Accurate and fast NB-IoT network measurements

For NB-IoT applications to function correctly, sufficient network coverage is required. Coverage must be measured to ensure a robust NB-IoT connection. Rohde&Schwarz mobile network testing provides a unique combined test solution that accurately measures the DL coverage using network scanners. It measures the device/network interaction, UL behavior, protocol, signaling load and energy efficiency during communications using NB-IoT devices connected to R&S®ROMES.

Your task

Today's LTE networks are optimized to deliver high data rates for multimedia services that require high bandwidth. The requirements for IoT use cases are different. LTE networks for IoT applications will be optimized for highest availability (deep indoor penetration) and lowest energy consumption. Unlike human beings, IoT installations such as smart meters installed in basements are unable to change position in order to obtain a better signal. Good network coverage is required to ensure a robust NB-IoT connection for the various NB-IoT applications.

Although NB-IoT is a 3GPP standard add-on to LTE, it represents a completely new radio system and coverage challenge. The following tasks are essential when planning and deploying new NB-IoT networks:

- Verifying NB-IoT RF coverage
- Ensuring NB-IoT service performance (QoS)
- Checking co-existence with other technologies (NB-IoT versus LTE/GSM)
- Troubleshooting in case of poor performance (QoS, QoE)
- Benchmarking to compare NB-IoT network coverage and other KPIs

For all these tasks, a powerful NB-IoT network test solution is essential.

Additional measurements are recommended to understand the device/network interaction, uplink behavior and protocol, signaling load and energy efficiency during NB-IoT communications.

T&M solution

Accurate NB-IoT coverage measurements are best executed with a network scanner with sufficient RF performance connected to state-of-the-art analysis software. You might think that this could be achieved by measuring with NB-IoT devices. However, an NB-IoT device only supports cell reselection measurements in idle mode, outside active discontinuous reception (DRX) and power saving mode (PSM) windows. An NB-IoT device will only measure neighbor cells if they are configured in the network and signaled in system information broadcast messages (SIB-NB 4 & 5). Consequently, accurate NB-IoT coverage measurements are best executed with a network scanner. There are still valuable measurements that can be obtained by using NB-IoT devices in addition to a scanning receiver as we shall see below.

NB-IoT network measurements based on NB-IoT devices help us understand device/network interaction, uplink behavior and protocol, signaling load and energy efficiency during NB-IoT communications:

- The accurate NB-IoT coverage solution consists of Rohde&Schwarz network scanners (R&S®TSMW, R&S®TSMA, R&S®TSME) and R&S®ROMES4 drive test software for network optimization and troubleshooting
- The complementary solution consisting of R&S®ROMES4 software and NB-IoT devices (based on NB-IoT/eMTC chipsets from leading chipset companies) provides deep insight into the device/network interaction and the efficiency of IoT communications
- R&S®ROMES4NPA problem analysis software analyzes both scanner and UE data

Results and key benefits

Rohde&Schwarz offers the only combined NB-IoT test solution with network scanners and NB-IoT devices connected to the analysis software from a single source.

The main benefits are:

- Intertechnology coexistence evaluated by using scanners with multitechnology capability: GSM, LTE, NB-IoT, spectrum, RF power scan, etc. The influence of NB-IoT on adjacent carriers/spectrum can be evaluated
- Accurate DL RF coverage information that can only be provided by network scanners
- Service performance measured with NB-IoT devices connected to R&S®ROMES4
  - Application layer KPIs such as success rate, setup time, transfer time, user data rate and latency
  - Network performance metrics such as spectral efficiency, latency, energy efficiency, resource utilization and coverage (DL and UL)
- Variety of NB-IoT chipsets and module vendors supported
- Cost advantage through reuse of existing R&S®TSMx scanner hardware (based on proven algorithms and scanner performance). The NB-IoT function is enabled via a software upgrade
- Faster drive/walk tests (more measurements in the same time) due to fastest LTE/GSM (multitechnology) scanning speed (with R&S®TSMx) for evaluating the influence of NB-IoT carriers on LTE/GSM (OPEX advantage)

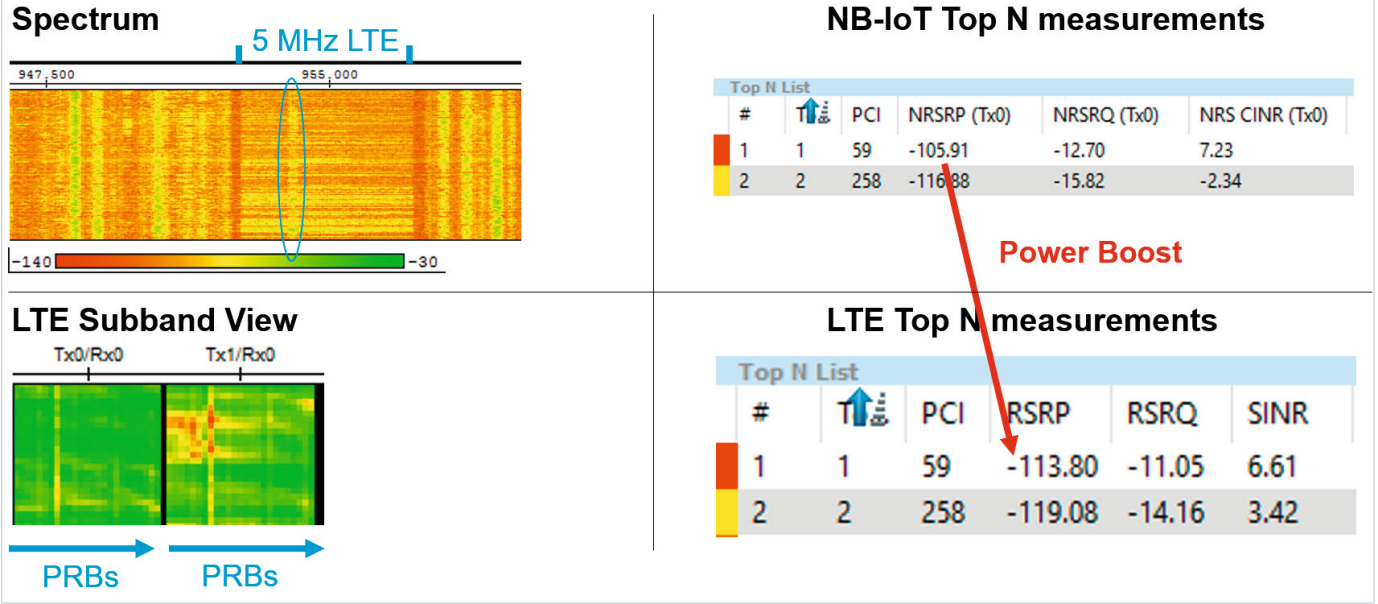
- More flexible use cases (walk tests possible) thanks to lightweight scanner hardware (▷ evaluation of NB-IoT carrier in basements (smart power meter), dense urban UE applications (i.e. parking meter)
  - Shoulder bag with R&S®TSMA and R&S®ROMES4 controlled by a tablet (small and lightweight measurement walk test solution for indoor/outdoor applications)
- Future-proof test solution: existing and future scanner products (R&S®TSME, R&S®TSMA, R&S®TSMW) support NB-IoT scanning with the appropriate technology software option
- Frequency range: NB-IoT measurements on all bands up to 6 GHz
- Same look and feel/usability: NB-IoT will provide the same unique features as LTE and other technologies, such as automatic channel detection (ACD), and use similar GUI views to ease usability

Key features

Important features of our scanners in combination with the R&S®ROMES4 analysis tool are measuring coverage (reference signal receive power, RSRP) and signal quality (carrier to interference and noise ratio, CINR). A scanner measures with much better RF accuracy than a commercial smartphone or an NB-IoT device. A scanner can measure the RSRP figures of all visible cells within the sensitivity and dynamic range threshold and at the same time provide deeper insight into all available NB-IoT cells (and accurate coverage).

The network scanners always work passively or non-intrusively, i.e. they do not affect the running network during the measurements.

Result example: Scanner measurements – NB-IoT and LTE



The R&S®ROMES4 software tool can also analyze data from connected NB-IoT devices. It provides deep insight into the communications between the NB-IoT network and the device with the NPA functionality (problem spot analysis for scanner and UE).

More information

Please contact your Rohde&Schwarz sales representative or visit www.mobile-network-testing.com/en/expertise/testing-mobile-networks/nb-iot/.

NB-IoT Details View

ME910C1-E1[1]

	Source	HSFN	SFN	SubFN	PRACH	RNTI	Type									
12750	NPUSCH	4	60	4	MSG3		U#F1	NewTx	TBS: 88 (RU: 4, ITBS: 0)	RV: 0		Rep: 1	Tones: 12	TxP: 17 dBm	PRACH Collision: not 7680ms dBm	-
12751	NPDSCH	4	65	7		TC	D	FAIL	TBS: 176	1	MCS: 6	-	-	-	-	-
12752	NPDSCH	4	68	2		TC	D	FAIL	TBS: 176	1	MCS: 6	-	-	-	-	-
12753	DCI	4	73	6	-	TC	U	New Data	SC: 18	RV: 0	MCS: 12	Rep: 0	HARQ: 0	RA: 3	SD: 1	DCIRep: 0
12754	DCI	4	79	2	-	TC	U	New Data	SC: 18	RV: 1	MCS: 12	Rep: 0	HARQ: 0	RA: 3	SD: 1	DCIRep: 0
12755	DCI	4	81	6	-	TC	U	New Data	SC: 18	RV: 1	MCS: 12	Rep: 0	HARQ: 0	RA: 3	SD: 1	DCIRep: 0
12756	DCI	5	101	1	-	C	D	New Data	SC: 0	RV: 0	MCS: 10	Rep: 0	HARQ: 2	RA: 3	SD: 0	DCIRep: 1
12757	NPRACH		217	1	MSG1		U	CL: 0	SC: 9/36	CP LONG		Rep: 0	-	TxP: -2 dBm	TxSFN: 217-6	Window: 218-6 -> 231-3
12758	NPDSCH	4	219	1		RA	D	FAIL	TBS: 56	0	MCS: 4	-	-	-	-	-
12759	NPRACH		281	1	MSG1		U	CL: 0	SC: 8/36	CP LONG		Rep: 0	-	TxP: 2 dBm	TxSFN: 281-6	Window: 282-6 -> 295-3
12760	NPDSCH	4	283	1	MSG2	RA	D	PASS	TBS: 56	0	MCS: 4	-	-	-	-	-
12761	NPUSCH	4	284	4	MSG3		U#F1	NewTx	TBS: 88 (RU: 4, ITBS: 0)	RV: 0		Rep: 1	Tones: 12	TxP: 17 dBm	PRACH Collision: not 7680ms dBm	-
12762	NPDSCH	4	304	7	MSG4	TC	D	FAIL	TBS: 176	1	MCS: 6	-	-	-	-	-
12763	NPDSCH	4	312	7		TC	D	FAIL	TBS: 176	1	MCS: 6	-	-	-	-	-
12764	DCI	4	315	2	-	TC	U	New Data	SC: 18	RV: 0	MCS: 12	Rep: 0	HARQ: 0	RA: 3	SD: 1	DCIRep: 0
12765	NPRACH		409	1	MSG1		U	CL: 0	SC: 10/36	CP LONG		Rep: 0	-	TxP: 11 dBm	TxSFN: 409-6	Window: 410-6 -> 423-3
12766	NPDSCH	4	411	1		RA	D	FAIL	TBS: 56	0	MCS: 4	-	-	-	-	-
12767	NPRACH		473	1	MSG1		U	CL: 0	SC: 8/36	CP LONG		Rep: 0	-	TxP: 17 dBm	TxSFN: 473-6	Window: 474-6 -> 487-3
12768	NPDSCH	4	475	1	MSG2	RA	D	PASS	TBS: 56	0	MCS: 4	-	-	-	-	-
12769	NPUSCH	4	476	4	MSG3		U#F1	NewTx	TBS: 88 (RU: 4, ITBS: 0)	RV: 0		Rep: 1	Tones: 12	TxP: 21 dBm	PRACH Collision: not 7680ms dBm	-
12770	NPDSCH	4	481	2		TC	D	FAIL	TBS: 176	1	MCS: 6	-	-	-	-	-
12771	DCI	4	483	2	-	TC	D	New Data	SC: 0	RV: 0	MCS: 6	Rep: 0	HARQ: 2	RA: 1	SD: 0	DCIRep: 0
12772	NPDSCH	4	483	8	MSG4	TC	D	PASS	TBS: 176	1	MCS: 6	-	-	-	-	-
12773	NPUSCH	4	485	1	MSG4		U#F2	ACK				Rep: 1	Tones: 1	TxP: 4 dBm		-
12774	DCI	4	486	6	-	C	U	New Data	SC: 18	RV: 0	MCS: 12	Rep: 0	HARQ: 0	RA: 3	SD: 1	DCIRep: 0
12775	NPUSCH	4	488	3			U#F1	NewTx	TBS: 1000 (RU: 4, ITBS: ...	RV: 0		Rep: 1	Tones: 12	TxP: 15 dBm	PRACH Collision: not 7680ms dBm	-
12776	DCI	4	489	6	-	C	D	ReTx	SC: 0	RV: 0	MCS: 3	Rep: 0	HARQ: 2	RA: 0	SD: 0	DCIRep: 0
12777	NPDSCH	4	490	1		C	D	PASS	TBS: 40	0	MCS: 3	-	-	-	-	-
12778	NPUSCH	4	491	4			U#F2	ACK				Rep: 4	Tones: 1	TxP: 23 dBm		-
12779	DCI	4	493	6	-	C	D	New Data	SC: 0	RV: 0	MCS: 6	Rep: 0	HARQ: 2	RA: 1	SD: 0	DCIRep: 0
12780	NPDSCH	4	494	2		C	D	FAIL	TBS: 176	1	MCS: 6	-	-	-	-	-
12781	NPUSCH	4	495	5			U#F2	NACK				Rep: 4	Tones: 1	TxP: 23 dBm		-
12782	DCI	4	508	8	-	C	U	ReTx	SC: 18	RV: 1	MCS: 6	Rep: 0	HARQ: 0	RA: 0	SD: 1	DCIRep: 0
12783	NPUSCH	4	510	5			U#F1	NewTx	TBS: 88 (RU: 1, ITBS: 6)	RV: 1		Rep: 1	Tones: 12	TxP: 15 dBm	PRACH Collision: not 7680ms dBm	-
12784	DCI	4	536	8	-	C	U	New Data	SC: 18	RV: 1	MCS: 6	Rep: 0	HARQ: 0	RA: 0	SD: 1	DCIRep: 0
12785	NPUSCH	4	538	5			U#F1	NewTx	TBS: 88 (RU: 1, ITBS: 6)	RV: 1		Rep: 1	Tones: 12	TxP: 20 dBm	PRACH Collision: not 7680ms dBm	-
12786	NPDSCH	5	101	9	MSG4	C	D	FAIL	TBS: 680	3	MCS: 10	-	-	-	-	-
12787	NPUSCH	5	103	2			U#F2	NACK				Rep: 4	Tones: 1	TxP: 23 dBm		-
12788	DCI	5	107	3	-	C	U	ReTx	SC: 18	RV: 1	MCS: 6	Rep: 0	HARQ: 0	RA: 0	SD: 1	DCIRep: 1
12789	NPUSCH	5	109	0			U#F1	NewTx	TBS: 88 (RU: 1, ITBS: 6)	RV: 1		Rep: 1	Tones: 12	TxP: 21 dBm	PRACH Collision: not 7680ms dBm	-
12790	DCI	5	698	7	-	C	D	ReTx	SC: 0	RV: 0	MCS: 8	Rep: 0	HARQ: 2	RA: 4	SD: 0	DCIRep: 1
12791	NPDSCH	5	699	7	MSG2	C	D	FAIL	TBS: 680	4	MCS: 8	-	-	-	-	-
12792	NPUSCH	5	701	0			U#F2	NACK				Rep: 4	Tones: 1	TxP: 23 dBm		-
12793	DCI	5	706	7	-	C	U	New Data	SC: 18	RV: 0	MCS: 6	Rep: 0	HARQ: 0	RA: 0	SD: 1	DCIRep: 1
12794	NPUSCH	5	708	4			U#F1	NewTx	TBS: 88 (RU: 1, ITBS: 6)	RV: 0		Rep: 1	Tones: 12	TxP: 20 dBm	PRACH Collision: not 7680ms dBm	-
12795	NPDSCH	4	962	3		RA	D	FAIL	TBS: 56	0	MCS: 4	-	-	-	-	-

NB-IoT transmission details: info per TTI from the PRACH, PDSCH, NPUSCH and NPDCCH DCI.

Ordering information

Designation	Type	Order No.
R&S®TSMW Scanner Option: NB-IoT	R&S®TSMW-K34	1515.7436.02
R&S®TSME Scanner Option: NB-IoT	R&S®TSME-K34	1522.6731.02
R&S®TSMA Scanner Option: NB-IoT	R&S®TSMA-K34	1524.6468.02
R&S®ROMES4 NPA Plug-In: NB-IoT UE analysis	R&S®ROMES4N35	4900.5264.02
R&S®ROMES4 Upgrade Service for 1 year	R&S®ROMES4UPC	1510.8140.02
R&S®ROMES4 NPA Plug-In: NB-IoT scanner analysis	R&S®ROMES4N34	4900.5206.02
R&S®ROMES4 Driver for Qualcomm NB-IoT chipset	R&S®ROMES4NBQ	4900.5258.02
R&S®ROMES4 Driver for Neul NB-IoT chipset	R&S®ROMES4NBN	4900.5287.02

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Data without tolerance limits is not binding | Subject to change

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