.



Nemo Invex offers *parameter-based route coloring*, which means that users can observe the values of certain network parameters from the route coloring on the map. Users can define which color refers to which parameter value. This way it is easy to spot the problem areas on a map. To make analysis even simpler, the same route can be drawn several times on the map and different route coloring can be applied to each of them. Also certain events can be shown as icons on the map.



*Nemo Invex maps can be exported to Google Earth*



*On a map you can view, for example, base station icons and a route plan*

Maps can also display a base station overlay. With a user-defined BTS file, the map shows the location of each base station, the defined antennas with antenna directions, and even antenna apertures and cell identifying parameters. During drive testing or playback, a line connecting the current location to the serving and/or neighbor cell (sector) will be drawn automatically (in CDMA systems, even multiple lines can be drawn to active sectors). This provides a highly visual impression of the network operation. For example, it can be instantly seen if a call is connected to a non-optimal cell. Also missing neighbors can be viewed on a map.

Nemo Invex supports MapInfo® raster and vector maps. It also supports MapX Geoset files (.gst) which enable the user to open several layers on a map and then save them all in a .gst file to be opened later on. All user-defined map settings, such as, the order of the different map layers and the zoom factor are stored in the .gst file. Maps can also be exported to [Google Earth](#) maps.

## DECODING

In events and messages grids, the data can be analyzed even more in-depth by *decoding* the individual events and messages simply by double-clicking the event in question. The user can define both the background and text color in event and message grids. This color coding can be done based on a certain message, sub channel or decoded message.

## NOTIFICATIONS

Notifications enable the user to add another dimension to the measurement process. Audio prompts help the user during drive testing to immediately notice when something special happens. Nemo Invex can be configured to play audio notifications or voice prompts whenever a certain event occurs. The voice prompts are Windows .wav files, and both female and male default notification sounds are available. However, you can record and use your own voice notifications instead of the default files as well. Custom notifications can also prove useful when creating a script file. For example, the user can set a video call to start only when it is supported by a cellular technology. Nemo Invex's advanced exporting functionality also enables you to export individual custom-made notifications.

## **NEMO OPEN FILE FORMAT**

Nemo Invex produces measurement files in an open ASCII file format. Files can be directly utilized in Nemo Analyze as well as in various third party post-processing/analysis tools. This is accomplished without any separate conversion or parsing of the files. Furthermore, measurement files from multiple test drives can be opened in Nemo Analyze as individual files and shown side by side, delta plotted, or used with statistical quality survey report generator without the trouble of combining all measurements into one big and cumbersome file.

A detailed description of the file format is included in the Nemo Analyze product documentation. The file format description contains all recorded events and the related parameters.

## NEMO TOOLS

Anite Finland Ltd. offers a comprehensive range of tools and software for measuring and analyzing wireless networks for *cost-effectiveness* and *optimal network performance*.

<b>Nemo Outdoor™</b>	Nemo Outdoor is a portable engineering tool for measuring and monitoring the air interface of all major wireless network technologies, including LTE, CDMA2000/EVDO, and HSPA+ Dual Cell.
<b>-with Indoor Option</b>	Ideal for indoor measurements. Lightweight Tablet PC makes it is easy to carry and allows the user to plot the measurement route on a floor plan with a click of a pen.
<b>-with Multi Option</b>	Enables benchmarking measurements on multiple networks and even on multiple technologies at the same time. Possibility to establish up to five simultaneous packet/circuit-switched data connections from test terminals.
<b>Nemo Analyze™</b>	Nemo Analyze™ is a powerful and versatile, cutting-edge analysis tool for performing benchmarking, troubleshooting and statistical reporting based on drive test data. The system scales from a standalone tool to an enterprise-level client/server solution and incorporates an innovative, low-maintenance database engine that has been designed and optimized specifically for high-performance post-processing of drive test data.
<b>Nemo Autonomous™</b>	Nemo Autonomous is a cutting-edge solution for automated large-scale measurements of the air interface of GSM, GPRS, EDGE, WCDMA, and HSDPA wireless networks. With Nemo Autonomous the measurement, troubleshooting, statistical reporting, analysis and benchmarking of networks is made easier, more extensive and cost efficient.
<b>Nemo FSR1™</b>	Nemo FSR1 is a revolutionary, modular digital scanning receiver that provides accurate, reliable high-speed RF measurements of wireless networks across multiple bands and technologies. Nemo FSR1 supports measurements on LTE, WCDMA, HSDPA, GSM, CDMA and EVDO networks.
<b>Nemo Handy-S™</b>	Nemo Handy-S is a lightweight, Symbian-based air interface measurement tool for GSM, GPRS, EDGE, WCDMA, HSDPA, HSUPA and Wi-Fi 802.11 b/g wireless networks.
<b>Nemo Handy-W™</b>	Nemo Handy-W is a Windows Mobile® 6.x Professional -based air interface measurement tool for EGSM, GPRS, EDGE, WCDMA, HSPA and CDMA/EV-DO wireless networks.
<b>Nemo Compact-i™</b>	Nemo Compact-i, the first and trendsetting Ultra Mobile PC-type measurement device on the market, broadens the Nemo handheld measurement tool palette to support the CDMA/EV-DO and HSDPA networks. Intelligent and compact computing performance introduced in a package that fits in your pocket.

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