

TD-LTE Industry Briefing

September 14, 2016 | No. 28

*Edited by GTI Secretariat
September 14, 2016*

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GTI 2.0

Promotes TD-LTE Evolution and 5G Development

GTI 2.0 Mission

Continuing TD-LTE Global Development

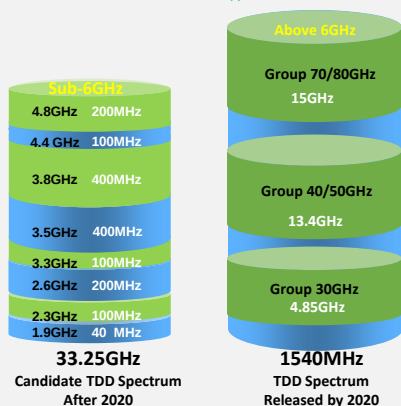
- Continuing to promote TD-LTE global deployment
- Continuing to enlarge the scale of converged TDD/FDD terminal and network
- Further promote the development of TD-LTE enhanced technologies

Propel 5G Development

- Promote and utilize the advantages of TDD to facilitate 5G development
- Promote 5G unified standard and end-to-end ecosystem
- Explore 5G cross-industry market and opportunities

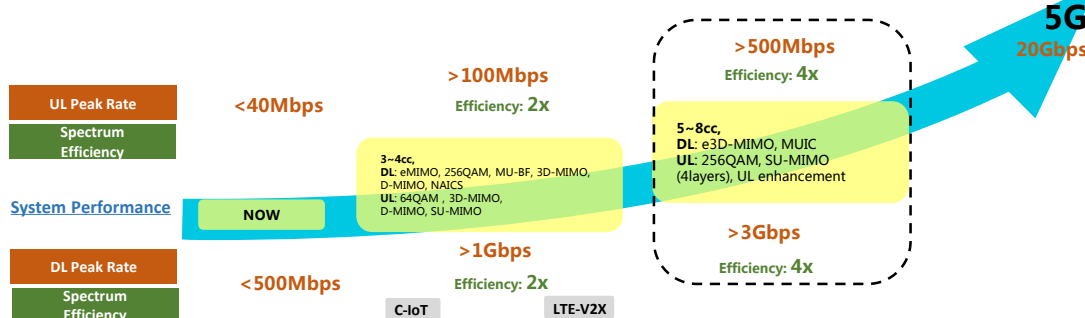
1. Continuing TD-LTE Evolution and Global Commercialization

Global Spectrum Efficient Utilization



- ✓ Spectrum Global Harmonization
- ✓ Obtain More Spectrum
- ✓ Large Contiguous Bandwidth Spectrum Release

2. TDD Technology Evolution Towards 5G



- ✓ Continuously Build Competence of TD-LTE Technology

3. Facilitate Commercialization

CONVERGED

Encourage **MORE** Converged LTE TDD/FDD deployment and operation

INNOVATIVE

Promote **MORE** Innovative business models, services and applications

SUSTAINABLE

Pay **LESS** Capex and re-use infra to achieve sustainable development

FINANCIAL

Provide **MORE** financial support and interaction with investors

GTI 2.0

Promotes TD-LTE Evolution and 5G Development

GTI 2.0 Mission

Continuing TD-LTE Global Development

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Propel 5G Development

- Promote and utilize the advantages of TDD to facilitate 5G development
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2. Accelerate 5G Development By 5G Innovation Program

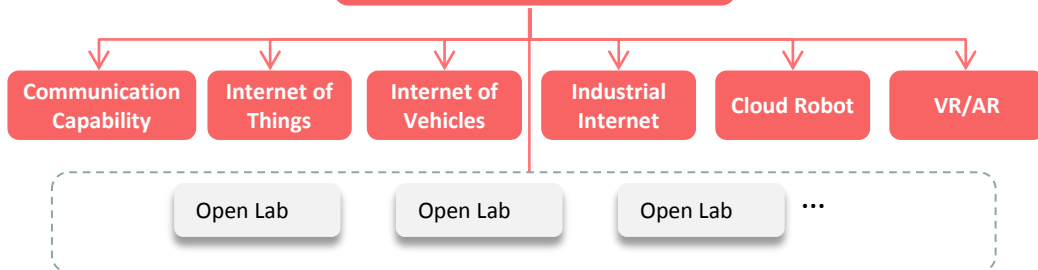
1 5G Innovation Program Objectives

- ✓ Promote the maturity of communication capability

- ✓ Promote the development of innovative services and applications

2 Work Scope

GTI 5G Innovation Program



3 Methodology

- Workshops address the key challenges in the development of 5G
- Build broader co-operation with cross-industry to develop new business
- Operators Open Labs carry out research and test
- Release and promote new products and services

4 Relations Between GTI and Operator Open Labs



Capture requirements

Release achievements

Operator 1
Open LabOperator 2
Open LabOperator 3
Open Lab

...

GTI Successfully Held GTI Summit in Shanghai

Organized by GTI and supported by GSMA, GTI Summit · Shanghai 2016 was successfully held on June 29th 2016, during Mobile World Congress (MWC) 2016 in Shanghai. This summit attracted more than 800 executives globally from government, leading telecommunication organizations, operators, vendors, service providers, media and consulting companies.

Summit Highlights:

- Further publicize GTI 2.0 prospect and update the latest progress of GTI 2.0
- Views sharing on 4G evolution and 5G prospects from leading enterprises of telecom industry
- Development prospects of new applications, new services and new markets in 5G era from consulting and vertical industry

Keynote Speech



Mr. Craig Ehrlich
Chairman
GTI

'We set out to take LTE TDD and merge it with FDD, so that we had global standard. 5 years later, we achieve success. In February in Barcelona earlier this year, we announced GTI 2.0. So this conference, in a sense, is the first time we would have been discussing with you our vision of GTI 2.0.'



Mr. Mats Granryd
Director General
GSMA

'On the TDD/FDD side, it's now supported on one common chipset. That's one of key factors why LTE is such a successful standard. It's no longer an issue if it's FDD or TDD technology. So when it comes to 5G, you know it's a huge excitement on 5G, it promises a hyper connected society.'



Ms. Cao Shumin
General Manager
CAICT

'The globally unified 5G standard is being developed in the framework of ITU and 3GPP, with the consideration of different parties' requirements. 5G is an enabling technology & network infrastructure for verticals, especially for Industrial Internet. The 5G standard for IoT should be studied with the same priority as eMBB. 5G trials play an important role in the R&D of 5G, and should be carried out in an open and collaborative way.'



Mr. Zhang Feng
Chief Engineer
MIIT of China

'As an important cooperation platform of promoting 4G technology, GTI played a key role in TD-LTE global commercialization. Afterwards, GTI 2.0 was launched in Feb. 2016, providing a platform for accelerating TD-LTE evolution, 5G R&D and innovation.'



Mr. Li Yue
President & CEO
China Mobile

'He shared China Mobile's Big Connectivity Strategy—to enlarge connection scale, to improve connection service, and to enrich connection applications. Mr. Li also expressed his praise and belief in GTI. 'GTI has played an important role in promoting the development of TD-LTE. In the future, with the support of industry partners, GTI 2.0 will obtain greater success.'



Mr. Luke Ibbetson
Head of Strategy and R&D
Technology, Vodafone Group

'IoT is one of our fastest growing business segments and it had been for the last few years. We are able to announce that we are in a position to upgrade 85% of the existing infrastructure to support NB-IoT, it allow us to start to rapidly plan for the launch capabilities as soon as next year.'

GTI Successfully Held GTI Summit in Shanghai



Mr. Xu Zhijun
Rotating CEO
Huawei

'GTI made a significant contribution to promote the development of TD-LTE end-to-end industry and global commercialization.'

He hoped GTI could achieve 2.0 objectives, promoting the development of 5G industry and 5G industry convergence especially in sub-6GHz.'



Mr. Ulf Ewaldsson
Senior Vice President & CTO, Head
of Group Function Technology
Ericsson

'5G is a platform for massive use and gave many 5G use cases, including sensors everywhere, broadband and media everywhere, smart vehicles and transport, infrastructure monitor, critical control of remote devices and interaction of Human-IoT.'



Mr. Wang Chuanfu
Chairman and President
BYD

'As to smart car, the requirements on mobile communication are high efficiency, high synchronism, and high safety. All of these scenarios have high demands for bandwidth and latency of mobile communication. So we need 5G to help us improve user experience.'



Mr. Francois Cadelon
Senior Partner and Managing Director
Boston Consulting Group

'It will be absolutely critical to unleash the power of Internet of Things, it includes the Internet of Vehicles and it includes Industrial Internet. 5G will be a key enabler.'



16th GTI Workshop Held in Shanghai

The 16th GTI (Global TD-LTE Initiative) Workshop took place during Jun. 27-28, 2016 in Shanghai, China, gathering more than 200 industrial leaders and experts from 19 operators and 36 industrial partners and organizations. A focus on TDD evolution towards 5G entailed subsequent work to support 5G on 4G hardware and a whitepaper to be delivered. Industrial progress on 3D-MIMO reassured operators that it should be adopted to lift performance and could be reused as 4G evolves to 5G. Updates on High Power UE were also introduced as a key to TDD Uplink enhancement.



In addition, latest progress and key issues on LTE-A, VoLTE, 3.5GHz, LTE Global Phone, Roaming, and Innovative Business Models and Applications were also shared and discussed in depth. Meanwhile, demonstrations were held with focuses on real-time 3D-MIMO experience, world-first 3.3-3.4GHz end-to-end system, WIMO Home solution and industrial progress and test systems on Cellular IoT, LTE-A, VoLTE and EVS.

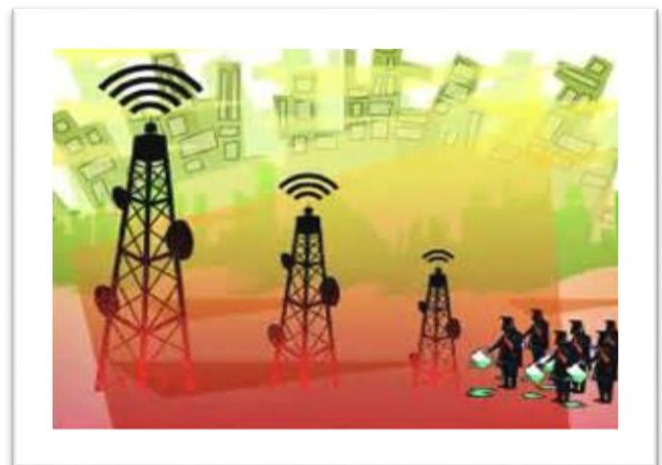


Reuse Infra as TDD Evolves to 5G

As TD-LTE has been widely commercialized on a global scale, many operators are eyeing a smoother yet more cost-effective evolution towards 5G. Therefore, it'd been brought up at the last workshop that the GTI would explore possibilities of leveraging as much as possible current investment to support 5G by 4G hardware with only software and baseband upgrade.



GTI plans on conducting feasibility study and a whitepaper to be delivered, and subsequently moving on to validation and trials. Working groups intend to start by calling for contributors and working with the industry to achieve 5G with the least cost.



GTI and CMCC Cooperate with Automotive Industry to Promote Cross-field Innovation in V2X

The “Road to the future: Smart Connectivity”2016 Connected Cars Forum was jointly hosted by GTI and China Mobile in Shanghai on June 28th. China Mobile invited OnStar, Audi (China), BAIC, BYD, Changan and the other well-known automobile enterprises, and Softbank, Datang, Huawei, Qualcomm, Rohde & Schwarz and other telecommunication companies together to jointly explore the current industry hotspots in V2X, like 5G, Connected & autonomous vehicles, LTE-V2X etc. 5G will provide a number of benefits over current 4G networks, which includes download speeds of up to 1Gbps, 1ms latency, and vastly improved network coverage. This is why automobile enterprises believe 5G could be vital in providing the reliability to allow autonomous cars on roads. During the forum, it was also held the China Mobile 5G Innovation Center Partner Award Ceremony. BYD, GAC, Audi (China), BAIC, LeTV Car, OnStar, Changan became center’s new partner. China Mobile 5G Innovation Center is dedicated to driving the maturity of end-to-end communication capability, promoting the development of 5G innovation applications and building a win-win cross-industry ecosystem. The joining of those new partners will promote a collaborative approach across industries and accelerate the maturity of V2X, contribute to the development of GTI Vertical Industry Business Model group, and together with GTI and China Mobile to build the V2X era.



GTI Investor Conference 2016 Held in Shanghai

As an exclusive event for TDD funding, the Investor Conference was held again by the GTI on June 28th in Shanghai where emerging operators from Singapore, Azerbaijan, Brazil, Iran and Canada presented their company profiles, business models and funding requirements to the investors.

GTI Investor Conference has been held periodically since 2014, aiming to bridge 4G industry with the investment community for potential cooperation, helping investors gain insights into 4G market and an in-depth understanding of TD-LTE industry.



Cellular IoT Session Held During the GTI Workshop in Shanghai

Following up the GTI Narrow Band-IoT (NB-IoT) Ad-hoc held early this year in Barcelona, during the 16th GTI workshop in Shanghai, GTI Cellular IoT (CIoT) session took place and gathered vertical players, MNOs and industrial partners on network, device, chipset, module and battery to discuss IoT market requirements, industrial progress, cross-industry cooperation, open lab and etc.

Meanwhile, a panel organized in an end-to-end manner allowed inspiring discussion among the demand side, operators and vendors, further boosting the development of CIoT technology and products towards industrial maturity.



Collaboration in Asia for 5G Spectrum Workshop

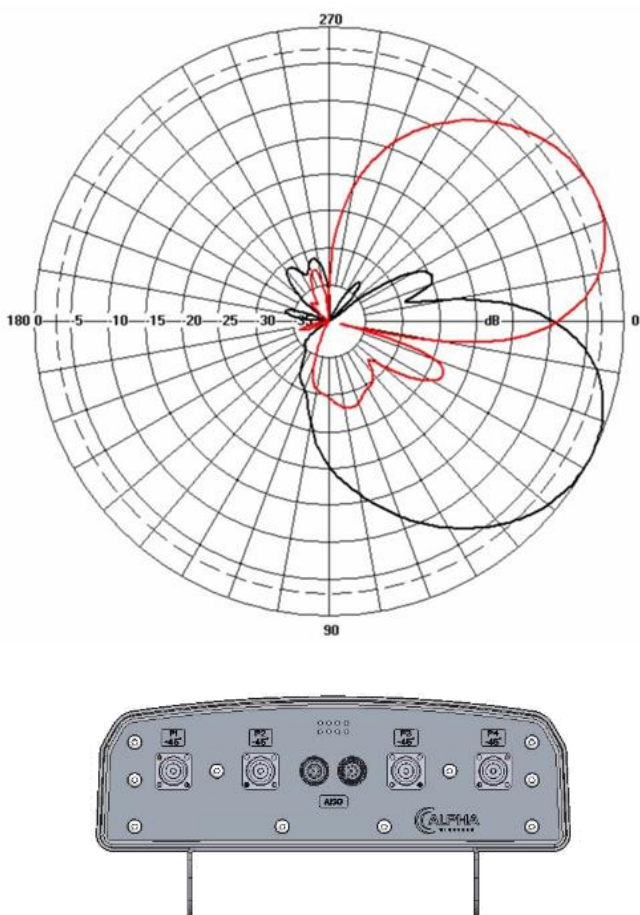
C-band is the key band of IMT spectrum below 6GHz



Organized by GTI (Global TD-LTE Initiative), GSMA (Global Mobile Suppliers Association) and GSA (Global mobile Suppliers Association), “Collaboration in Asia for 5G Spectrum” workshop was successfully held in Shanghai on June 28th, during 2016 MWC (Mobile World Congress). Regulators from China, Japan, South Korea were invited, gathering more than 100 industrial leaders and experts from industry to share their latest spectrum release progress and discuss to find a common approach on spectrum bands for 5G at the next WRC-19 and also to find how suitable are the existing IMT bands (from WRC-15) for deployment of 5G services. RRB Director General from MIIT, Xie Feibo, attended the meeting and delivered an important speech on China's 5G commercial timetable and spectrum planning. According to the discussion, regulators from CJK achieved consensus on that **more spectrum including sub-6GHz and high frequency bands are needed for 5G, C-band is the key band of IMT spectrum below 6GHz and harmonization is strongly recommended on 5G spectrum planning.** The common ground formed during this summit on spectrum for 5G from the region will have a positive impact and accelerate development and adoption of 5G technologies for both the region and global level. The collaboration among CJK will ensure them as the front runner of 5G in the long run.

Twin Beam Antenna Technology

Build a six-sector site with three antenna using twin beam antenna technology and increase your data capacity by 70-80%.



As the appetite for data continues to grow, various approaches to increase capacity are being used and explored:

- *Adding new sites – this can take up to two years and will cost hundreds of thousands of dollars.*
- *Adding spectrum – assuming spectrum is available this can cost millions or even billions.*
- *Offloading to other networks such as Wifi – this poses security issues and requires the users to run suitable applications.*
- *Small cells – this can take time, and although not as costly as adding new macro cells, it still requires a significant outlay.*
- *Increasing the number of sectors – more antennas are needed so more tower space will be required which may not be available, planning and zoning may be an issue, and technical issues such as increased wind loading will need to be addressed.*

All of these involve significant cost and technical challenges, and because of this using twin beam antenna technology and converting a three-sector site into a six-sector site is becoming an attractive and low cost option. Twin beam antenna technology provides two independent 33° antenna beams from a single antenna package, so you can build a six-sector site using three antennas. Theoretically, this can double your capacity, but real measurements have shown a 70-80% improvement and all without increasing the wind-loading on already congested masts.

So, now you can easily upgrade your existing three-sector sites or build new sites, with increased capacity, without incurring significant additional costs.

China Mobile and Nokia Conduct Trial of Innovative Centralized RAN & 4G Technologies

China Mobile and Nokia conduct trial of innovative Centralized RAN and 4G technologies inside sports stadium. Nokia and China Mobile carry out first ever deployment of Centralized RAN within a TD-LTE network at the Beilun Stadium in Ningbo, China. Trial delivered exceptionally high-quality, high-speed mobile experience with improvement of upload speeds by 62%. Centralized RAN technology is a key step in evolution to Cloud-RAN networks.

Spectators at stadium events are increasingly expecting the same level of mobile connectivity they have in the home as they share pictures and videos via social media or upload content to the cloud. However, slower network speeds and interference can traditionally impact the experience.

To address this challenge, Nokia worked with China Mobile to deploy, for the first time, Centralized RAN technology in a TD-LTE network at the Beilun Stadium in Ningbo, China. The technology monitored the signals of up to six radio cells, combining those of the best four to communicate with subscribers' devices and turn interference into useful traffic.

Some 6,000 spectators inside the stadium were provided with an exceptional high-quality, high-speed mobile experience, with upload speeds improved by 62 percent compared to existing TD-LTE networks in high-traffic locations. During peak usage times, devices were receiving data at speeds of 12 megabits per second (Mbps) or more, allowing users to use webchat applications and upload pictures without service degradation. The power efficiency of their devices was also improved by up to 33 percent.

Nokia's Centralized RAN technology can be deployed via software upgrade to an existing Flexi Multiradio 10 Base station network. For mobile operators, Centralized RAN is a key step in their Cloud RAN network evolution.

4G Wireless Broadband Opens Up Broadband New Era

The Smart Home @ Wireless summit, sponsored by GTI, was attended by more than 100 participants including Huawei, Nokia, Qualcomm Technologies, among which 20 operators, analysts, and media representatives. This summit provided the opportunity to exchange ideas and outline the strategy to derive the most benefit from the 4G WBB industry.

Huawei demonstrated a mature E2E ecosystem at this summit, including latest CPE and MiFi, with support of all main LTE TDD bands, 4x4 MIMO, TDD+FDD 3CC CA, and many more. A range of diversified user experiences were shown at the Smart Home exhibition area including 360° live VR monitoring with 4G backhaul, strong visual impression with 4K, 1080P and 720P comparison. Visitors were also able to control lights, curtains, and robot sweepers remotely by using a mobile App. One application allowed attendees to try on virtual clothes facing a mirror in a dressing room, with the image simultaneously being sent to a smartphone. For family home entertainment systems, it allows for an immersive experience when using with VR games.

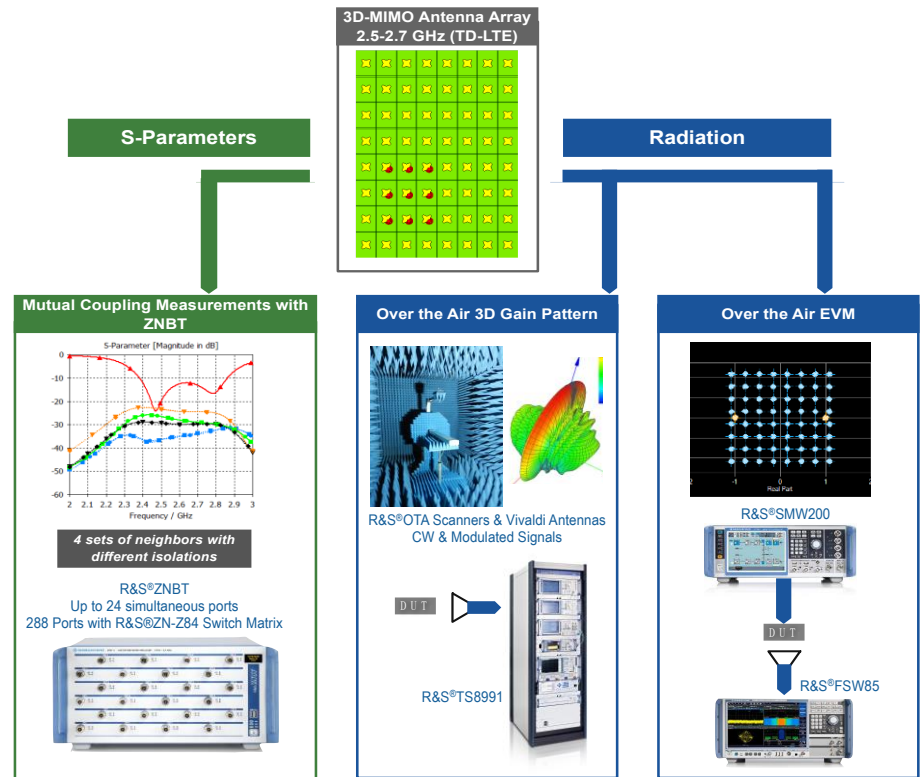
Qualcomm Technologies shared the latest Qualcomm® Snapdragon™ LTE chipset and roadmap, including the first gigabit class LTE solution -- the Snapdragon X16 LTE modem. With peak download speeds of up to 1 Gbps -- or 500x the speed of 3G 10 years ago and 10x the speed of LTE only 5 years ago, the Snapdragon X16 LTE modem will support future WBB services like AR, VR and apps that require instantaneous connectivity to the cloud.

Nokia brought Fast Mile CPE on spot for exhibition, Nokia FastMile offers guaranteed speeds and easy-to-install residential devices (Fast Mile CPE), providing higher capacity by utilizing advanced antenna topology and interference mitigation technologies.



3D-MIMO Measurements @ R&S

3D-MIMO combines beamforming in both horizontal and vertical planes together with MIMO spatial multiplexing. The 3D-MIMO array is comprised of over 100 elements (transceivers plus antennas) that can significantly increase the network capacity with reducing the energy consumption of the network. The integrated nature of the 3D-MIMO array presents new challenges for antenna and transceiver measurements.



S-Parameters: 3D-MIMO Mutual Coupling Measurements

Due to the mutual coupling that occurs between neighboring antenna elements, a vector network analyzer that can simultaneously measure all antennas in a 3x3 grid is critical for antenna array optimization for 3D-MIMO. The R&S® ZNBT can measure up to 24 simultaneous ports and can be further extended to 288 ports using a 2x24 R&S® ZN-Z84 switch matrix. This allows significantly faster measurements of 3D-MIMO antenna arrays compared to a more traditional 4-port VNA (90% faster).

Over-the-air: Beamforming

R&S has developed a new near field technique together with leading universities that samples the near field much faster than a static measurement (40 times faster at 6 GHz). R&S is extending this technique to make CPRI-free 3D-MIMO radiation measurements where direct access to the DUT digital IQ data is not required. Extending the frequency further up to the E-Band, R&S can perform dynamic beamtracking measurements from the 3D-MIMO array using receive antenna arrays up to 3000 elements.

OTA Transceiver Calibration

In addition to traditional OTA measurements of antenna radiation patterns, R&S can measure the performance of individual or multiple transceivers inside the 3D-MIMO array. For example, providing a stimulus signal from a R&S®SMW200A signal generator and using the R&S®FSW signal analyzer, the Error Vector Magnitude of the transceiver can be analyzed, alleviating the need for difficult conductance measurements inside a 3D-MIMO array. The variety of available signal sources like LTE/LTE-A and 5G waveform candidates and up to 2GHz bandwidth support ensures comprehensive verification capabilities for 3D-MIMO systems in sub-6GHz and mmWave frequency bands.

World's First 3.3GHz to 3.4GHz TD-LTE E2E System in Live Demo at GTI

China Mobile and Huawei jointly announced the inaugural demonstration of the first end-to-end (E2E) TD-LTE system operating over the 3.3GHz to 3.4GHz frequency band at the Global TD-LTE Initiative (GTI) workshop in Shanghai. The demonstration system was developed with the integration of the Huawei's newly modified commercial 3.5GHz TD-LTE products, which currently are widely deployed worldwide. The system reveals that the industry chain of the spectrum for IMT identified by the World Radio-communication Conference 2015 (WRC-15) is maturing.



China Mobile and Huawei jointly completed the world's first 3.3 GHz to 3.4 GHz TD-LTE E2E system

The most remarkable achievement in spectrum identification for IMT at WRC-15 held in Geneva in November 2015 was the establishment of the contiguous 300 MHz C-Band spectrum. Originally, the 3.4 GHz to 3.6 GHz frequency band for IMT was available around the world. After the 3.3 GHz to 3.4 GHz frequency band was identified in 45 countries in regions such as Africa, Latin America, and the Asia Pacific, continuous spectrum was achieved in these countries. This will significantly reduce the spectrum pressure on operators confronted with a huge increase in network traffic. The adoption of the contiguous spectrum allocations and carrier technologies affords operators the capability to provide a better user experience.

Currently, all commercial systems that operate on C-Band incorporate TD-LTE technologies, due to the TDD multi-antenna technology's advantages of improving spectral efficiency for high frequency bands. Recently, Nigeria, South Africa, and other countries proposed the arrangement of 3.3 GHz to 3.4 GHz for TDD at the WP5D conference. The China Communication Standards Association (CCSA) also actively promotes the research and IMT identification in 3.3-3.4GHz in China.

GTI is committed to the advancement of consistent C-Band spectrum planning around the world, and the 3.5 GHz Interest Group established in 2013 has quickly accelerated industry chain maturity. More than 40 global operators, with over 60 commercial terminal models, currently integrate commercial and pre-commercial network deployments on the 3.5 GHz band. GTI will continue to cooperate with global industry partners to promote C-Band TDD-oriented planning and contribute to further implementation at the national level and into the international standardized organization 3GPP specifications.

ZTE Releases Pre5G White Paper at MWC Shanghai

On June 28, at Mobile World Congress (MWC) Shanghai 2016, ZTE officially released the Pre5G: Building the bridge to 5G white paper, aimed at enhancing the performance and capabilities of 4G networks through providing 5G-like experience on existing networks and implementing a comprehensive evolution to 5G.

ZTE Pre5G involves, not only the application of key 5G technologies with commercial capabilities (for example, Massive MIMO) on 4G networks, but also the enhancement of LTE-A Pro technologies in 3GPP architecture. Additionally, it involves multiple 5G development technologies, such as Massive CA, UDN, 256QAM, LAA, LWA, and NB-IoT.



As the bridge from 4G to 5G, Pre5G focuses on the following three fields: enhanced mobile bandwidth, IoT and cloud networks. ZTE has provided a comprehensive NB-IoT solution for the rapidly increasing IoT requirements in multiple vertical industries, constructing an IoT ecosystem and exploring innovative applications. Pre5G networks will begin with IaaS (virtual-network-based function), gradually developed to PaaS (open and programmable network), and finally achieve XaaS (fully open network capability) to support end-to-end 5G sliced networks and service innovation.

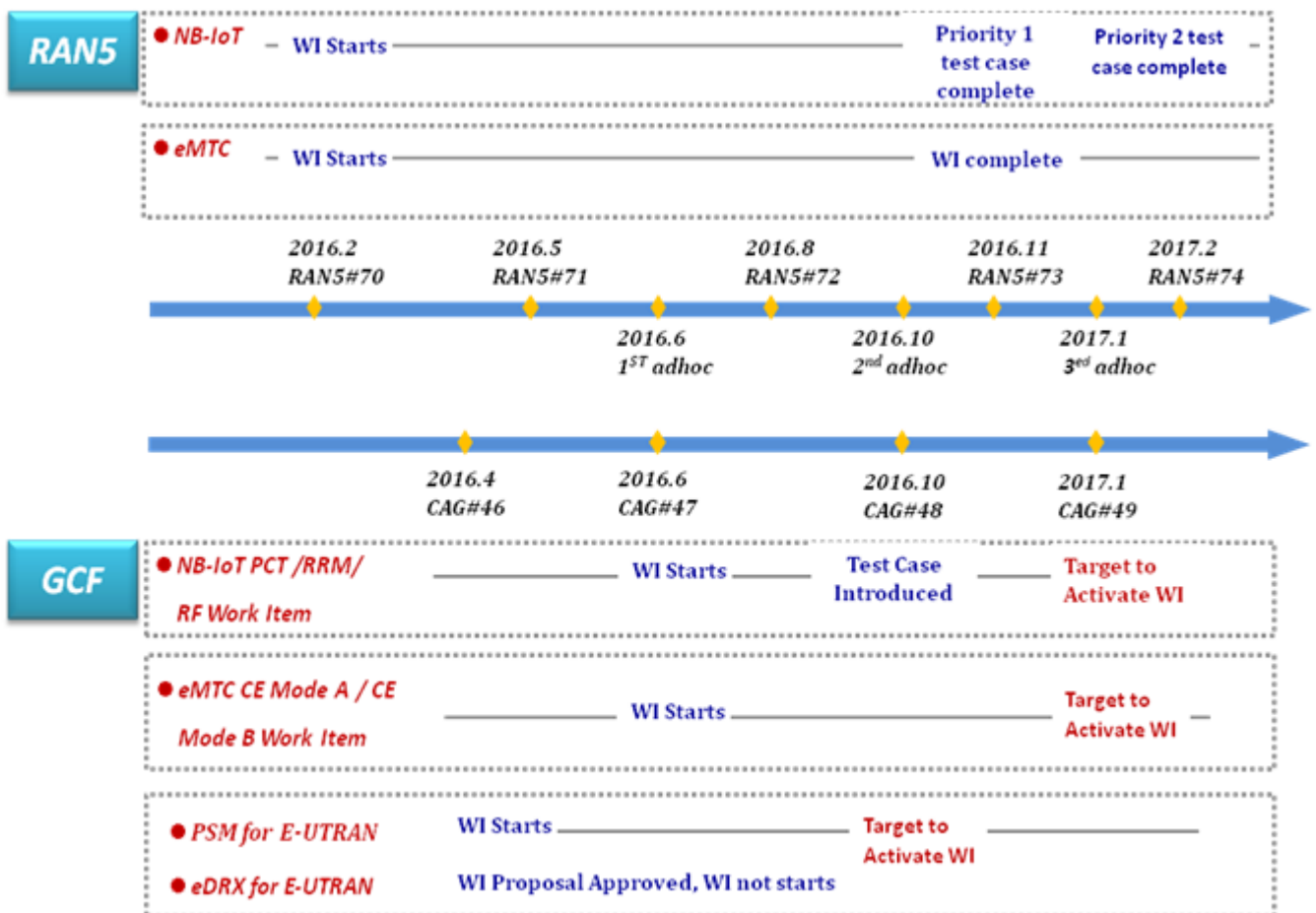
ZTE has partnered with many domestic and overseas customers, aiming to provide the best solution. Pre5G Massive MIMO has been successfully deployed to many telecom operators in China, the Asia-Pacific region and Europe.

Progress of CloT Testing and Certification Standard

CloT as a new network for IoT applications defined in 3GPP, can provide large indoor coverage, massive connections, ultra-low device cost, low device power consumption and optimized network architecture. NB-IoT and eMTC were introduced in 3GPP Rel-13.

The core specifications of eMTC were completed in March and core specifications of NB-IoT were completed in June 2016. Subsequently NB-IoT and eMTC testing work items were introduced by China Mobile and Ericsson in February, which are to be completed in December this year. Due to the urgent industry needs three adhoc meetings are planned to speed up CloT standard progress and TTCN development.

GCF, aiming at CloT test platform validation and device certification, approved NB-IoT and eMTC certification work items in June. To facilitate NB-IoT test industry three sub work items were set up to cover RF/Demodulation test, RRM test and Protocol test. eMTC work items include CE Mode A and CE Mode B. The interested companies are engaged into NB-IoT and eMTC testing and certification work to activate these items in Q1 2017.



The Explosion of IoT Devices Ask for New Carrier Acceptance Testing Solutions (1)

Latest 3GPP developments like eMTC and NB-IoT will allow mobile operators to support their customers in the migration of 2G/3G powered IoT services to the 4G world and will enable operators to address much bigger share of the wireless IoT communication market, especially in the attractive market of low power sensor networks. Based on a GSMA report /1/ presented at the MWC in Shanghai we can expect alone in China one billion connections by 2020, with the majority using Rel.13 technologies like NB-IoT, eMTC and EC-GSM-IoT. Connecting these massive number of devices to the network is a technical challenge as such, but having in mind that these are most probably a million of different IoT devices with quite diverse communication behavior brings a new challenge on the table.

In the early days of mobile broadband networks some mobile operators facing serious problems with devices and applications causing very high signaling load, in some cases resulting in total network outages. In order to avoid such scenarios operators require the test of devices not only on the RF and protocol level but also on the application level. For smart devices like phones and tablets the traffic characteristics and network behavior of main services like calling, messaging, browsing or streaming are well known, but who would predict the behavior of IoT applications? They are very different by nature and the behavior strongly depend on the specific implementations. Therefore testing of IoT devices and applications is a main requirement of mobile operators in order to guarantee network friendly operation as well as to ensure the desired performance and quality. Some mobile operators are doing this already for years, but the potentially huge amount devices to be tested in the future for more efficient solutions. Interestingly some operators are still executing these tests in a real network environment instead of using e2e network emulators with extensive measurement and analysis functionalities.

Using test equipment like the R&S®CMW290 as well as predefined test cases and scenarios allow very efficient and easy repeatable testing as it will be required for the IoT carrier acceptance testing of the future.

The R&S®CMW290 is another member of the well-established R&S®CMW platform from Rohde & Schwarz and supports cellular and non-cellular standards.

The Explosion of IoT Devices Ask for New Carrier Acceptance Testing Solutions (2)

The R&S®CMW290 can simulate a cellular network and set up a connection between the IoT device application and the IoT application server in the cloud. This allows to check the correct functioning in a well-defined network. Additional options such as IMS server, audio or eCall/ERA-Glonass functionality are also available for the R&S®CMW290 and round out the IoT test solution, offering an excellent price/performance ratio.



Figure : Using R&S®CMW290 for e2e application testing to check network-friendly behavior and performance in carrier acceptance testing in an R&S®TS290 test system

Therefore the R&S®CMW290 is the perfect platform to perform carrier acceptance testing for IoT devices using predefined operator test cases as provided by the R&S®TS290. Besides test cases defined by specific operators the GSMA has defined so called IoT device connection efficiency test cases /2/ which comprise four categories of testing: IoT device application tests, communication module tests, connection efficiency tests, and radio policy manager tests.

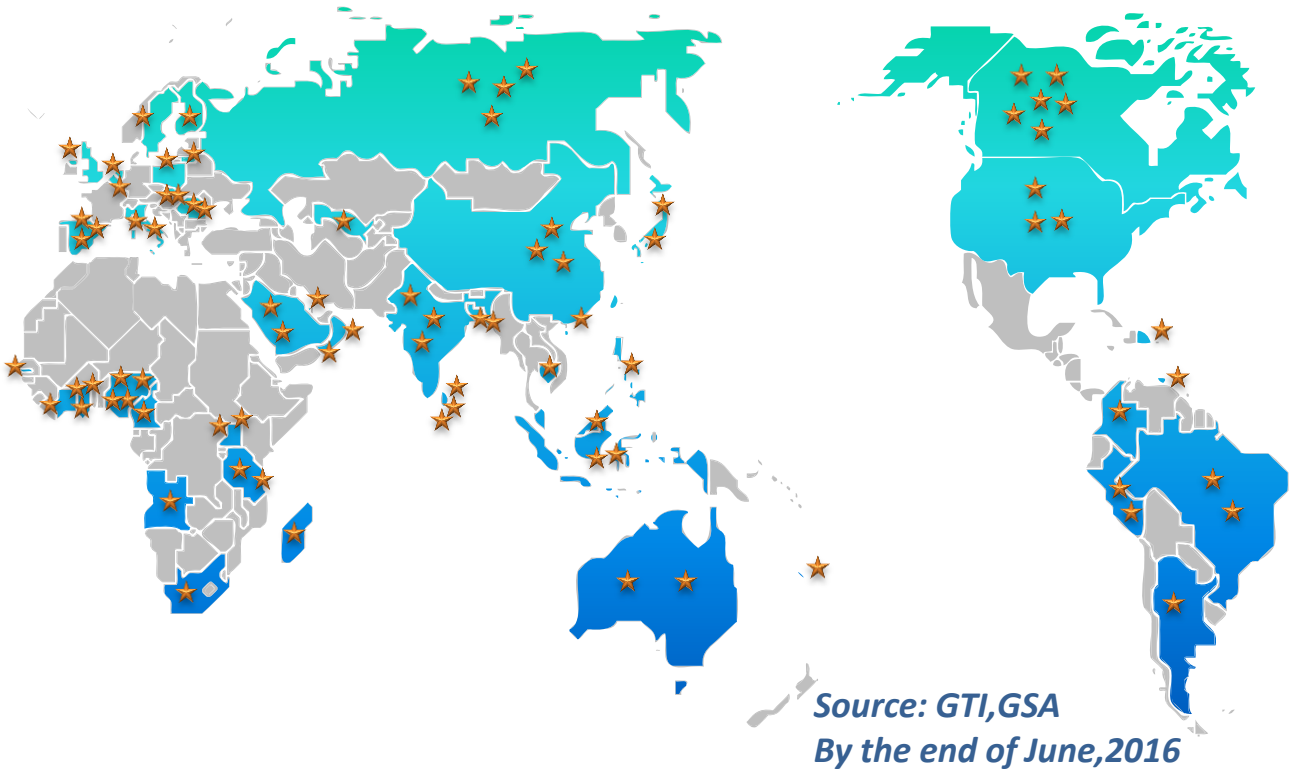
Rohde & Schwarz supports IoT carrier acceptance test cases with the new IoT test system R&S®TS290 in order to help operators as well as application and device developers to perform all necessary tests and measurements to bring IoT applications to market as quickly as possible – with the desired quality and performance.

TD-LTE Global Market Overview

Global Deployment as the Mainstream Mobile Broadband Technology

82 TD-LTE commercial networks have been launched

Additionally, over **92** TD-LTE commercial networks are in progress or planned



LTE Multi-mode Multi-band Terminals Have Reached Full Maturity

**455+ suppliers have launched 3689+ TD-LTE terminals,
including 2830+ TD-LTE Smartphones.**

TD-LTE Device Type	Quantity	TD-LTE Device Type	Quantity
USB modems	118	Smartphones	2830+
MiFi/CPE	548	Mobile Tablets	103

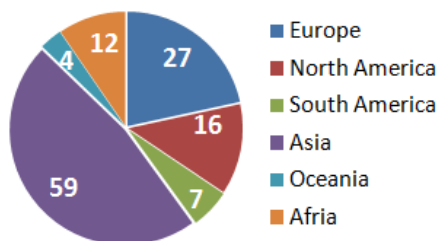
*Source: GTI, GSA, TDIA

*Note: Four Main Types
Of The TD-LTE Terminals

GTI Development Overview

125 Operators and 129 Partners Joined GTI by July 2016

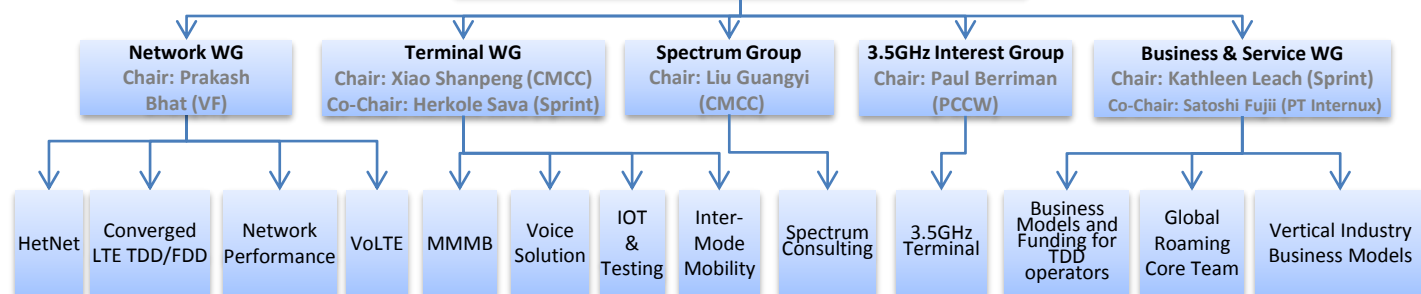
125 Operators



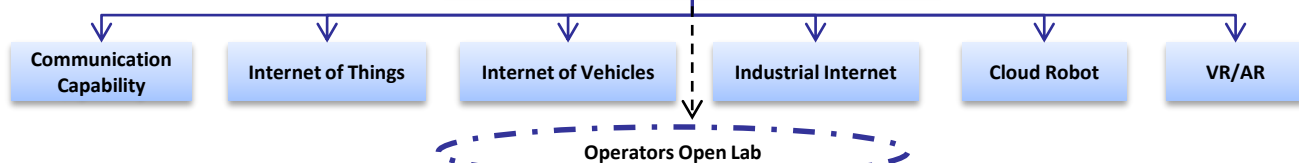
129 Industry Partners



GTI TD-LTE Technical & Product Work



5G Innovation Program



GTI Activities

	2016	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sept/Oct	Nov/Dec
Summit		Time: 23 rd Feb. (MWC) Venue: Barcelona, Spain GTI Summit		Time: 29 th Jun. (MWCS16) Venue: Shanghai, China GTI Summit			
Workshop		Time: 18 th -19 th Feb. (MWC) Venue: Barcelona, Spain The 15 th GTI Workshop	Time: 15 th Apr. Venue: Beijing, China 5G Technology and Testing Workshop	Time: 26 th -27 th Jun. (MWCS16) Venue: Shanghai, China The 16 th GTI Workshop		Time: 28 th - 29 th Nov. Venue: Osaka, Japan ➢ XGP Forum 20th anniversary Event & 2016 Japan China TDD Forum ➢ The 17 th GTI Workshop	Time: 14 th . Nov. Venue: Bangkok, Thailand 4G Towards 5G – TDD Spectrum Workshop
Vertical		Time: 19 th Feb. (MWC) Venue: Barcelona, Spain NB-IOT Ad-hoc	Time: 28 th Jun. (MWCS16) Venue: Shanghai, China IOV Ad-hoc	Time: 27 th Jun. (MWCS16) Venue: Shanghai, China C-IoT Ad-hoc	Time: 11 th Oct. Venue: Frankfurt, Germany V2X Workshop	Time: TBD (24 th -25 th), Nov. Venue: Tokyo, Japan ➢ IOT Ad-hoc ➢ IOV/Robotics/Ad-hoc	
Exhibition		22 nd -25 th Feb (MWCS16) Barcelona, Spain	15 th Apr Beijing, China	23	29 th Jun-1 st Jul (MWCS16) Shanghai, China		14 th -17 th Nov (ITU Telecom World) Bangkok, Thailand

Appendix 1 – Welcome to Join GTI (to operators)

More Information about GTI

To find out more information about GTI, please visit <http://gtigroup.org> or email us.

How to Join GTI

GTI Operators (with TDD Spectrum)

1. Fill out the application form (download from <http://gtigroup.org/joinUs.html>), and return to GTI Secretariat: GTI_Secretariat_list@lte-tdd.org and/or GTI@lte-tdd.org;
2. Sign the Accession Form and return the signed copy to 5 initiators;
3. Once the participation process finishes, a GTI website account and associated password will be assigned to the new participant.

GTI Observers (without TDD Spectrum)

1. Fill out the application form (download from <http://gtigroup.org/joinUs.html>), and return to GTI Secretariat: GTI_Secretariat_list@lte-tdd.org and/or GTI@lte-tdd.org;
2. Sign the declaration form and return the hard copy to GTI Secretariat;
3. Once the participation process finishes, a GTI website account and associated password will be assigned to the new participant.

Appendix 2 – Welcome to Join GTI Partner Forum (to non-operators)

More Information about GTI Partner Forum

*To find out more information about GTI and GTI Partner Forum,
please visit <http://gtigroup.org> or email us.*

How to Join GTI Partner Forum

1. Fill out the application form (download from <http://gtigroup.org/joinUs.html>), and return to GTI Secretariat:
GTI_Secretariat_list@lte-tdd.org and/or GTI@lte-tdd.org; GTI Secretariat and Working Group Chairmen will review;
2. Sign the Declaration Form and return the signed hard copy to GTI Secretariat;
3. Once the participation process finishes, a GTI website account and associated password will be assigned to the new participant.

CONTACT GTI:

If you have any questions, comments, suggestions regarding TD-LTE or general enquiries regarding GTI, please contact:

GTI@lte-tdd.org