

We Know 5G.

TEMS Investigation 22.1.3

infovista

KNOW YOUR NETWORK™

Ahmad Taha

Solution Manager | Network Testing

Agenda

- TEMS Investigation Overview & Key Benefits
- TEMS Investigation Use Cases
- What's New
- Our Customer References
- Conclusion



Overview and benefits



TEMS™ Investigation

No 1 software solution for air interface testing

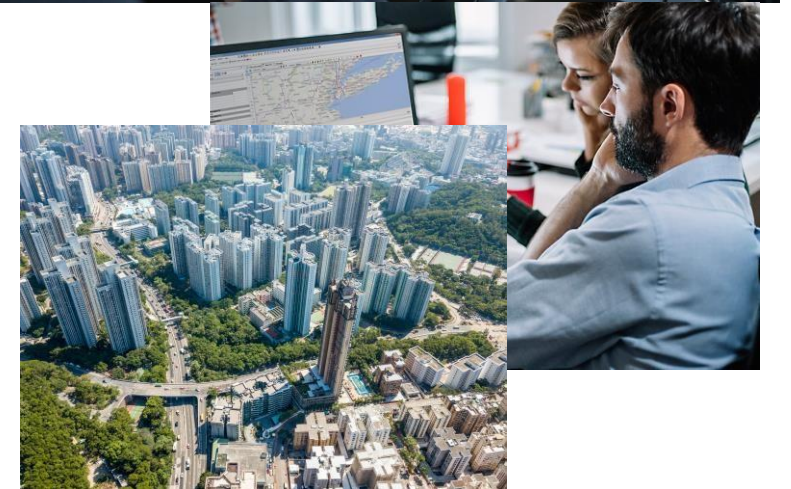
What is TEMS Investigation?

TEMS Investigation is our market-leading end-to-end network testing solution for verifying, optimizing, troubleshooting and benchmarking your mobile network.

Why TEMS Investigation?

TEMS Investigation, allows you to test every new function and feature in your network. This allows you to better understand Customer Experience and to verify, optimize and troubleshoot your mobile network. Through our close cooperation with equipment vendors, chipset manufactures and device vendors we are able to use all major new devices. This allows us to quickly provide in-depth subscriber (QoE) and the network (QoS) insights to enable you to make better network investment choices.

Whether you are rolling out a new network technology such as LTE or 5G, implementing a new network service like NB-IoT or VoLTE, or optimizing an existing mobile infrastructure, TEMS Investigation gets the job done right the first time. When integrated with TEMS Director, TEMS Investigation becomes a key component of your mobile network test platform.



TEMS™ Investigation – Benefits



Wide range of supported devices

To test the latest technology in your network, TEMS Investigation quickly integrate new devices.



Target user experience

Allows the tester to truly test networks and services, end-to-end from a subscriber perspective.



Flexible testing & analysis

Device forcing features, scripting, interface versatility and workflow integration enabling testing of every network feature.



Optimize equipment utilization

Via our Global License Server you can monitor and optimize equipment utilization and users can easily share licenses to reduce costs.



Service testing

Besides measuring traditional voice and data services. TEMS allows you to script tests of any OTT service or application available on a network.



Multi-source measurement

TEMS Investigation supports many different types of data collection equipment, such as smartphones, scanners, IoT devices and more.



Technology

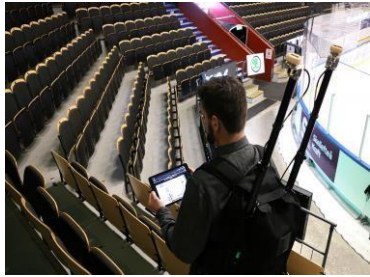
Is New technology being deployed in your network? If this requires new devices to support it – rest assured, TEMS Investigation will support it.



Standardized Test methodology

TEMS employs test methodology recommended by ETSI and ITU-R. All our tools follow the rules laid down by various standardization bodies

TEMS Investigation Use Cases



Lab testing & trials



Initial tuning



Network acceptance



Optimization



Troubleshooting



Network verification
regression testing

TEMS™ Investigation – Use Cases



Lab Testing

Demands high flexibility and requires quick adaptation to the latest technology. TEMS Investigation plays a key role in the early phases of introducing 5G in the networks.



Initial Tuning

is a labour-intensive, network optimization activity, aiming to prepare the network for commercial launch. Network design, hardware installation and parameter settings are evaluated and tuned



Network Acceptance

Field measurements from a user's perspective are performed on a cluster basis, and key performance indicators (KPIs) are calculated and reported..



Troubleshooting

Findings related to site verification, initial tuning, optimization and service quality campaigns and present solutions. Investigate issues raised by O&M/OSS systems and customer complaints..



Network Verification

New RAN features and services have to be validated from a user's perspective and compared with previous performance to ensure a high quality user experience.



Multi-source measurement

Enables a better understanding of the impact individual smartphones have on the performance.



Spectrum Clearance

Enables user to ensure that any new Spectrum is clear of interference. Essential prior to any new roll-out



Customer Experience Verification

TEMS ensures that network provides a high customer experience as recommended by ETSI and ITU-R. All our tools follow the rules laid down by various standardization bodies

Architecture

TEMS Investigation packages

TEMS Investigation Professional

Includes full set of product features, including ability to collect measurement data as TEMS log-files. Available as term based and perpetual licenses

TEMS Investigation Replay

Includes ability to replay TEMS log-files. No data collection capabilities



Via our Global License Server you can monitor and optimize equipment utilization and users can easily share licenses to reduce costs.

infovista

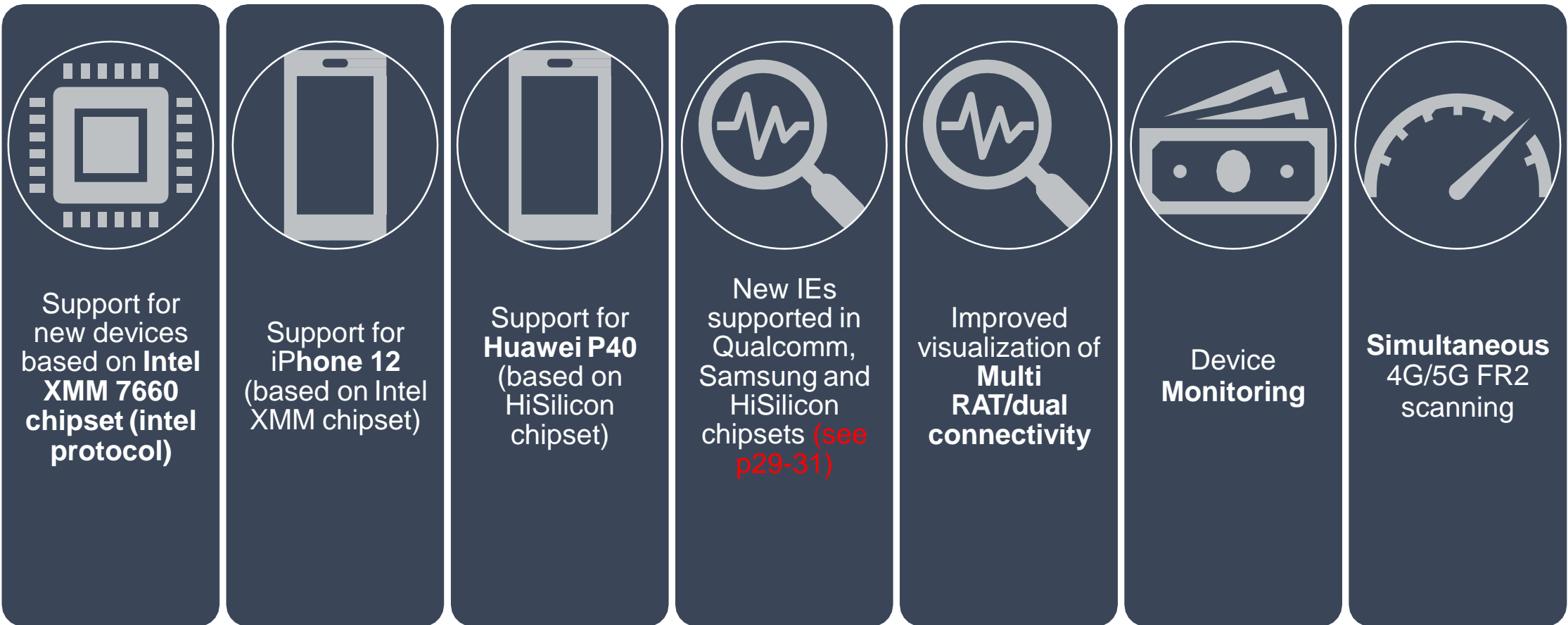


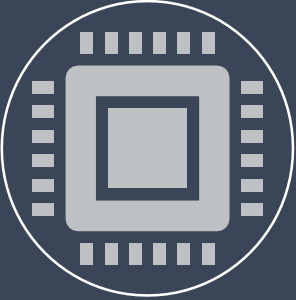
TEMS Investigation 22.1


What's New !





What's New in TEMS Investigation 22.1





- 


Support for new devices based on **Intel XMM 7660 chipset (intel protocol)**
- 

Support for **iPhone 12** (based on Intel XMM chipset)
- 

Support for **Huawei P40** (based on HiSilicon chipset)
- 








New IEs supported in Qualcomm, Samsung and HiSilicon chipsets (see [p29-31](#))
- 

Improved visualization of **Multi RAT/dual connectivity**
- 

Device Monitoring
- 

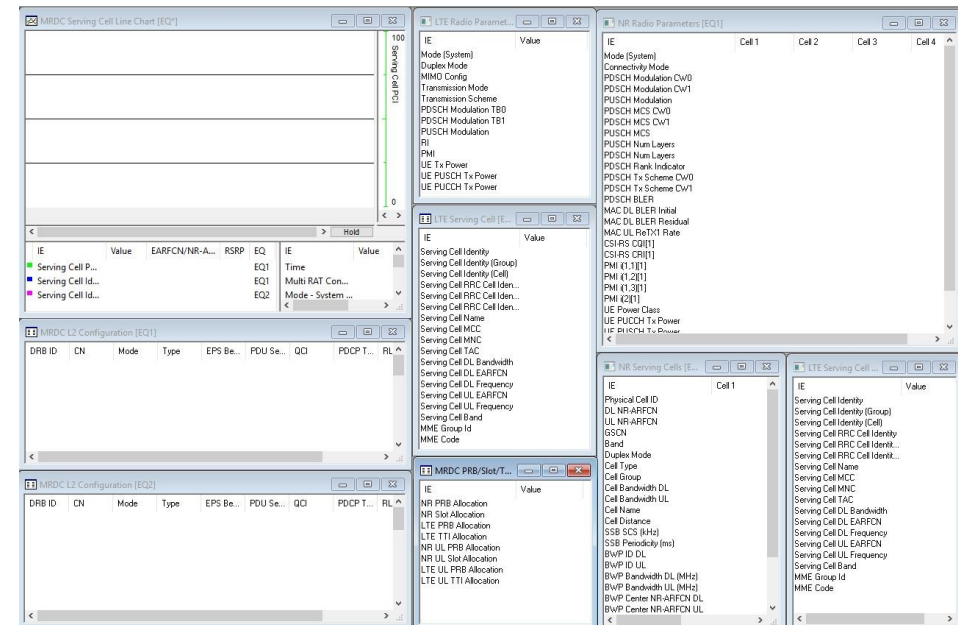
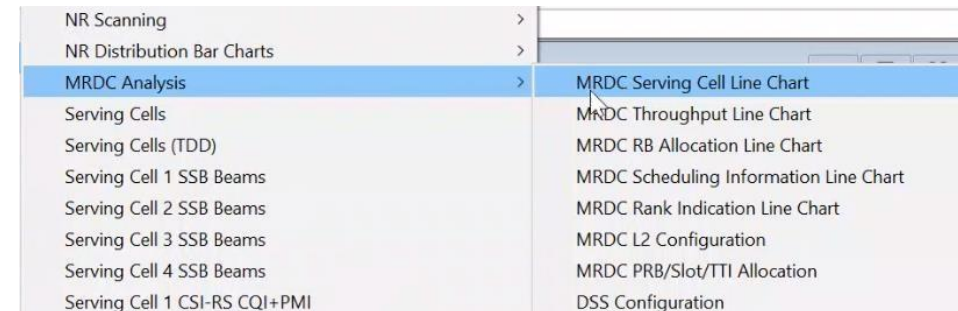
Simultaneous 4G/5G FR2 scanning

What's New in TEMS Investigation 22.1.3

						
Support for Samsung Note 20+ (based on Qualcomm and Exynos chipset)	Support for Sony Xperia 1 II (based on Qualcomm chipset)	Support for OnePlus 8 5G (based on Qualcomm chipset)	Support for Vsmart Aris 5G Max (based on Qualcomm chipset)	New TopN Scanner Monitor	Improved Monitor Search and Log-file Mask	Dynamic Data Sampling Rate configuration

Multi-RAT / Dual Connectivity monitors

- Now DSS analysis is easily available with pre-configured monitors, developed by our 5G experts.
- Now you can mix information elements from different RAT states (5G + LTE) in the same monitors
- Very valuable when troubleshooting throughput issues, as you will instantly spot if the wrong Carrier Aggregation or even wrong RAT state is causing problems
- With the new Multi RAT monitors, you can now quickly verify that DSS is enabled and work as expected.



MRDC Serving Cell Line Chart [EQ*]

LTE Radio Paramet...

IE	Value
Mode (System)	LTE
Duplex Mode	FDD
MIMO Config	4x2
Transmission Mode	TM-4
Transmission Scheme	Transmit Diversity
PDSCH Modulation TB0	QPSK
PDSCH Modulation TB1	64QAM
PUSCH Modulation	64QAM
RI	1
PMI	0
UE Tx Power	
UE PUSCH Tx Power	-31.00
UE PUCCH Tx Power	-14.00

NR Radio Parameters [EQ1]

IE	Cell 1	Cell 2	Cell 3	Cell 4
Mode (System)	LTE			
Connectivity Mode	EN-DC mode, ...			
PDSCH Modulation CW0	QPSK			
PDSCH Modulation CW1				
PUSCH Modulation	64QAM			
PDSCH MCS CW0	8			
PDSCH MCS CW1				
PUSCH MCS	19			
PUSCH Num Layers	1			
PDSCH Num Layers	1			
PDSCH Rank Indicator				
PDSCH Tx Scheme CW0				
PDSCH Tx Scheme CW1				
PDSCH BLER	0.42			
MAC DL BLER Initial	0.41			
MAC DL BLER Residual	0.41			
MAC UL ReTX1 Rate	0.00			
CSI-RS CQI[1]				
CSI-RS CRI[1]				
PMI i(1,1)[1]				
PMI i(1,2)[1]				
PMI i(1,3)[1]				
PMI i(2)[1]				
UE Power Class	3			
UE PUCCH Tx Power				
UE PUSCH Tx Power				

LTE Serving Cell [EQ1]

IE	Value
Serving Cell Identity	72
Serving Cell Identity (Group)	24
Serving Cell Identity (Cell)	0
Serving Cell RRC Cell Ident...	26079489
Serving Cell RRC Cell Ident...	101873
Serving Cell RRC Cell Ident...	1
Serving Cell Name	
Serving Cell MCC	310
Serving Cell MNC	310
Serving Cell TAC	5555
Serving Cell DL Bandwidth	20 MHz (100 RB)
Serving Cell DL EARFCN	66911
Serving Cell DL Frequency	2157.50
Serving Cell UL EARFCN	132447
Serving Cell UL Frequency	1707.50
Serving Cell Band	Band 66 (AWS-3)
MME Group Id	32700
MME Code	50 LTE Anchor

NR Serving Cells [EQ1]

IE	Cell 1
Physical Cell ID	19
DL NR-ARFCN	127970
UL NR-ARFCN	137170
GSCN	1300
Band	Band n71 (600)
Duplex Mode	FDD
Cell Type	SCG1-PSCell
Cell Group	SCG1
Cell Bandwidth DL	10 MHz
Cell Bandwidth UL	10 MHz
Cell Name	
Cell Distance	
SSB SCS (kHz)	15
SSB Periodicity (ms)	20
BWP ID DL	0
BWP ID UL	0
BWP Bandwidth DL (MHz)	9.36
BWP Bandwidth UL (MHz)	9.36
BWP Center NR-ARFCN DL	127400
BWP Center NR-ARFCN UL	136600

LTE Serving Cell [EQ2]

IE	Value
Serving Cell Identity	78
Serving Cell Identity (Group)	26
Serving Cell Identity (Cell)	0
Serving Cell RRC Cell Identity	26080257
Serving Cell RRC Cell Ident...	101876
Serving Cell RRC Cell Ident...	1
Serving Cell Name	
Serving Cell MCC	310
Serving Cell MNC	310
Serving Cell TAC	5006
Serving Cell DL Bandwidth	10 MHz (50 RB)
Serving Cell DL EARFCN	68786
Serving Cell DL Frequency	637.00
Serving Cell UL EARFCN	133322
Serving Cell UL Frequency	682.00
Serving Cell Band	Band 71 (600)
MME Group Id	32700
MME Code	50

MRDC L2 Configuration [EQ1]

DRB ID	CN	Mode	Type	EPS Be...	PDU Se...	QCI	PDCP T...	RL
3	EPC	AM	Split	5		6	NR	NR
4	EPC	AM	MCG	6		5	LTE	LTE

MRDC L2 Configuration [EQ2]

DRB ID	CN	Mode	Type	EPS Be...	PDU Se...	QCI	PDCP T...	RL
3	EPC	AM	MCG	5		6	LTE	LTE

DSS Configuration [EQ1]

Serving Cell	DSS Configuration	Band	Bandwidth	Frequency
Serving Cell 1	DSS Configuration 1	71	10 MHz (50 ...	637.00
Serving Cell 1	DSS Configuration 2			
Serving Cell 1	DSS Configuration 3			
Serving Cell 2	DSS Configuration 1			

Device Monitoring information



Have you ever encountered that you've done your drive test but with unexpected low performance, just to realize that the device capabilities were reduced due to low battery or high temperature?

Smartphone performance is often affected by low battery or high temperatures

Measuring network performance under these conditions is not recommended

It is now possible to prevent this problem, by reviewing the new device monitoring information that will provide alarms if such states occur that risks the phone reducing capacity so you can take immediate action

No more re-drives due to low battery!

IE	Value	CI/SC...	(NR/E/U)...	EQ
Equipment Available Memory	4445			EQ1
Equipment Battery Level	100			EQ1
Equipment CPU Temperature	44			EQ1
Equipment CPU Temperature Count	8			EQ1
Equipment CPU Throttling Temperature	44			EQ1
Equipment CPU Throttling Temperature Count	1			EQ1

Message Details

Find:

EQ2

Sensor Report

Time : 14:01:15.358
 ReportVersion : 1
 Number of CPUs :
 Available Memory : 7332 MB
 Low Memory : 0 MB
 Memory Threshold : 226 MB
 Total Memory : 11363 MB

	PID	USER	PR
:			
:	5528	logd	30
:	6470	system	18
:	21418	root	20
:	21346	u0_a287	20
:	20358	root	0
:	6119	gps	19
:	21151	root	20
:	2281	root	RT
:	18281	root	20
:	7114	oem_5013	

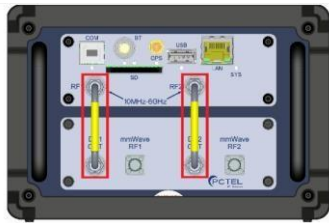
Battery Status : Full
 USB Charging : Yes
 AC Charging : No
 Battery Max Level : 100
 Battery Current Level : 100
 Estimated Remaining Charge Time : Unknown
 Average Current : 4294967213 uA Charging
 Number of CPU Temperature Records : 1
 CPU Temperatures :
 [0] : 49.00 (C)
 Number of GPU Temperature Records : 0
 Number of Battery Temperature Records : 0
 Number of Skin Temperature Records : 0
 Number of Shutdown Temperature Records : 0
 Number of Throttling Temperature Records : 0
 Number of Throttling Temperature VR Records : 0
 Altitude : 58.26 m.a.s.l.
 Accuracy : +/- 8.00 m
 AirPressure : 1033.70 mbar

Simultaneous 4G/5G FR1 and 5G FR2 scanning

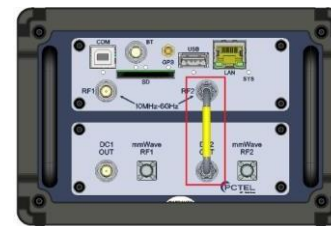
Previously the PCTEL scanner could only do either sub6GHz or mmWave. Now you can scan both at the same time. It requires a new PCTEL License: **HBflex Simultaneous Sub-6GHz and MM-Wave Test Option**

Customers now have a choice to select the FR2 measurement modes

- Two antenna mode FR2 measurements for higher speed dedicated FR2 measurements
- Single antenna mode for simultaneous sub 6GHz and mmWave measurements



2 Port high speed FR2



Simultaneous FR2 & 4G/FR1

Feature

FR2 speed

DSS

10 meas/ sec

N/A

5 meas/sec

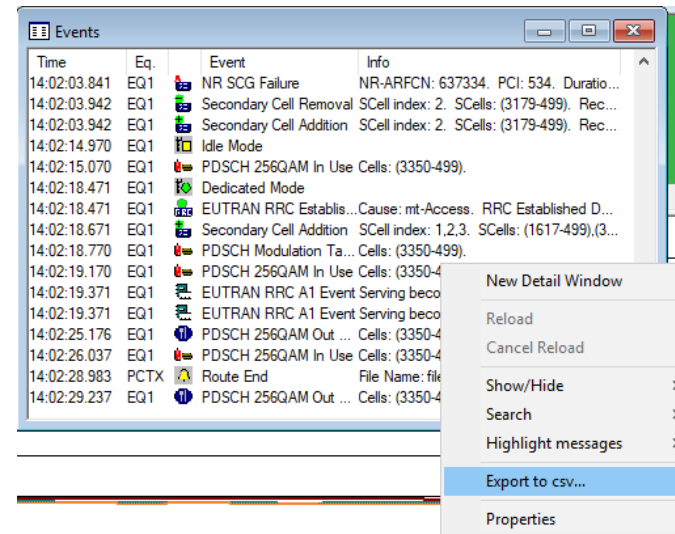
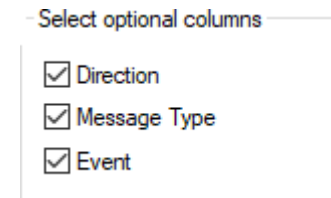
Yes

General Product Enhancements

- Improved **Search capability for the list monitors**, like: IP/ L3/ Event/ Sip/ etc, a valuable feature simplifying and speeding up trouble shooting
- New scanner monitor introduced - **Best Serving RSRP for 5G-** TopN of all NR-ARFCNs cells, simplifies coverage analysis
- Introduce **Configurable (dynamic) sample rates**, making it possible to chunk data in Time or Size. Allowing amount of data in measurement to be tuned to use-case need
- Introduced new **log masks and filters**, making it possible to tune the amount of data recorded for different test cases
- We have unified our **ODM Scripting** across our TEMS portfolio - making it possible to share across portfolio (Pocket/ TI/ Paragon/ Sense- all same)
-

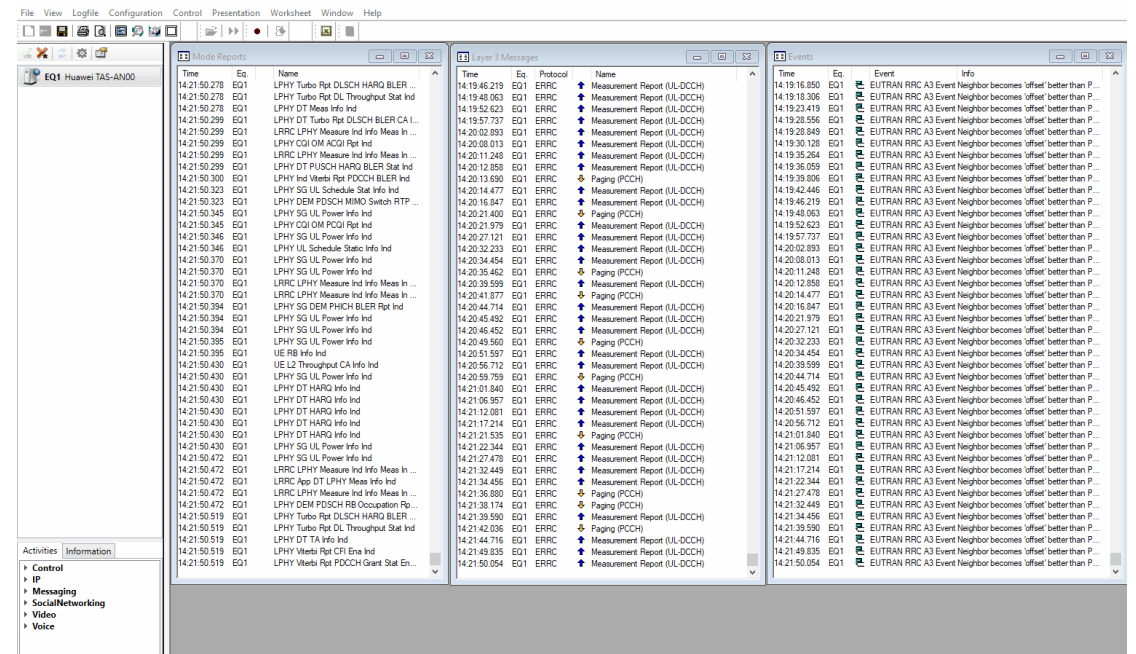
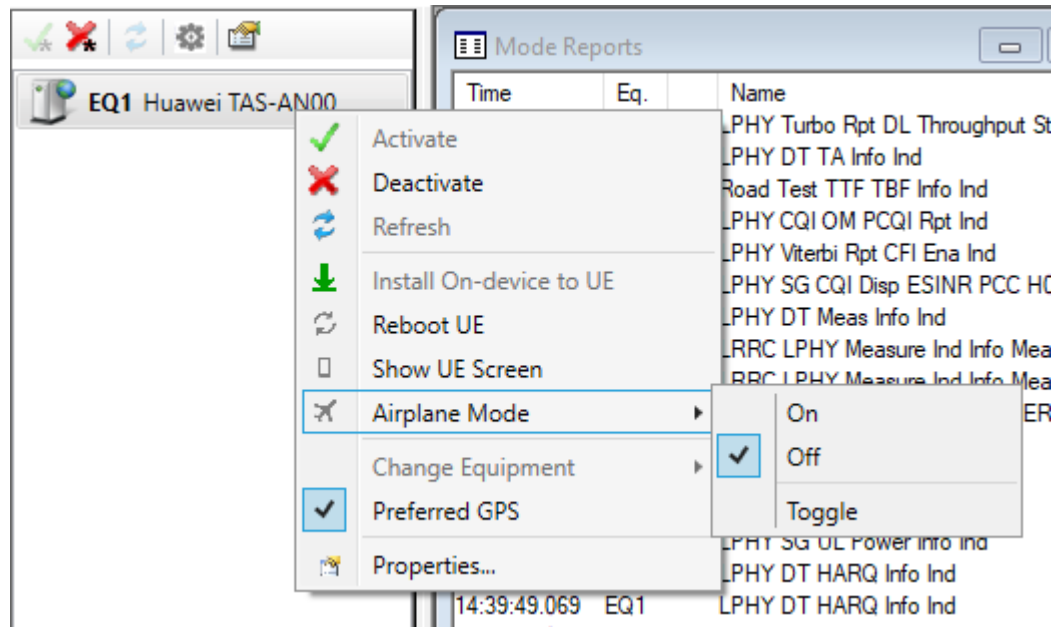
Text Export Enhancements

- The text export has been improved by removing the frame number column and allowing the user to select which optional columns to include in the export.
- It is also now possible to export the entire content of a message window to a CSV file by right clicking in the message window.



Shortcut to toggle airplane mode on a UE

- In TEMS Investigation 22.1 a short cut to turn airplane mode on/off is now available by right clicking the equipment navigator



5G Developments



What's New - 5G Developments

We support devices that are built with 2nd generation chipsets...

Close cooperation with vendors and operators has allowed us to develop support for a huge number of devices (quickly)... Connected device support is key for success.

- The new [Qualcomm Snapdragon 865 Platform](#) provides a number of key features
 - Includes new Qualcomm X55 modem supports 5G SA and DSS. It provides 7.35Gbps in mmWave and 5.1Gbps in sub-6GHz.
- The new [Samsung Exynos 990 5G Mobile Processor](#)
 - Includes new [Samsung Exynos 5123 5G Modem](#) supports E-UTRA-NR Dual Connectivity (EN-DC) that provides 7.35Gbps in mmWave and 5.1Gbps in sub-6GHz
- The new [Huawei Kirin 990 5G chipset](#)
 - Includes integrated 5G modem that provides 2.3Gbps DL



5G NR Stand-Alone testing

For early adopters, infrastructure vendors and labs, now possible to test 5G NR Stand-Alone, where 5G radio bearer is used for both control signaling and payload transfer. (Previously, in NSA mode, only the payload used the 5G radio bearer)

Part of that, TEMS Paragon supports full Layer-3 signaling, RRC (Radio Resource Control inf.), as well as NAS (Non-Access Stratum related inf.), crucial for availability and connectivity verification.

Samsung Galaxy S20+ has the capability to collect 5G NR SA information, (so do other devices with Qualcomm X55 or Exynos 5123 chipset)

Picture/ KPIs

HiSilicon Kirin - 5G NR Information elements

Through HiSilicon ICD we support over 150 Reports (IE)s, currently focusing on 5G availability and service performance testing by measuring Coverage and Throughput,

- Serving cell
- Cell measurement
- Throughput different layer
- Beam information CSI-RS/ SSB
-
- Cell accessibility troubleshooting using events
- Data KPIs distributions to see variation over time
- Radio resource allocation testing (BWP)
- An additional 70 IE are planned in TEMS Investigation 22.2

Samsung Exynos - 5G NR Information elements

Now including information about modulation and codecs as well as physical resource block information, to present details about the actual resource utilization. Important for detailed troubleshooting and optimization.

- Through Samsung ICD we support over 200 Reports (IE)s
 - Serving cell
 - Cell measurement
 - Throughput different layer
 - BLER
 - Event information
 - RLC analysis
 - Beam information CSI-RS/ SSB
- Downlink Control Signaling testing in NR (PDCCH allocation levels etc.)
- RACH troubleshooting (initial cell access latency etc.)

Qualcomm Snapdragon - 5G NR Information elements

Enhanced to include additional signaling information, like RACH (Random Access Channel) and BWP (Band Width Parts). Both are important for mobility, to optimize signaling vs. band width utilization, which in 5G is more flexible comparing 4G.

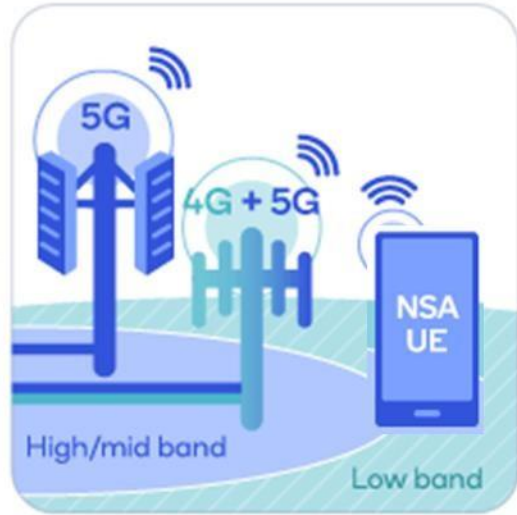
Through Qualcomm ICD we support over 220 Reports (IEs), including:

- Cell measurement
- Throughput different layer
- BLER
- Event information
- RLC analysis
- Beam information CSI-RS/ SSB
- BWP information
- RACH measurements
- Mobility (Handover) testing (LTE Inter-System neighbours such as NR cells)
- Multi-RAT Dual Connectivity troubleshooting on L2 (Setting up bearers, leg switching etc)
- An additional 20 IE are planned in TEMS Investigation22.2

Dynamic Spectrum Sharing



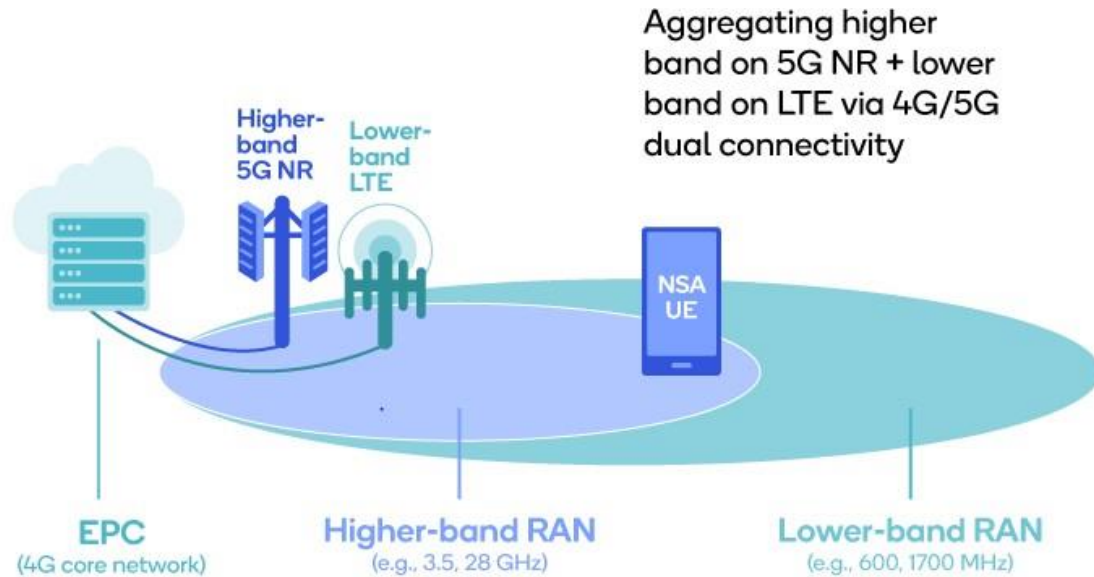
LTE to 5G Evolution : Phase 2- Dynamic Spectrum Sharing



	Baseline Capacity & Coverage	5G on mid bands and high band	Shared mid-bands
High bands (24 GHz – 40 GHz)			
Mid bands (3.5 GHz – 8 GHz)			
Mid bands (1 GHz – 2.6 GHz)			
Low bands (sub 1 GHz)			

Low and Mid-bands 600 MHz -2.6 GHz shared between 4G and 5G

LTE to 5G Evolution: Phase 1 without Dynamic Spectrum Sharing



	Baseline Capacity & Coverage	5G on mid bands and high band
High bands (24 GHz – 40 GHz)		
Mid bands (3.5 GHz – 8 GHz)		
Mid bands (1 GHz – 2.6 GHz)		
Low bands (sub 1 GHz)		

Non-standalone mode and 4G/5G dual connectivity accelerate 5G commercial deployments.

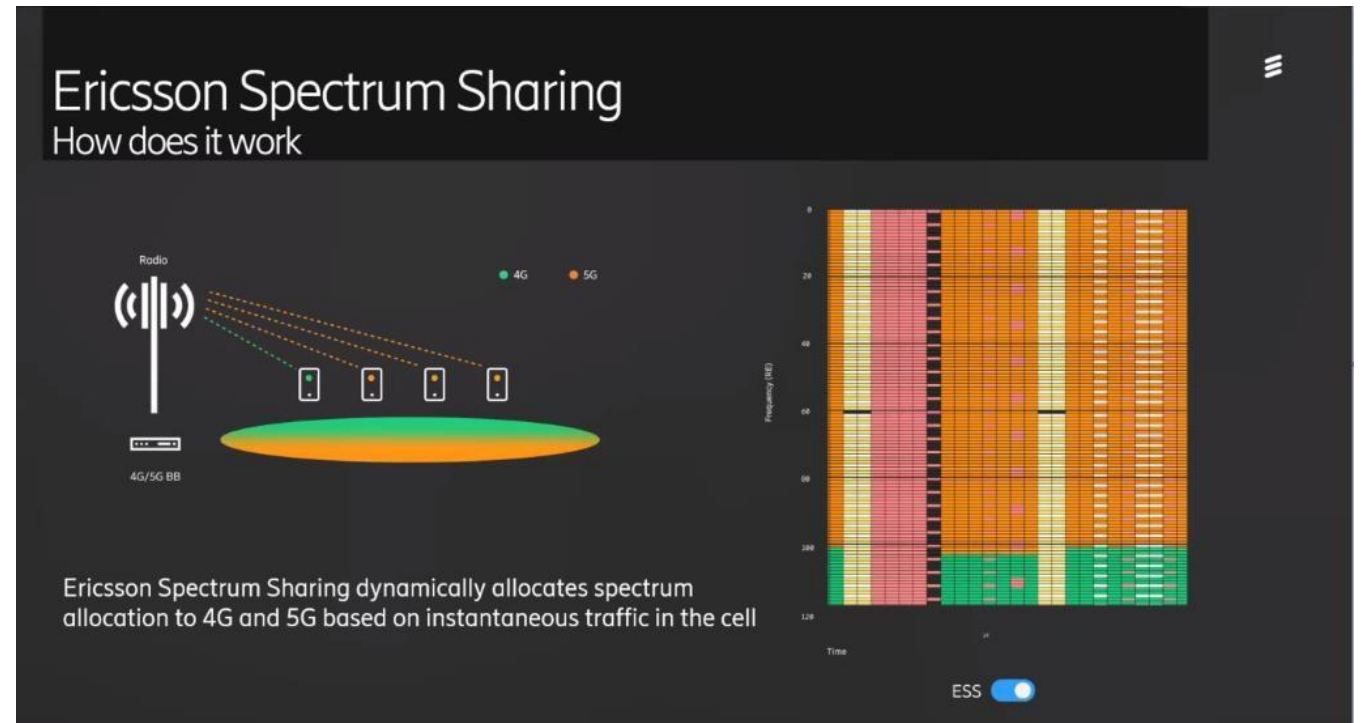
High bands and mid-bands > 3.5 GHz used for 5G

Mid-bands 600 MHz -2.6 GHz used for 4G

Dynamic Spectrum Sharing

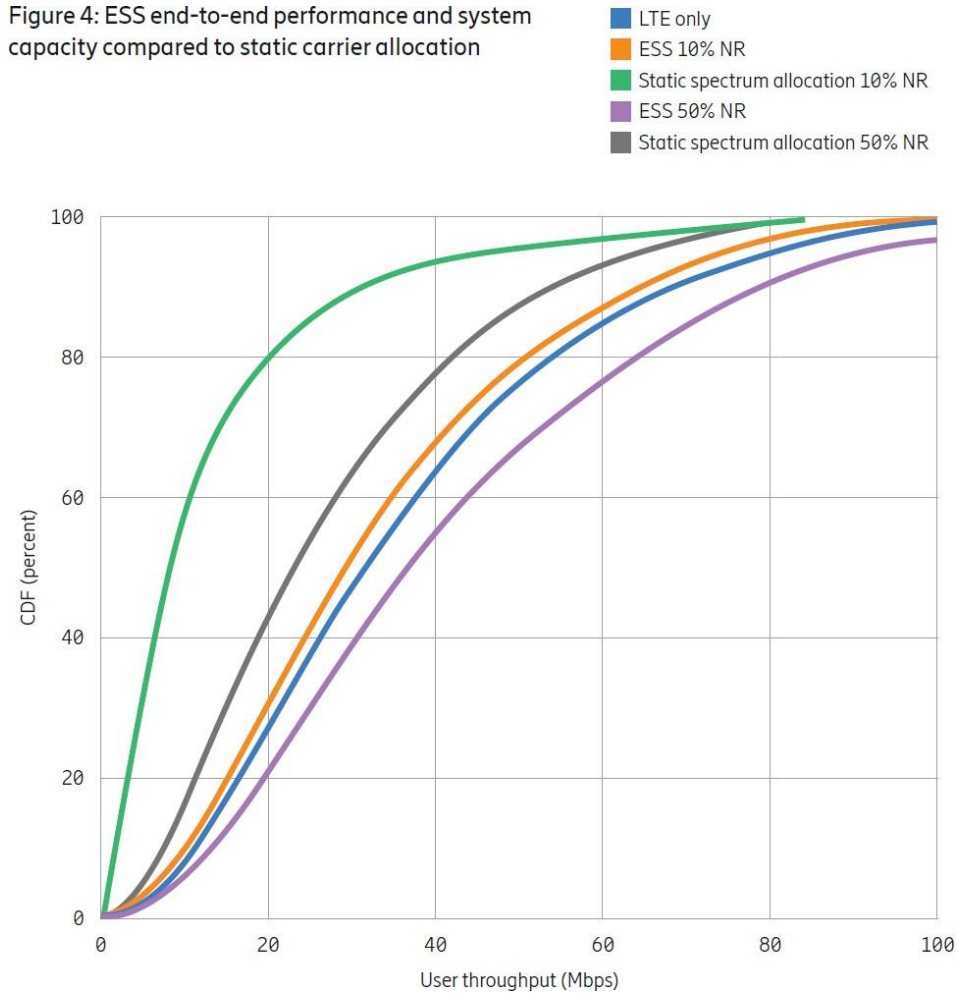
Dynamic Spectrum Sharing allows operators to dynamically switch between LTE and 5G NR transmission on existing LTE bands, giving better NR coverage

- Scheduling decisions every 1msec
- LTE and NR share same resource block, to maximize resource utilization, using lower LTE bands
- Quality measures of LTE and NR as well as related QoS settings are used when scheduling LTE and NR data dynamically



Why DSS helps Transition Networks from 4G to 5G

Figure 4: ESS end-to-end performance and system capacity compared to static carrier allocation



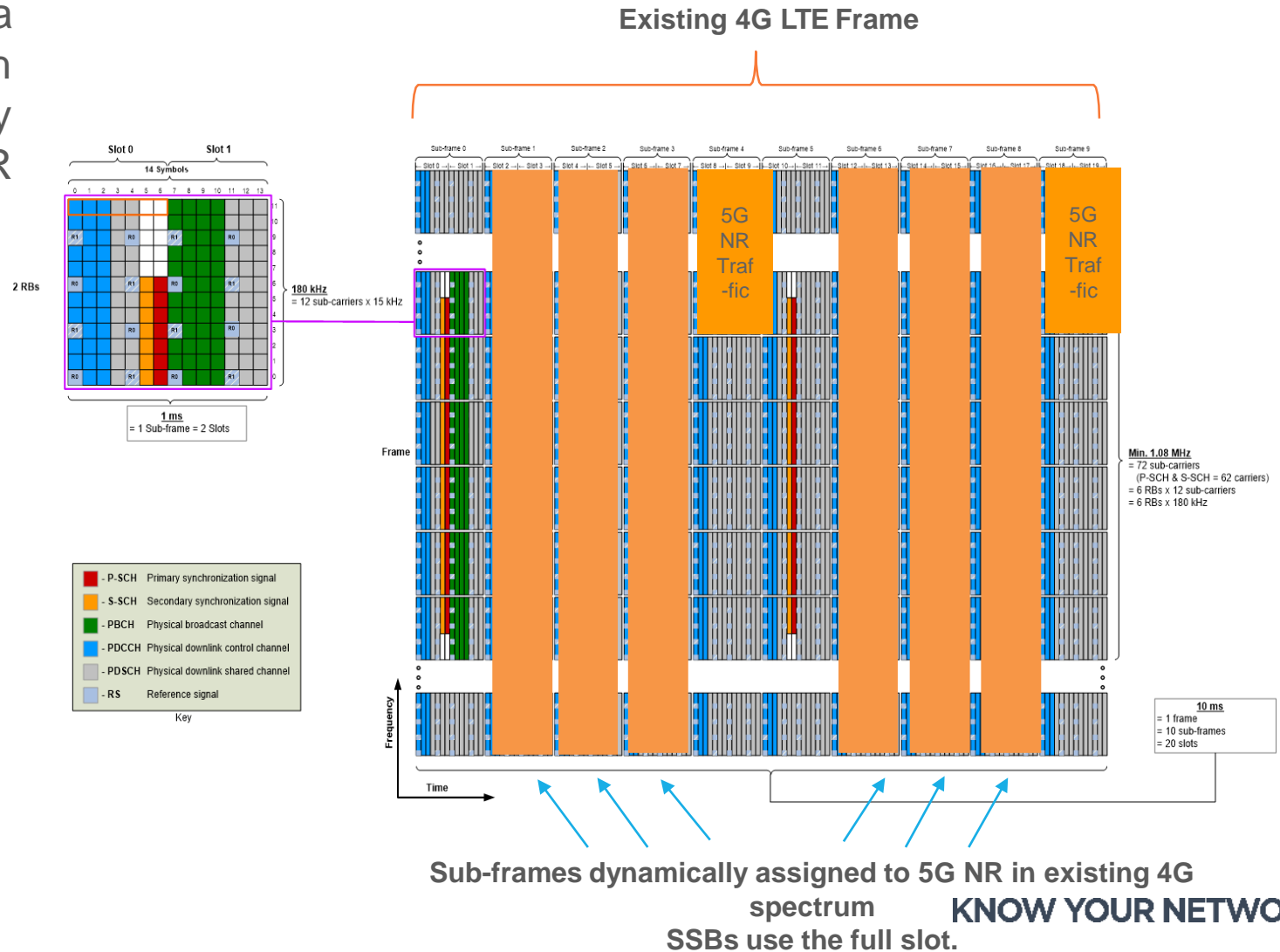
Purple line shows Ericsson Spectrum Sharing (ESS)
Throughput advantage when traffic is 50% LTE/50% NR

From Ericsson: Cumulative Distribution Function (CDF)

What is Dynamic Spectrum Sharing (DSS)

Dynamic Spectrum Sharing is a software controlled feature, which allows operators to dynamically switch between LTE and 5G NR transmission on existing LTE bands

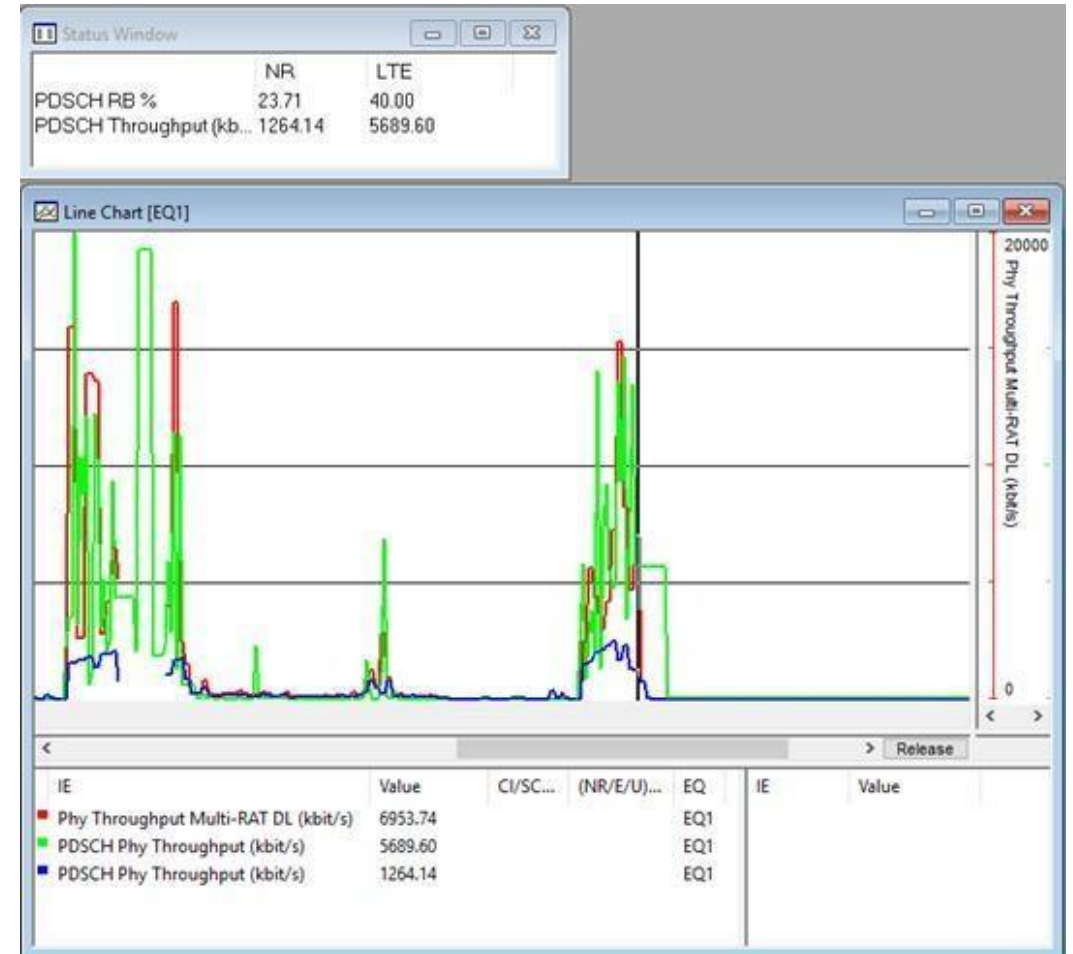
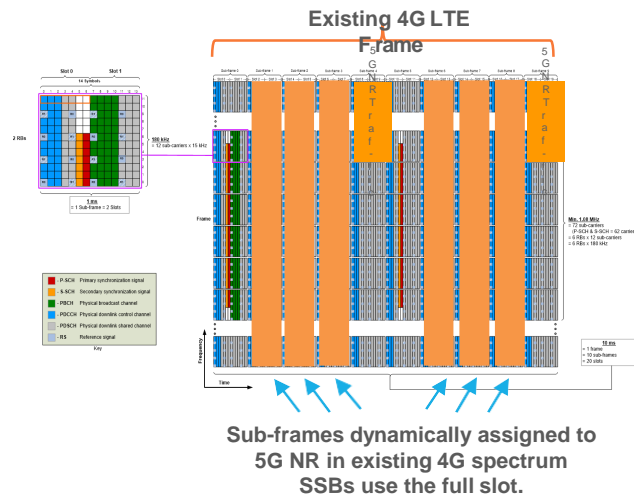
Uses the concept of Multicast-broadcast single-frequency network (MBSFN) from eMBMS



DSS IEs supported

IEs available using current TEMS Investigation monitors:

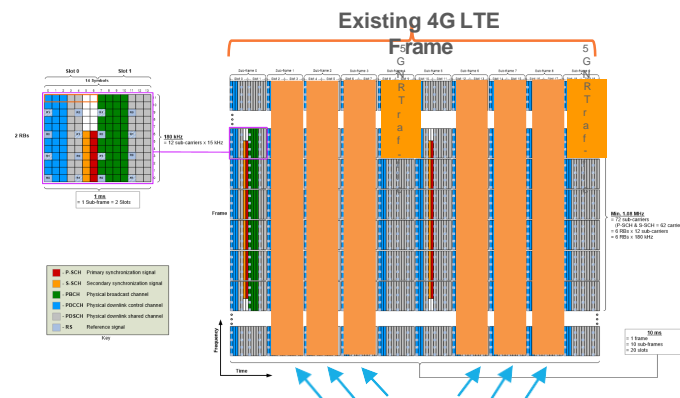
- Resource block distribution
- Data Throughput



LTE Signalling using MBSFN*

Typical use cases to test and verify:

- NR Coverage- sharing LTE Low band, also considering Standalone and CA behaviors using both NR/LTE
- Spectral efficiency, Throughput, and Latency



Sub-frames dynamically assigned to 5G NR in existing 4G spectrum SSBs use the full slot.

```

ssb-periodicityServingCell : ms20
dms-TypeA-Position : pos3
lte-CRS-ToMatchAround
SetupRelease : setup
Setup
carrierFreqDL : 312
carrierBandwidthDL : n50
mbsfn-SubframeConfigList
EUTRA-MBSFN-SubframeConfigList :
[0] :
radioframeAllocationPeriod : n4
radioframeAllocationOffset : 0
subframeAllocation1 : fourFrames
fourFrames : 11000000000010000000000
[0] : 1
[1] : 1
[2] : 0
[3] : 0
[4] : 0
[5] : 0
[6] : 0
[7] : 0
[8] : 0
[9] : 0
[10] : 0
[11] : 0
[12] : 1
[13] : 0
[14] : 0
[15] : 0
[16] : 0
[17] : 0
[18] : 0
[19] : 0
[20] : 0
[21] : 0
[22] : 0
[23] : 0
nrofCRS-Ports : n4
v-Shift : n1
ssbSubcarrierSpacing : kHz15
ss-PBCH-BlockPower : -7
pdsch-Config
SetupRelease : setup
Setup
dms-DownlinkForPDSCH-MappingTypeA
dms-AdditionalPosition : pos1

```

```

spCellConfigDedicated
initialDownlinkBWP
pdcch-Config
SetupRelease : setup
Setup
searchSpacesToAddModList :
[0] :
searchSpaceId : 2
controlResourceSetId : 1
monitoringSlotPeriodicityAndOffset : sl1
monitoringSymbolsWithinSlot : 0010000000000000
[0] : 0
[1] : 0
[2] : 1
[3] : 0
[4] : 0
[5] : 0
[6] : 0
[7] : 0
[8] : 0
[9] : 0
[10] : 0
[11] : 0
[12] : 0
[13] : 0
aggregationLevel1 : n0
aggregationLevel2 : n4
aggregationLevel4 : n0
aggregationLevel8 : n0
aggregationLevel16 : n0
searchSpaceType : ue-Specific
dc-Formats : formats0-1-And-1-1
pdsch-Config
SetupRelease : setup
Setup
dms-DownlinkForPDSCH-MappingTypeA
Setup
dms-AdditionalPosition : pos1
uplinkConfigCommon
frequencyInfoUL
frequencyBandList
MultiFrequencyBandListNR :
[0] : 1
absoluteFrequencyPointA : 389064
scs-SpecificCarrierList :
[0] :
offsetToCarrier : 0
subcarrierSpacing : kHz15
carrierBandwidth : 52
frequencyShift7p5kbz : true

```

Dynamic Spectrum Sharing using PCTEL Scanner

PCTEL 5G Scanners support the detection of DSS

Some new DSS Scanner IE will be available

This feature requires a new license from PCTEL

- 4G LTE - 5G NR Dynamic Spectrum Sharing Option



For the scanning receiver to decode DSS:

- Setup 4G eTopN and 5G NRTopN decode on respective bands
- For 4G select the Signal Mode as 4G/5G Spectrum Sharing from the script (settings)
- Scanner automatically adjust on 4G to detect spectrum sharing frames

DSS Performance Dashboard

Resource utilization dashboard combines PRB utilization for LTE and NR in Downlink

LTE and NR data traffic dictates the percentage of PRBs used (aggregated over interval)

Same concept can be applied to Uplink case

Following Information Elements are useful for DSS

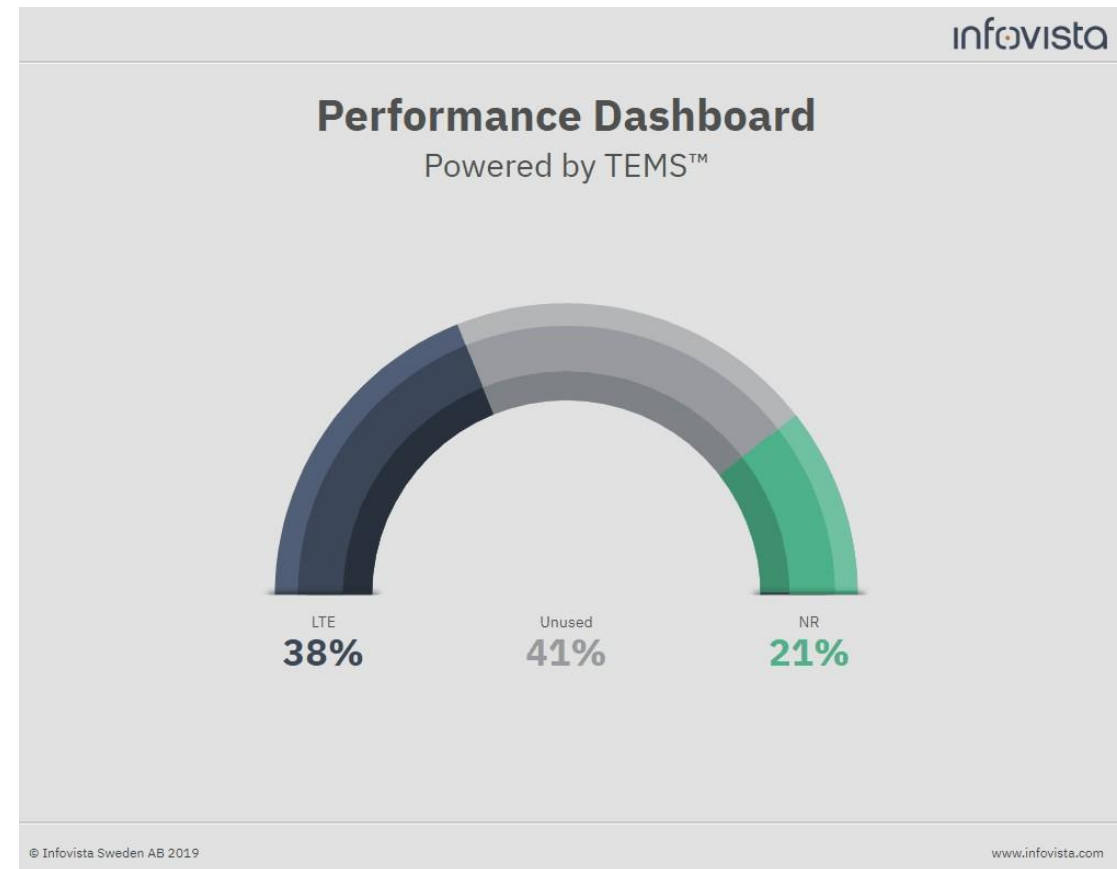
PDSCH PRB Allocation Count TB1/TB2 per carrier *

PUSCH PRB Allocation Count per carrier *

Phy Throughput Multi-RAT DL (kbit/s) *

Phy Throughput Multi-RAT UL (kbit/s) *

* LTE and NR technologies



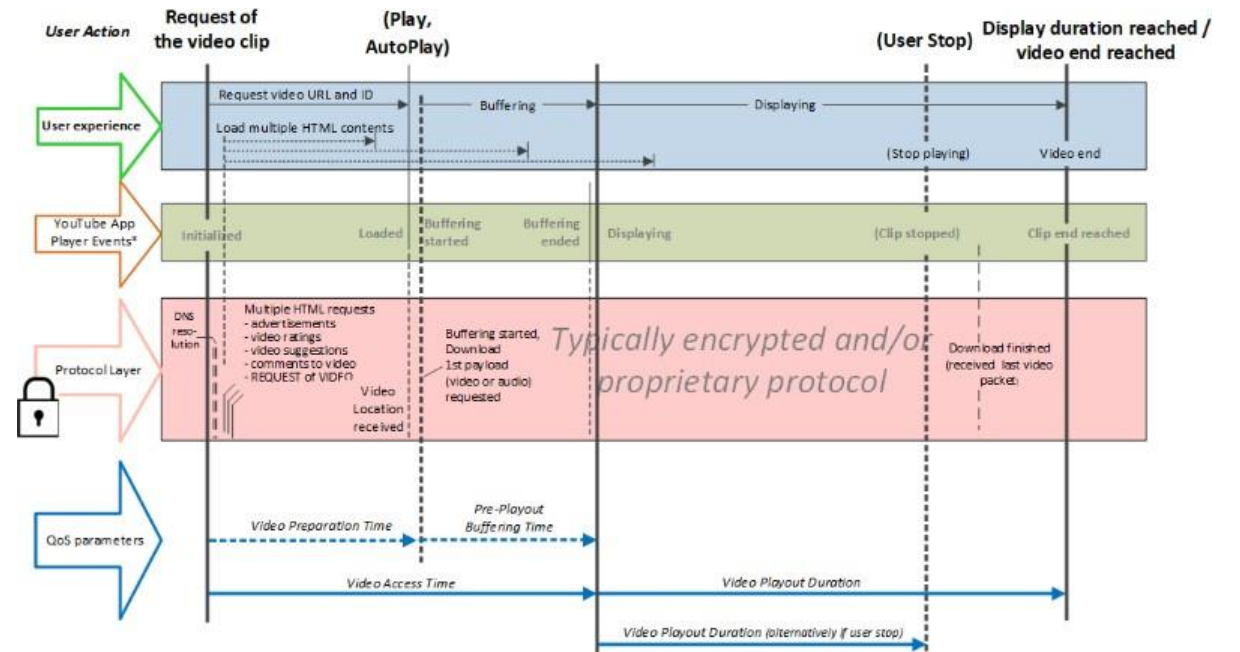
Data testing Enhancements



ETSI KPIs- YouTube testing

Compliant: ETSI TR 101 578 V1.3.1 (2018-10), QoS measurements for IP-based video services like YouTube™

ETSI KPI	Status
4.3.1 Video Access Failure Ratio	Existing
4.3.2 Video Access Time [s]	Existing
4.3.17 Impairment Free Video Session Ratio[%]	New
4.3.24 Video Playout Cut-off Ratio [%]	Existing
4.3.27 Video Playout Duration [s]	New
4.3.29 Accumulated Video Freezing Duration [s]	Existing
4.3.34 Video Freezing Time Proportion [%]	New
4.3.35 Video Quality	Existing
4.4.1 Video Preparation Failure Ratio [%]	Existing
4.4.2 Video Preparation Time [s]	Existing
4.4.3 Pre-playout Buffering Failure Ratio [%]	Existing
4.4.4 Pre-playout Buffering Time [s]	Existing



iPerf 3 – In Tethered Mode

iPerf service, an important test to verify maximum achievable bandwidth on IP networks, especially for new technologies like LTE-A and 5G NR having strong requirements about good capacity- this feature is now further enhanced:

- PC-solution- tethered edition, making it possible to run test with any device- TEMS device and Commercial device including routers and modems)
- Part of our script designer, it is now possible to configure a range of ports (pool of ports) to use for iPerf testing
 - A valuable feature for use cases like benchmarking where you have lot of devices sharing same script, rather than to have it configured per device individually, difficult to administrate.

iPerf 3 - ODM solution

On-Device solution- making it possible to run test in-side the device- TMS device and Commercial device including routers and modems)

sQLEAR Availability

- sQLEAR is made available on an annual basis, and is licensed per TEMS Investigation system.
- It requires that VoLTE testing is enabled, and that the devices that will perform the testing are fully TEMSed devices that support VoLTE on the network under test
- It requires, sQLEAR License Option, 12-month

IoT Improvements



What's New – IoT Improvements

- TEMS Investigation 22.0 introduced a feature to verify the IoT power save mode.
- IoT devices can be used for critical applications, where unnecessary power consumption can be devastating. In case of unnecessary power consumption your IoT device might stop working earlier than expected. TEMS Investigation 22.0 now allows for analyzing the Layer 3 timers to verify the important power saving mode function and avoid any unexpected down time. (eDRX will be supported soon)
- With TEMS Investigation and Pocket, you can also test critical functions of your IoT device. The first thing is of course connectivity, and by utilizing generic test cases to push data via UDP or MQTT for file uplink/downlink success rate. To simplify the tests you can use our inbuild script designer that simplifies the tests, write the script once and use it for all your tests.

What's New – IoT Improvements

TEMS Investigation 22.0 further enhanced with new features allowing you to test and verify IoT characteristics important for different applications.

- Round Trip Time (RTT) delay testing, by doing service testing (FTP/ HTTP/ UDP/ Ping) over DoNAS, which is important to verify for time critical applications
- Power saving mode verification, by measuring belonging L-3 timers (T3412/ T3324) controlling the eDRX logic, giving you the possibility to avoid unnecessary power consumption impacting IoT battery performance negatively, and shortening the uptime.

ETSI Score



What's New – ETSI Score

- Although not part of TEMS Investigation 22.0, we should mention this new service
- Data collected from TEMS tools can now be ranked using a scoring methodology recommended by ETSI.
- We have been able to provide the umlaut score indicator, but now we can supply a service to provide a score customized to local conditions and demands.
- Customers just need to send us TEMS log-files in confidence, and we will provide them with a Network Score based on ETSI recommendation...

- The ETSI recommendation (ETSI TR 103 559 V1.1.1) can be found [here](#)

Devices



Introducing...



iPhone 12 Pro Max



iPhone 12 Pro



iPhone 12



iPhone 12 mini



iPhone Testing

Infovista has an agreement with Apple to be able to run tests and collect trace information from iPhones

Supported models (TI 22.2.1)

iPhone 12*

iPhone 11*

Possible to connect, out of support

iPhone Xs, XR

iPhone X

iPhone 8

iPhone 7

iPhone 6S

*All variants



New Intel XMM based devices

- Connectable device, Apple License Option Bundle -12m
 - Apple iPhone 11 A2111, A2221, A2223
 - Apple iPhone 11 Pro A2160, A2215, A2217
 - Apple iPhone 11 Pro Max A2161, A2216, A2218
-
- TheApple iPhone 11 is based on the Intel XMM 7660 chipset, and the Information Elements are currently quite basic



iPhone capabilities in TEMS Investigation

Supports scripting of all major service tests

CS Voice

Data Services via PC*

FTP UL/DL

HTTP UL/DL

iPerf (Network bandwidth)

Ping

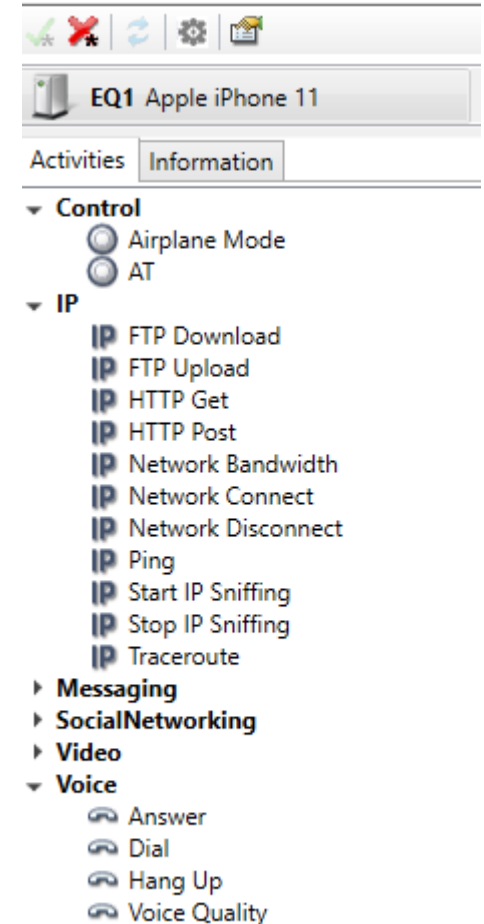
Traceroute

PS Attach, PS Detach

IP Sniffing for ETSI KPI Creation

VoLTE (SIP)

- AQM measurements via ACU R2**
 - POLQA
 - M2M



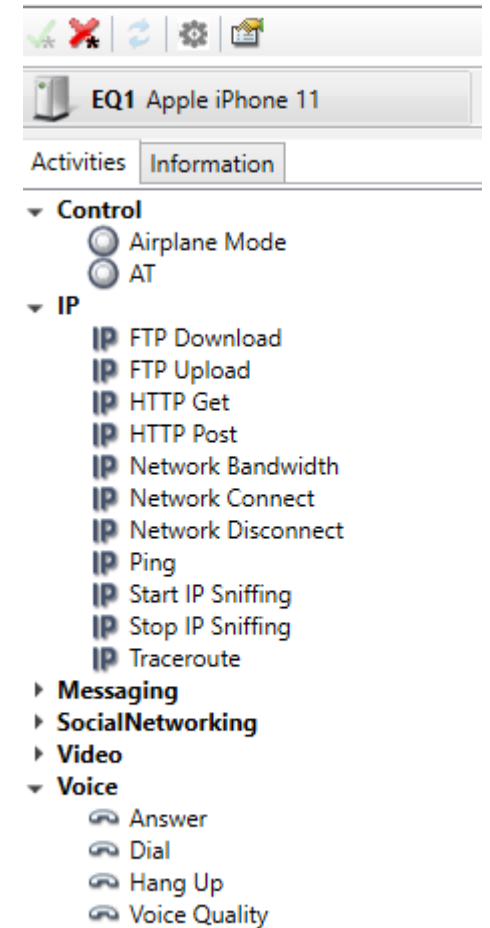
* Data tests via PC are currently done in tethered mode (not ODM). Limits throughput to ~200Mbps
** Requires adaptor - 3.5mm jack adapter over lightning, with power/data sync
While possible to use ACU R2 but due to technical challenges it is not advised for large measurement campaigns. POLQA tuning is *currently* not done for iPhone 11 and 12 series.

Control capabilities in iPhone (via menu system)

Manual RAT lock (LTE/UMTS/GSM)

Manual Band Lock

Auto answer



New Qualcomm Snapdragon 865 based devices

- TEMS devices, requires Qualcomm N license option
- **Samsung – Galaxy S20+ SM-SC52 (Japan Docomo variant)**
- **Samsung – Galaxy S20+ SM-SCG02 (Japan AU variant)**
- **Samsung - Galaxy S20+ 5G SM-G9860**
- **Samsung - Galaxy S20+ 5G SM-G986W**
- **Samsung - Galaxy S20+ 5G SM-G986U**
- **Samsung - Galaxy S20+ 5G SM-G986U1**



Other Qualcomm Snapdragon 865 based devices

TEMS devices, requires Sony F license option:

- Sony Xperia 1 II (mark2) 5G – XQ-AT51 (US / EEA / Russia)
- Sony Xperia 1 II (mark2) 5G – XQ-AT52 (TW / HK / SEA)

TEMS devices, requires Qualcomm N license option:

- OnePlus 8 5G – IN2023, IN2013. IN2017

Connectable devices, requires Qualcomm N license option:

- LG v60 ThinQ 5G – LM-V600EA
- Xiaomi Mi 10 Pro 5G – M2001J2G
- Motorola End Plus - XT2061-3
- OPPO Find X2 - CPH2025
- Vsmart Aris Max 5G



New Samsung Exynos 5123 based devices (in TI 22.1)

- TEMS device, requires Samsung G license option
- **Samsung** - Galaxy S20+ 5G SM-G986B
- **Samsung** - Galaxy S20 Ultra 5G SM-G988B



New HiSilicon based devices

Connectable devices, requiring HiSilicon License Option 12-m Bundle :

- Huawei Mate P40 5G - ANA-AN00 – Huawei Kirin 990 5G
- Huawei Mate P40 5G - ANA-NX9 – Huawei Kirin 990 5G
- Huawei Mate P40 Pro 5G - ELS-AN00 – Huawei Kirin 990 5G
- Huawei Mate P40 Pro 5G - ELS-NX9 – Huawei Kirin 990 5G

Note:

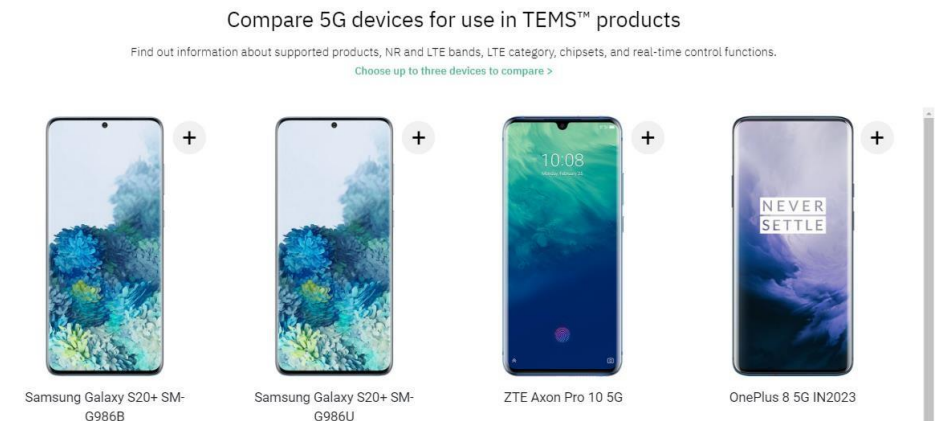
- Initially with limited support, according to list of supported IEs
- Every test device must have it's Diag port activated by HiSilicon.
- Following the IV supply processes, it is triggered by the SO# TI-HU-5G-FW



New Devices

Devices supported by TEMS is now available here

- <https://support-tems.infovista.com/document/DeviceList/index.php>
- Moreover, we have included a new Device Comparison tool on the TEMS page
- https://know.infovista.com/device-comparison/p/1?utm_source=website&utm_medium=ad&utm_campaign=TEMSPortfolio



Other options

Modem, PCI modems and routers, IoT

- Thethered mode
- Any commercial device can be used by TEMS Investigation as connectable - > if the chipset is supported we can integrate it wihtin days. This allows to test HTTP, FTP, Ping, CallSetup as scripted test. MOS scores can be done via the ACU R2. You can also run with a default MOS that will give you an indicator on the status. The ACU could be tuned on demand.
- Lab & regression testing of services, devices and infra structure - see that the device is working in the network, that the network behaviour is the same before and after.

Thank you!

www.infovista.com

