

TS-LBS LOCATION BASED SERVICES

LATEST NEWS AND FUTURE OUTLOOK

ROHDE & SCHWARZ

Make ideas real



COMPANY RESTRICTED

LBS GENERAL OVERVIEW

 Available
 Planned

A-GNSS Minimum Performance	LBS Protocol Conformance	Network Based Positioning OTDOA/eCID	Operator Acceptance Field2Lab	LBS Hybrid	5G NR	Indoor Positioning	LBS Development Features	A-GNSS OTA	RED EN 303 413 L1+L2/L5 e112
LTE A-GNSS	OMA SUPL2.0 TTCN3	LTE OTDOA eCID	Verizon AT&T	LTE A-GNSS Hybrid	5G NR FR1 SA/NSA	WLAN BT-LE	Margin Search PEM Mode	Verizon LTE GPS	Adjacent frequency band
WCDMA A-GNSS	LTE LPP C-Plane	Inter-band OTDOA	T-Mobile DoCoMo	LTE A-GNSS OTDOA	5G NR FR1 Rel.16	Barom. LPPe	User def Scenarios OTDOA/eCID R&D	CTIA 4.0 LTE A-GNSS	Receiver spurious emissions
GSM A-GPS	WCDMA RRC C-Plane	CA OTDOA	Softbank CMCC	Position Calcul.	5G NR FR1 PosSIB	LPP R13 Bar.Perf.	LBS Receiver Testing	CTIA 5G-NR A-GNSS	e112 LTE 5G-NR
3Const. GNSS	GSM RRLP C-Plane	NB-IoT eMTC	Dish		5G NR FR2 SA/NSA	ToF/TOA	GPS, GLONASS, BeiDou Galileo	CTIA 5G-NR 3rd party API	

HARDWARE UPGRADE PATH

R&S 5G FR1 TEST SOLUTIONS OVERVIEW

COMBINABLE

IMS / VoNR / RCS
(ATE)

Throughput
(PQA)

Protocol
(NPT)

Location Based
Services

Protocol
(PCT)

COMBINABLE

RRM

RF

NetOp

LBS

PCT

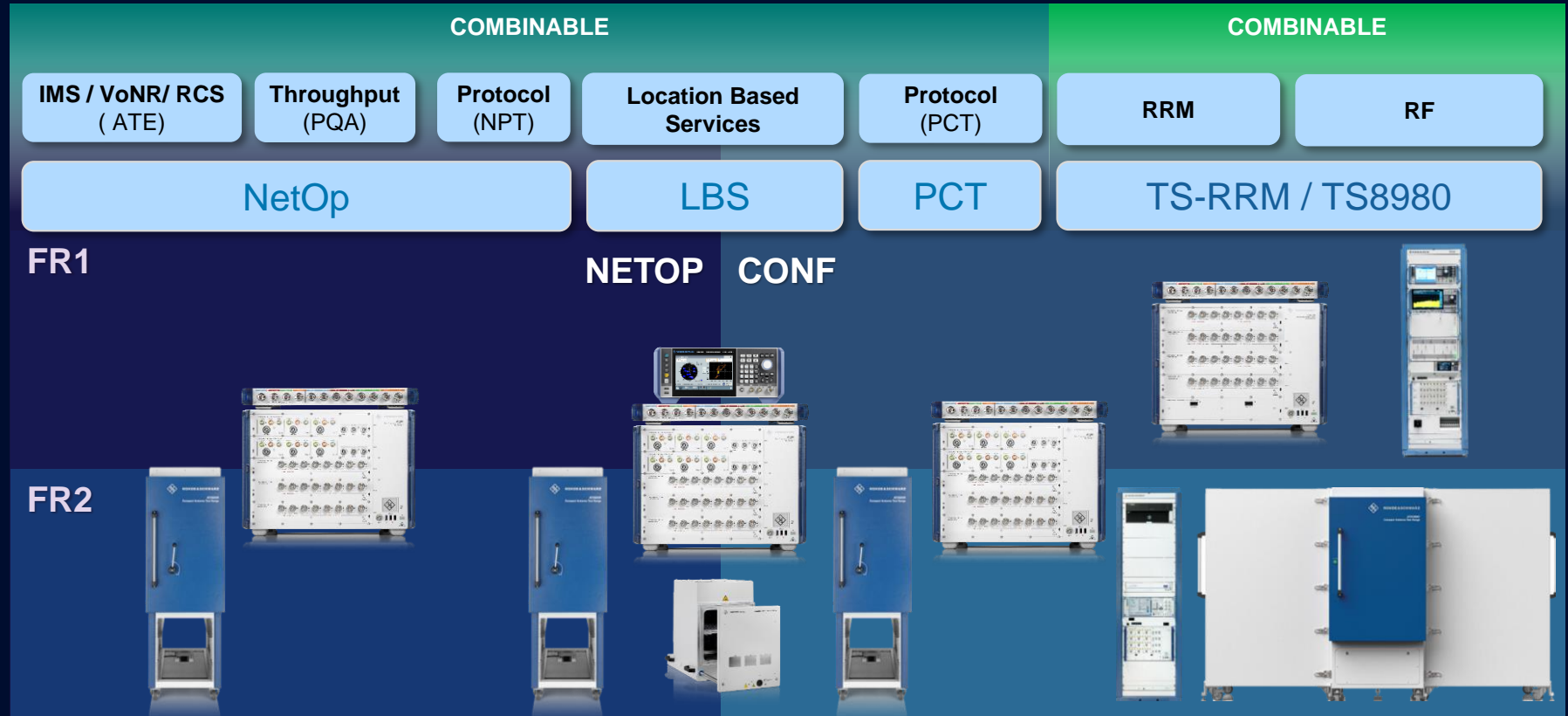
TS-RRM / TS8980

FR1

NETOP CONF



R&S 5G FR1/FR2 TEST SOLUTIONS OVERVIEW



NEW LBS REL.16 HW UPGRADE

- ▶ CMX500 to CMX500 OBT
- ▶ RFU inside CMX500
- ▶ CMW500 not required

Software upgrade

- ▶ R15 no additional SW required
- ▶ Rel.16 stack extension
- ▶ LBS Server R16 extension
- ▶ Multi-Cell Rel.16 Support
- ▶ Supporting all 5G NR TCs

RFUs
FR1

Available now



FR2 TS-LBS-NR TURNKEY CONFORMANCE TEST SYSTEM

- ▶ Adding CMX IF boards
- ▶ Adding CMQ500 or ATS800R
- ▶ Adding RRH

FR2 extension



UPGRADE PATH PARALLEL TESTING

- ▶ split into 2 Setups:
 - 2x SMBV100B
 - NR
 - Legacy

- ▶ CMX+CMW (setup1+2) will be deprecated in mid 2024

- ▶ R16 updates only available on OBT

TS-SB-CMX



Legacy
TS-SB



5G NR
TS-CMX



Version	Setup1	Setup2	OBT
LBS NR version	< V17.53	> V18.20	> V18.10



SPLIT TS-SB TO 5G AND LEGACY

- ▶ Reuse one SMBV100B
- ▶ TS-SB-CMX split to 5G system and Legacy system
- ▶ Either 2 different Contest PC can be used or 2 different contest installations
- ▶ 5G and legacy cannot be run in sequence due to single SMBV100B
- ▶ Minor re-cabeling may be needed



Sharing SMBV100B





TS8991
API-3rd parties
API-ETS
CTIA OTA LBS
A-GNSS



TS8991 CTIA validation and listed

CTIA OTA LBS



COMPANY RESTRICTED

5G NR OTA GNSS TEST SOLUTIONS

R&S Turnkey solution



LBS system



WPTC CHAMBER



CONTEST SW

R&S TS 8991
system
R&S Chamber

- Turnkey solution
- R&S WPTC chamber
- R&S Contest SW

Solution for third parties



LBS system



3rd party
External Chamber
Provider

3rd party
OTA SW

3rd Party
Chamber
solutions

- LBS OTA API
enables easy of
integration with 3rd
party suppliers

TS8991: 5G NR FR1 OTA - WHAT HAS TO BE MEASURED?

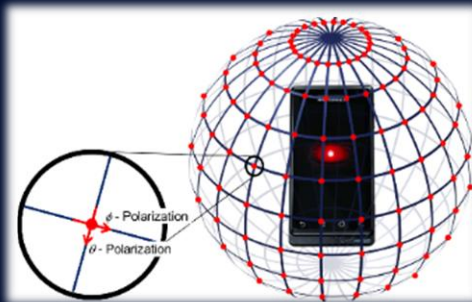
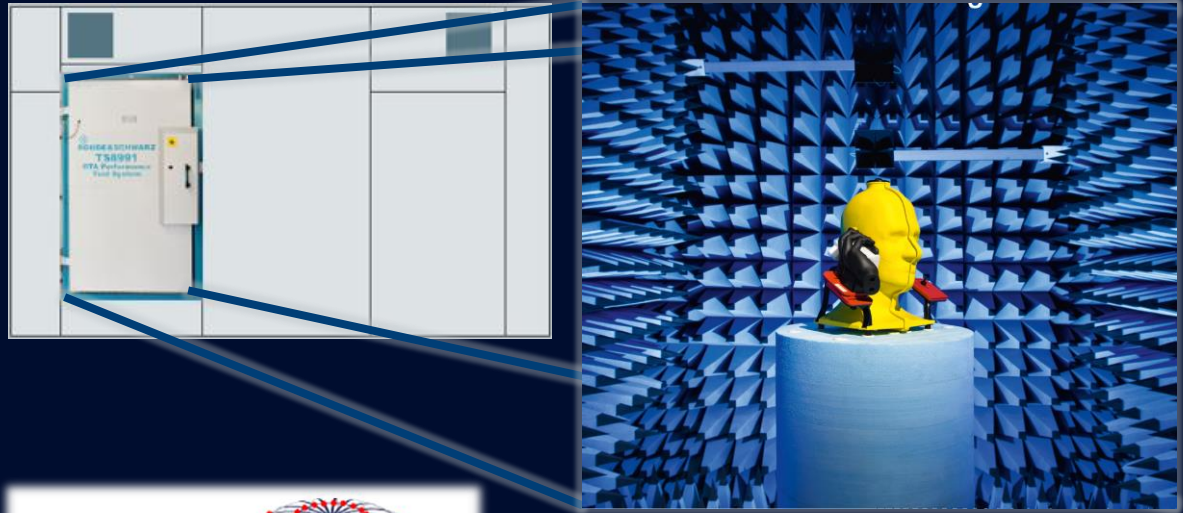
▶ ... again TRP and TIS

- **TRP** = **T**otal **R**adiated **P**ower is an spatially average of EIRP measurements \approx Max output power but radiated
- **TIS** = **T**otal **I**sotropic **S**ensitivity is an spatially average of EIS measurements \approx Reference sensitivity but radiated

▶ ... in a full 3D fashion

- Elevation
- Azimuth
- Two polarizations

... but because of the lower frequency range in a WPTC size chamber with a conical cut scan in a direct far field



For OTA GNSS is just TIS required

OTA 5G NR GNSS FR1 ON TOP OF TS8991

OTA 5G NR FR1 LBS upgrades on TS8991

- ▶ Reuse all TS8991 HW
- ▶ Reuse existing CONTEST SW
- ▶ adding SMBV100B
- ▶ adding LBS Framework
- ▶ adding TC Packages

TS8991



R&S Turnkey solution

R&S TS8991 system
with R&S Chamber

- Turnkey solution
- R&S WPTC chamber
- R&S Contest SW



LBS system



OTA 5G NR GNSS FR1 ON TOP OF 3RD PARTY OTA SOLUTION

OTA 5G NR FR1 GNSS upgrade on ETS OTA Solution

- ▶ Reuse all 3rd Party HW+SW
- ▶ Adding **CMX as OBT**
- ▶ Adding **SMBV100B**
- ▶ Adding **LBS Framework**
- ▶ Adding **LBS API** (Remote Control Software)



External Chamber
Provider

3rd Party SW

TS-LBS-NR



3rd Party Chamber
Solutions

LBS OTA API
enables easy of
integration with 3rd
party suppliers

e112



GUIDELINES FOR
COMPLIANCE WITH
DELEGATED REGULATION
(EU) 2019/320

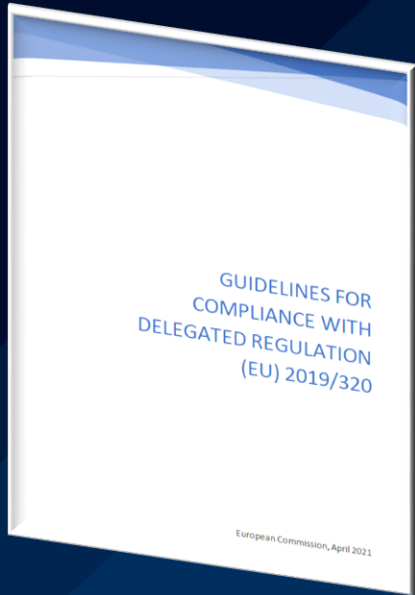
**Delegated Regulation
(EU) 2019/320**

LTE / 5G NR
effective from 17.03.2022

E112 DELEGATED REGULATION (EU) 2019/320

GUIDELINE DOCUMENT

DELEGATED
REGULATION (EU)
2019/320



▶ 3 Test sections

- Section 5: “Galileo compliance” → Lab test
- Section 6: “AML compliance” → Lab test
- Section 7: “WLAN location compliance” → Field test

▶ Lab Test regime:

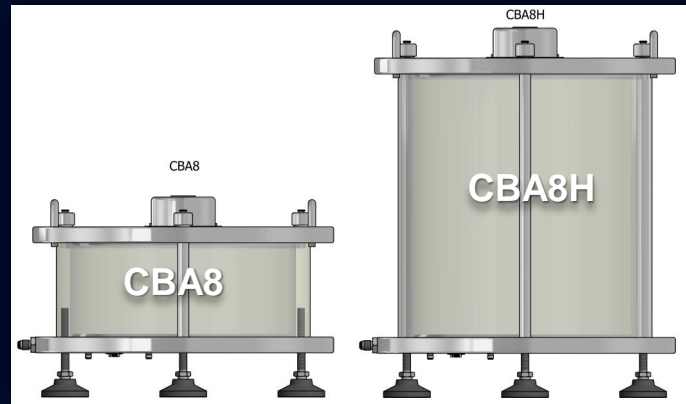
- Over-the-air (a shielded box is allowed)
- Dual-Frequency (E1+E5) Signal generator for GNSS
- Network emulator (for AML and reset commands)
- A-GNSS is optional

BAROMETRIC CHAMBER TEST SOLUTION

COMPANY RESTRICTED

BAROMETRIC PERFORMANCE TESTS ON LBS

- ▶ Barometric performance testing for z-axis
- ▶ FCC mandates 3m accuracy
- ▶ ELS based Z-axis reporting
- ▶ can be placed in temperature chamber
- ▶ Chamber in 2 sizes

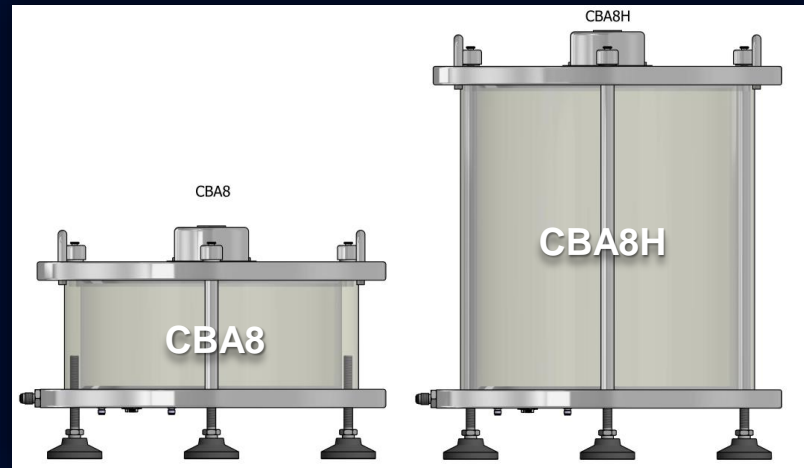


CBA8
Barometric Chamber



BAROMETRIC PERFORMANCE CHAMBERS

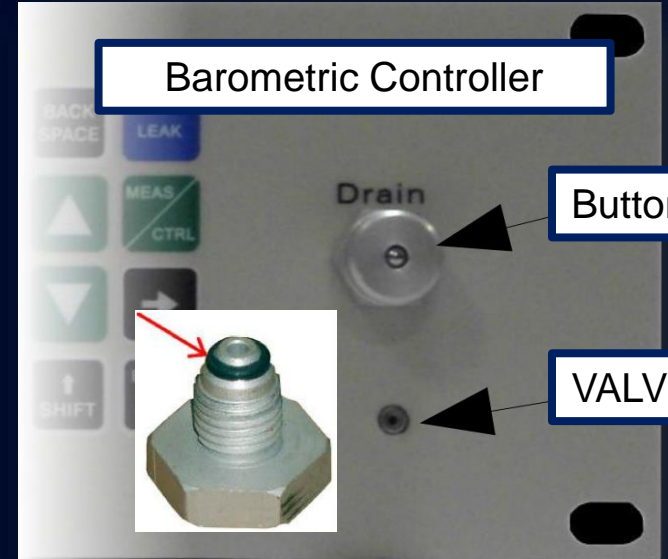
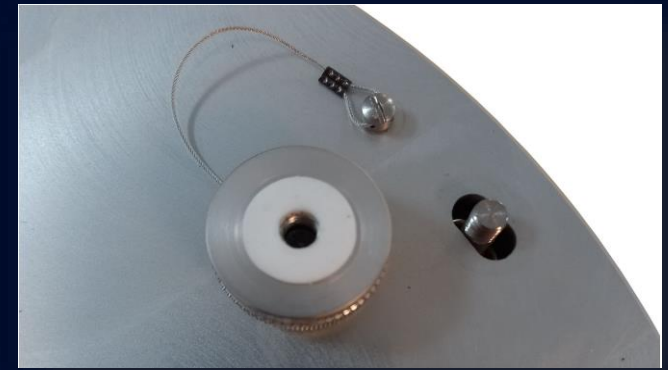
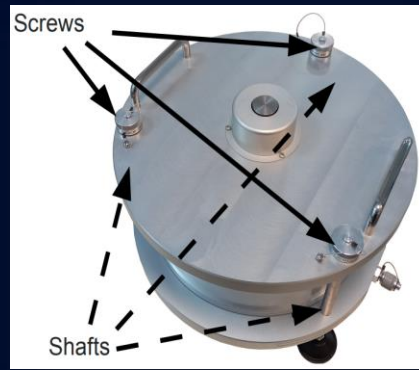
- ▶ Small chamber
 - Mobiles
 - Watches
 - Variables
- ▶ **NEW!** large chamber
 - Tablets
 - iPads
 - Small Notebooks



Name	CBA8	CBA8H
Interior (Diameter x Height) cm	24x10	24x27
Exterior (WxHxL) cm	32x21x32	32x38x32
SMA ports	2	4
USB ports	1	1
DC input port (for USB Hub)	No	Yes
USB Hub up to 10 ports (Optional)	No	Yes
Pressure change rate	914 meter/minute	700 meter/minute
Stabilization time	3 minutes	3 minutes

BAROMETRIC PERFORMANCE RE-DESIGN

- ▶ Chamber
 - Screws changed
 - Shafts added
- ▶ Controller
 - New version of Valves
- ▶ Upgrade Kit
 - Under definition



NEW BAROMETRIC CASE

New deliveries will come with new case with calibration please add the new case as well

► Transportation

- New case covering both controller and chamber
- One case for both sizes small and large chamber

► Add always the new case with next calibration

- calibration with
- new case (two options)

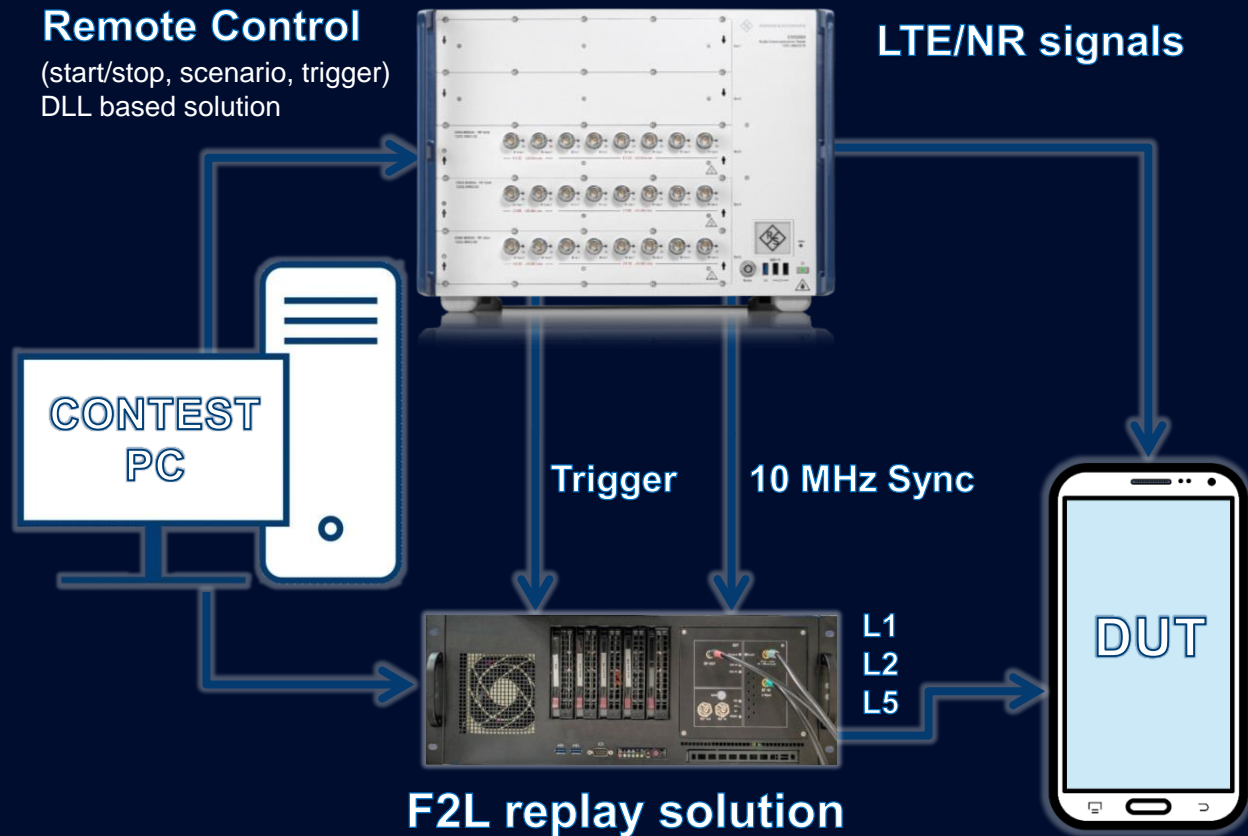


5G NR F2L (FIELD TO LAB) TEST SOLUTION

NEW 5G NR F2L SOLUTION

- ▶ Support all US NetOps
- ▶ Supports multi-frequency (L1E1, L2, L5/E5) GNSS replay
- ▶ Replay's open source GNSS IQ data formats
- ▶ Synchronized with CMX500 for assisted GNSS scenario
- ▶ One replay box including recordings on SSD and RF GNSS output

CMX500 Base Station Simulator



PosSIB

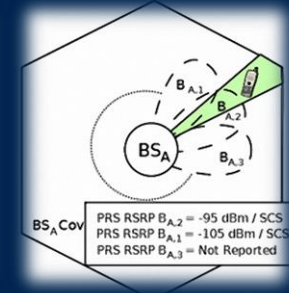
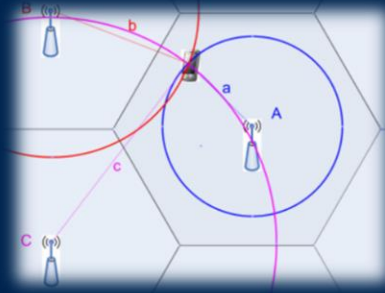
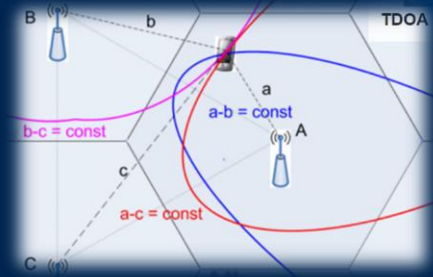
UL-TDOA

DL-TDOA

AoD

AoA

RTT



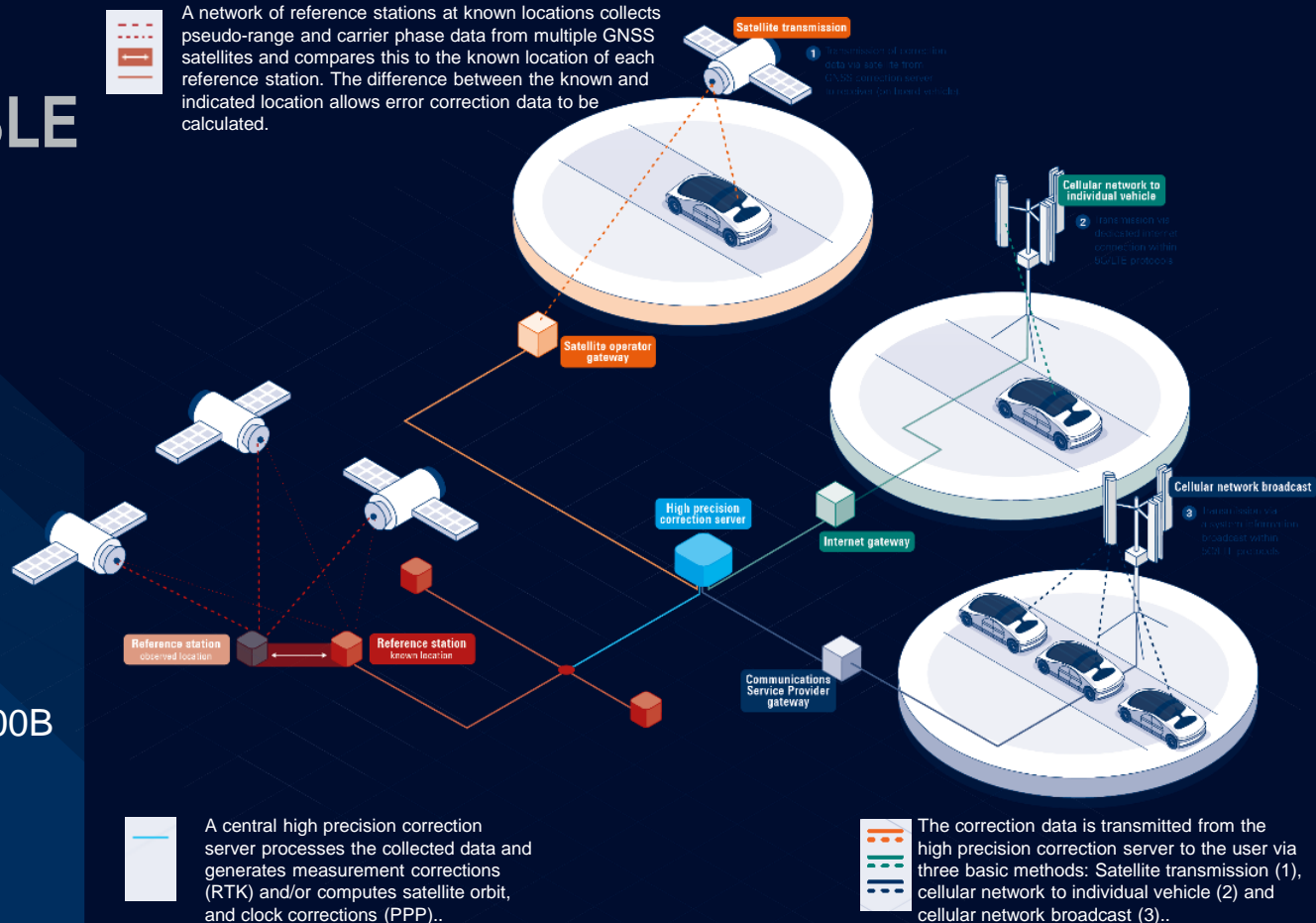
PRS RSRP $B_{A,2}$ = -95 dBm / SCS
PRS RSRP $B_{A,1}$ = -105 dBm / SCS
PRS RSRP $B_{A,3}$ = Not Reported

3GPP RELEASE 16 FEATURES

3GPP Release 16 Features

RTK/PPP POSSIB AVAILABLE

- ▶ High Precision GNSS positions based on RTK/PPP over PosSIB
- ▶ 4 key technology pillars
 - High Precision,
 - Global availability,
 - Integrity
 - Continuity of service
- ▶ RTK available on SMBV100B (SMBVB-K122)
- ▶ PosSIB available on CMX (CMX-KA192)



SOFTWARE UPGRADES AND FUTURE OUTLOOK

COMPANY RESTRICTED

First TMO F2L validations based on our new F2L system HW available

Full 5G LBS support available on CMX500 OBT configuration

Dish LBS E911 (VoNR, eCID, MC-RTT) test plan validated

Verizon LBS E911 test plan validated

E112 over 5G conformance test plan available

Official version for 5G OTA LBS systems API integrated with ETS Lindgren

PosSIB for RTK/PPP supported on CMX+SMBV100B

SMBV100A CANNOT be used with upgrade to GNSS 2020

LATEST LBS NEWS

3GPP 2020 SCENARIO

- ▶ **SMBV100A** no support of:
 - 2020 scenarios from 3GPP
 - GSM (legacy)
 - WCDMA (legacy)
 - LTE (legacy)
 - 5G NR
 - Mutli-Frequency GNSS
- ▶ Replacement with **SMBV100B** mandatory required by mid of 2023

Support of GPS,
GLONASS, BeiDou,
Galileo, SBAS and
QZSS, including GPS
P-Code

Simultaneous signal
generation in the
GNSS frequency
bands L1, L2 and L5
with up to 102 GNSS
channel and 2020
scenarios

SMBV100B



T-MOBILE LBS STATUS

QTEST Q1 2024

- ❑ R&S LBS is a validated platform for 5G FR1/FR2 LBS Testing
- ❑ R&S is the only vendor with full 5G NR test coverage for LBS at T-Mobile including z-axis accuracy tests with barometric chamber
- ❑ R&S LBS OBT+ support with **100%** coverage
- ❑ **Validated: T-Mobile R16 ECID VoNR test plan**
- ❑ **Expected: T-Mobile GNSS F2L test plan (requires new F2L hardware)**



LBS 5G R&D GNSS GUI

- ▶ R&D LBS GUI will be available soon
- ▶ LBS5-KT005: NR LBS R&D NSA & SA A-GNSS
- ▶ Option can be enabled for 3GPP and NetOp products
- ▶ Margin search available

Lbs R&D NSA test case configuration

LTE Cell 0 | NR Cell 0

FDD 1 5 MHz Mid

Search Parameters

R&D Mode

Categories

- Common
- Cell
- LPP/SUPL
- LBS Measurements**
 - Test Limits
 - LPP QoS Settings
 - LPP General Settings
- Generic GNSS
- Satellite scenario #1
 - General information
 - GPS, SVID 1
 - GPS, SVID 4
 - GPS, SVID 17
 - GPS, SVID 19
 - GPS, SVID 20
 - GPS, SVID 23
- Satellite scenario #2
 - General information
 - GPS, SVID 1
 - GPS, SVID 7
 - GPS, SVID 8

Test Limits

LBS Measurements > Test Limits

Response Time Limit: 20300 ms

Maximum Horizontal Accuracy error [m]: 101.3

LPP QoS Settings

LBS Measurements > LPP QoS Settings

Requested Response Time: 20000 ms

Requested Horizontal Accuracy [m]: [0; 10000] 19

LPP General Settings

LBS Measurements > LPP General Settings

Etc Reset Sending Frequency: BeforeEachLocationRequest

OK Cancel

LBS 5G R&D R16 CELLS GUI

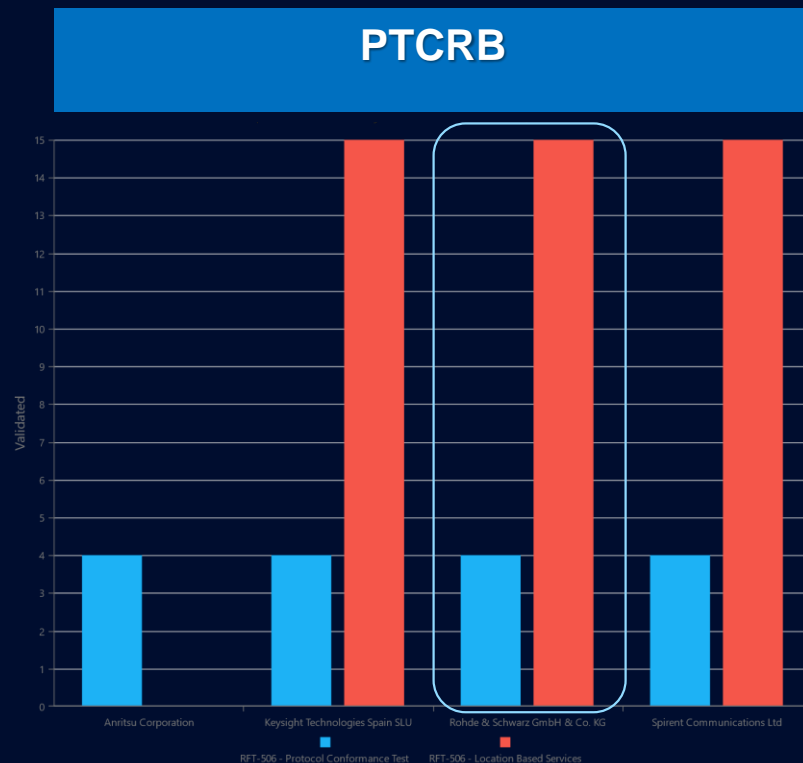
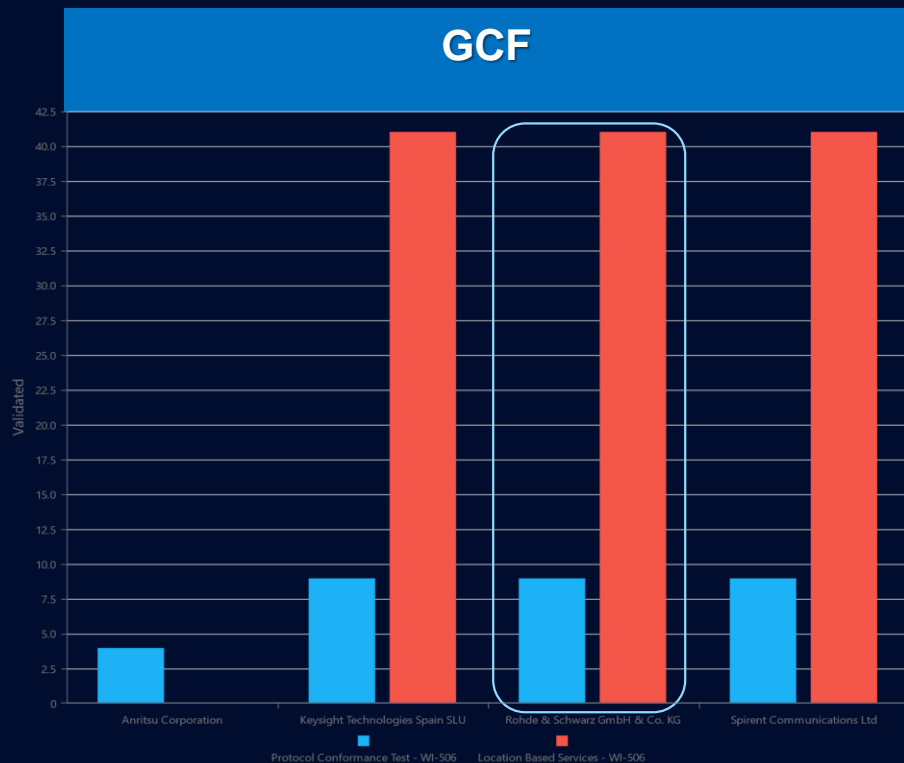
► Properties R&D GUI

- Test case limits (accuracy, response time)
- LPP QoS messages configuration
- Cell Powers
- ETS Reset sending
- SUPL init method

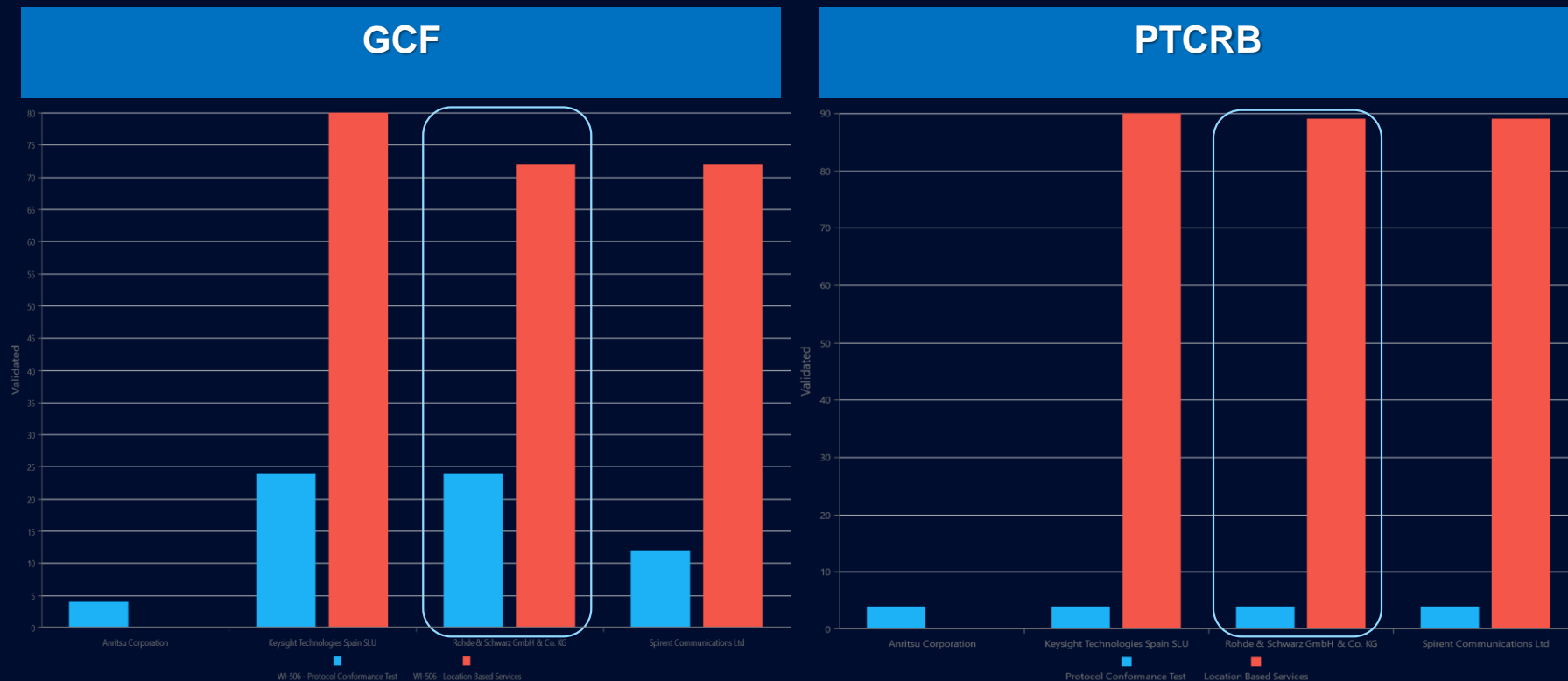
The image displays three screenshots of the 'Lbs R&D NSA test case configuration' GUI. Each screenshot shows a search bar, a search button, and an 'R&D Mode' toggle switch.

- Top Screenshot:** Shows 'LTE Cell 0' selected. The 'Common' category is active, and the 'Use Emergency Call' toggle is turned off.
- Middle Screenshot:** Shows 'LTE Cell 0' selected. The 'Cell' category is active, and the 'Downlink Power' is set to -85 dBm.
- Bottom Screenshot:** Shows 'NR Cell 0' selected. The 'Cell' category is active, and the 'Downlink Power' is set to -85 dBm.

VALIDATION STATUS FOR 5G (GCF AND PTCRB) BAND INDEPENDENT



VALIDATION STATUS FOR 5G (GCF AND PTCRB) BAND SPECIFIC



Thank you for your attention!

*“If you want to go fast, go alone.
If you want to go far, go together!”*

African proverb