

TD-LTE Industry Briefing

April 29, 2016 | No. 27

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GTI Successfully Held GTI Summit in Barcelona

GTI 2.0 was officially launched in GTI Summit 2016 Barcelona

GTI Summit 2016 Barcelona, organized by GTI and supported by GSMA, was successfully held on February 23rd 2016, at Mobile World Congress (MWC) 2016 in Barcelona.

With the support and guidance of 5 Chairmen/CEOs from top operators, Mr. Sunil Bharti Mittal (Founder and Chairman of Bharti Enterprises), Mr. Shang Bing (Chairman of China Mobile), Mr. Masayoshi Son (Chairman & CEO of SoftBank Group Corp), Mr. Chang-Gyu Hwang (Chairman and CEO of KT) and Mr. Vittorio Colao (CEO of Vodafone Group Plc), GTI 2.0 was officially launched at the summit.



Leadership Speech



Mr. Craig Ehrlich
Chairman
GTI

'GTI is stepping into a new phase—GTI 2.0: GTI will continue to work in the task forces and working groups to ensure complete cooperation compatibility at every level with TDD and FDD. GTI will start to focus on 5G area, working closely with all the other 5G organizations to promote 5G development.'



Mr. Masayoshi Son
Chairman & CEO
SoftBank Group Corp

'Since 2011, GTI has made great achievements through its 5 years' effort. TD-LTE has become a global standard that so huge numbers of people are using. Today, I also expect GTI 2.0 continues to promote the evolution of technology to meet the requirements of 1 million times growth of mobile data traffic in next 30 years.'



Mr. Sunil Bharti Mittal
Chairman
Bharti

Bharti Airtel is delighted to be a part of GTI 2.0. We have led the roll-out of TD-LTE in India and are confident that it will emerge as the preferred standard for evolving mobile technologies. We look forward to collaborating with the consortium partners towards developing technology ecosystem for the future and help build a digitally inclusive world."



Mr. Zhao Houlin
Secretary-General
ITU

'I witnessed the establishment of GTI in 2011 and affirmed the important contribution of GTI in the past five years for LTE global commercialization and TDD/FDD convergence. Now, GTI 2.0 is kicked off at this conference. I expect GTI to make greater contributions to the further LTE evolution and 5G development in the future.'



Mr. Shang Bing
Chairman
China Mobile

'China Mobile will fully support GTI 2.0 objectives. We will work closely with GTI partners to further promote TD-LTE evolution, global deployment and propel 5G development and joint innovation to embrace the new era of 'Everything Connected.'



Mr. Mats Granryd
Director General
GSMA

5G is promising higher speed and lower latency. And I am pretty sure it will be the corner stone of the next generation of hyper connected society. And it is a whole ecosystem that now being developed around 5G. I hope we will continue to see innovation and collaboration in order to drive the speed and low latency applications because now we are at the forefront on building a hyper connected society."

GTI Successfully Held GTI Summit in Barcelona

China Mobile Launched 5G Innovation Center



At the GTI Summit 2016 in Barcelona, China Mobile officially launched China Mobile 5G Innovation Center jointly with its first 11 partners, aiming to propel 5G development.

China Mobile 5G Innovation Center will focus on Communication Capability, Internet of Things, Internet of Vehicle, Industrial Internet, Cloud Robot, VR/AR and other fields in the evolution from 4G to 5G. Working closely with partners in the telecom industry, Internet industry and vertical industry, China Mobile 5G Innovation Center will drive the maturity of end-to-end communication capability, promote the development of 5G innovation applications and build a win-win cross-industry ecosystem.

Release of VoLTE\CA Cost-effective Chipsets and Smart Phones

China Mobile released \$50 VoLTE smart phone solutions with Spreadtrum & Leadcore, and \$100 VoLTE & CA smart phone solutions with Qualcomm & Mediatek at GTI Summit 2016.

China Mobile released 3 smart phones of its own house brand, including an entry-level VoLTE smart phone - A1s, the first smart phone supporting TDD uplink CA - A2, and six-mode smart phone – N2.

China Mobile and Samsung jointly released 5 VoLTE\CA customized smart phones, including Galaxy J5, J7, A5, A7 and S7.



GTI 2.0

Targets TD-LTE Evolution and 5G Development

With a new 5-year strategic plan and mission, GTI 2.0 aims to continue to promote the TD-LTE Global development and to foster a cross-industry innovative and synergistic 5G ecosystem by establishing 5G Innovation Program.

GTI 1.0
2011 ~ 2015



GTI 2.0
2016 ~

We become

- ◆ Influential player across the mobile community
- ◆ Global presence with operators and key vendors

Move forward

- ◆ 4G Development
- ◆ 5G R&D and Commercial Preparation
- ◆ Cross-industry Opportunity

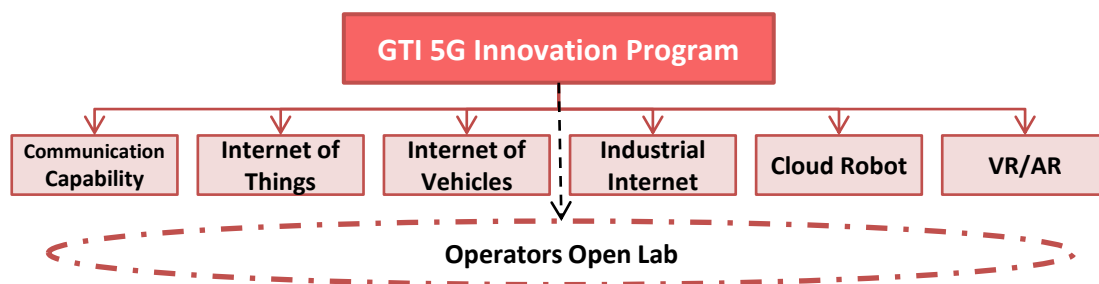
GTI 2.0 Mission

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



GTI Leaders Committee Members

GTI Leaders Committee was set up with 5 leading operators' Chairmen/CEOs as members to provide strategy guidance to GTI 2.0 development.



Sunil Bharti Mittal
Founder and Chairman
Bharti Enterprises



Shang Bing
Chairman
China Mobile



Chang-Gyu Hwang
Chairman & CEO
KT



Masayoshi Son
Chairman & CEO
SoftBank Group Corp



Vittorio Colao
Chief Executive
Vodafone

China Mobile 5G Innovation Center: Collaboration for A Fantastic 5G World



Around the 6 key work areas, several Open Labs will be set up to conduct the research and innovation. Bringing together leading industry partners with a shared vision, China Mobile 5G Innovation Center is dedicated to building a cross-industry ecosystem and win-win cooperation.



'In order to catch the significant opportunity brought by 5G, I believe what's most important is to innovate and collaborate. Traditional communication industry and vertical industry should change from innovation of its own to cross-industry synergy, then we can jointly expand 5G new markets, explore new applications and embrace the transformative 5G world.' — Mr. Li Zhengmao, EVP, China Mobile

GTI

5G Innovation Program

Capture requirements



Release achievements



China Mobile 5G Innovation Center

13 Partners in China Mobile 5G Innovation Center



NOKIA

ZTE



QUALCOMM



KEYSIGHT TECHNOLOGIES

ROHDE & SCHWARZ

Haier

Hisense

6

SGAI 北京首钢自动化信息技术有限公司
BEIJING SHOUGANG AUTOMATION INFORMATION TECHNOLOGY CO., LTD

15th GTI Workshop Continued with Trending Topics

The 15th GTI (Global TD-LTE Initiative) Workshop took place during Feb 18-19, 2016 in Barcelona, Spain, gathering more than 150 industrial leaders and experts from 30 operators and 33 industrial partners and organizations to share latest progress and discuss key issues about LTE-A/TDD+, LTE Global Phone, 3.5GHz, TD-LTE UL Enhancement, Roaming, and Business & Financial Models.



In addition, operators and vendors also presented NB-IoT Ad-hoc for the first time from aspects of the market status, network, device and open lab, which provoked intense discussions on common concerns.

GTI Awards 2015 were Presented at GTI Night

GTI Awards were presented at the GTI Night 2016 held on Feb 23rd, 2016 during the Mobile World Congress (MWC) in Barcelona. More than 100 high-level representatives from global operators, industry partners and organizations attended the event.

7 industrial partners specializing in various areas including network, device, testing equipment, chipset and module won awards on ‘innovative technical product’ and ‘innovative solution and application’. Besides, 4 operators were granted awards of ‘market development’ for their significant accomplishment in promoting TD-LTE and LTE TDD/FDD global deployment.

Award Category	Winner
Innovative Technical Product	Huawei
	Qorvo
	Qualcomm
	Rohde&Schwarz
Innovative Solution and Application	Ericsson
	Huawei
	Nokia
	ZTE
Market Development	Optus
	Sprint
	STC
	Vodafone

Founded in 2012, the GTI Awards program aims to acknowledge achievements and success of industry players in TD-LTE ecosystem across a wide range of market segments. GTI Awards 2015 intends to recognize outstanding contributions in promoting TD-LTE development and its evolution, and encourage the development of innovative products, solutions and applications that address challenges faced by GTI operators.

Antenna Selection and Optimization for Small Cell Networks



Using a radio's integrated antenna is convenient, but it will require a larger site count, and will only offer mediocre network performance

Abstract

The careful choice of antennas improves network performance while decreasing overall capital investment. Using a radio's built-in antenna is an easy option, but more careful network planning shows an external antenna can reduce overall site count and significantly improve the experience of mobile network users. In this paper, the InfoVista networking planning tool is used to build two small cell networks in an identical downtown area, one using the radio's integrated antenna, and the other using a carefully chosen high performance external antenna. A site count reduction of 20%+ is gained using the external antenna, and data rate improvements of up to 20% across the network are achieved even when using the lower site count.

Small cell sites typically utilise a radio which can be mounted on existing street furniture. This reduces the need for complex site acquisition and planning permissions, and capacity can be located where it is most needed.

Small cell radios typically come supplied with an integrated antenna, with the option to add an external antenna if required. The integrated antenna is low gain and fixed tilt, but it can simplify mounting and planning issues. However, adding an external antenna of choice can significantly improve performance, and it will reduce the overall network site count.

Furthermore, choosing an external antenna with variable tilt allows the extent of an antenna signal within a cell to be controlled, and this will limit interference into adjacent cells. This is difficult using fixed tilt antennas, as there is no easy means to adjust the antenna beam area, and different locations will ideally need different tilt settings. For example, in dense areas you need more down tilt to make the cell smaller and to get optimal data throughput. Variable tilt antennas are a solution to this problem, and therefore they improve the overall customer experience and put control back into the hands of network operators.

The purpose of this white paper is to illustrate the improvements in both site count and network performance that can be achieved by using external antennas rather than the integrated ones supplied with the radio.

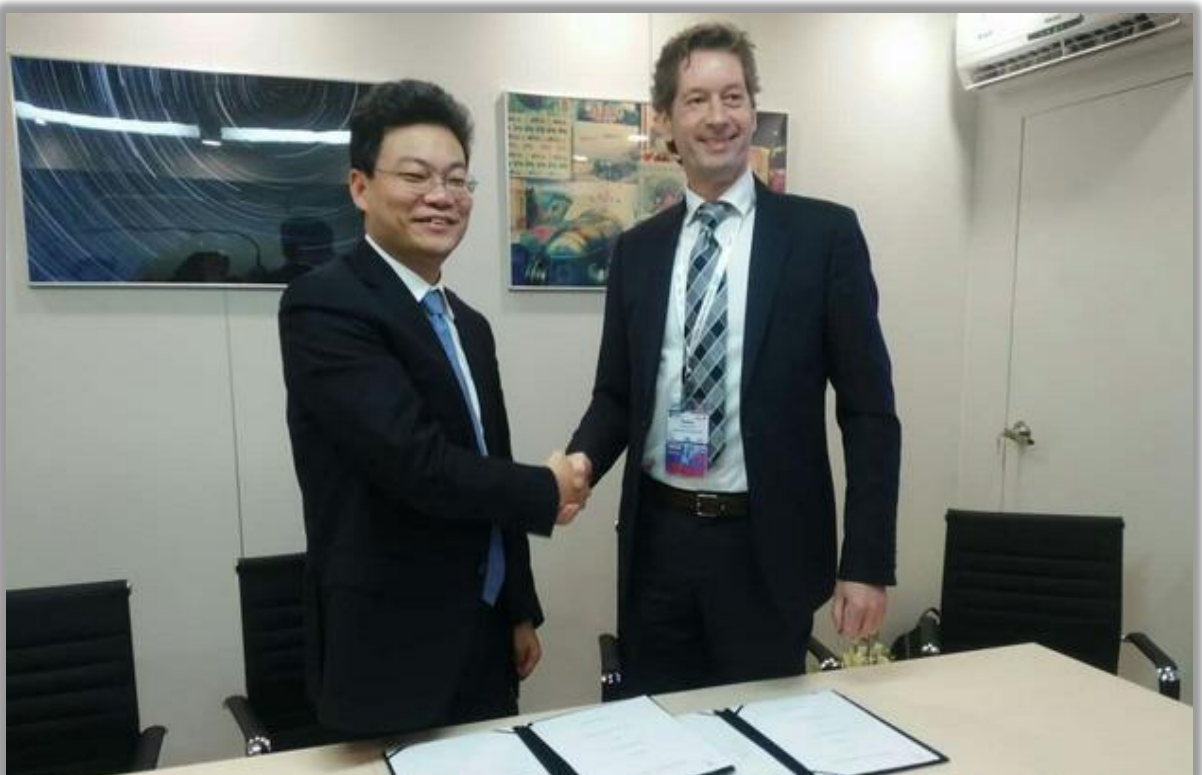
For detailed information, please visit:

<http://www.alphaantennas.com/Docs/Public/ASAOFSCN1.pdf>

Drei to Build the European First Massive MIMO Trial

Hutchison Drei Austria (“Drei” for short) has recently penned a memorandum of understanding with ZTE on the Pre5G Massive MIMO cooperation, with the aim to build the first Pre5G trial in Europe, marking a milestone of ZTE in carrying out its Pre5G/TDD+ strategy into commercial application.

Hutchison Telecom is an international operator whose business covers the UK, Italy, Austria, Denmark, Australia, Hong Kong, Indonesia and other countries and regions. It is also the pioneer of global mobile broadband communications. Drei is its wholly owned subsidiary. Since 2011, the networks of Drei constructed solely by ZTE have been evaluated many times as the best networks in Austria for their excellent performance.



Matthias Baldermann, CTO of Drei, noted:“ Hutchison Drei Austria will continue to explore new technologies to provide our users with the best possible experience. We see that Pre5G can better meet the growing demand of users. The cooperation with ZTE is very meaningful and we are looking forward to it.”

GSMA Awards for ZTE Pre5G Massive MIMO and the Leading Position of TD-LTE

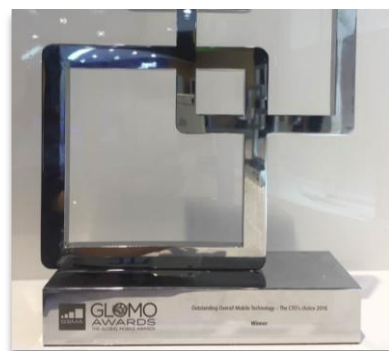
At the MWC 2016, ZTE won the Best Mobile Technology Breakthrough award and the Outstanding Overall Mobile Technology – the CTO's Choice 2016 award for its Pre5G Massive MIMO technology. Among many roads to 5G, TD-LTE has further established its leading position. The technological breakthroughs and commercial prospects of the Pre5G Massive MIMO are highly recognized by CTOs of global operators.



The MWC sponsored by the GSM Association (GSMA) is the world's most influential gathering in the mobile communications industry, and the GSMA's Global Mobile Awards represent the highest honor in this industry. ZTE has promoted the application of core 5G technologies meeting commercial conditions on 4G networks, effectively alleviating the pressure of data traffic surge on telecom operators before standardization of 5G technologies, thereby attracting a great deal of attention from the whole industry. The Pre5G Massive

MIMO technology solves the problems of capacity demands surge and insufficient site resources in existing networks. In a commercial network, the average single-carrier peak rate of Pre5G Massive MIMO exceeds 400 Mbps, increasing spectral efficiency by four to six times as compared with that of existing 4G networks. With the Pre5G Massive MIMO technology, multiple 4G users can enjoy 5G-like experience on LTE UEs within a space simultaneously without interfering with each other.

Since September 2014, ZTE and China Mobile have conducted a series of pre-commercial tests on existing terminals. These tests have proved that Massive MIMO base stations can effectively improve vertical and intensive coverage, with an outstanding performance in intensive coverage in high-rise buildings and hotspot macro coverage. In addition, ZTE has signed Pre5G/5G cooperation agreements with many operators. The Pre5G Massive MIMO technology is expected to be commercially available on a large scale in the global market in 2016, and will bring great advantages in the commercial environment.



Linkem to Deploy “Top-Down” 3.5G LTE-A Network in Rome

In February 2016, Linkem of Italy announced its plan at the Mobile World Congress to work with ZTE Cooperation in building a 3.5G LTE-A-based TD-LTE network in Rome. This will be the first fixed wireless network in Italy and also the world's largest 3.5GHz fixed wireless network in a single city.



Linkem is a leading wireless broadband operator in Italy. Its 3.5GHz network covers the entire Italy to provide individuals and businesses with wireless data services. To fully protect the historical architectures in Roman, the network is deployed in "top-down" mode, which means that the network infrastructure is not built by digging into the ground, but deployed on existing sites of Linkem.



CEO of Linkem said: "The construction of the TD-LTE network is significant for meeting the government's goal of high-speed broadband access in Digital Agenda 2020." He also expressed the hope of overtaking other operators through the wireless broadband solution provided by ZTE, and Rome means a lot in the competition.

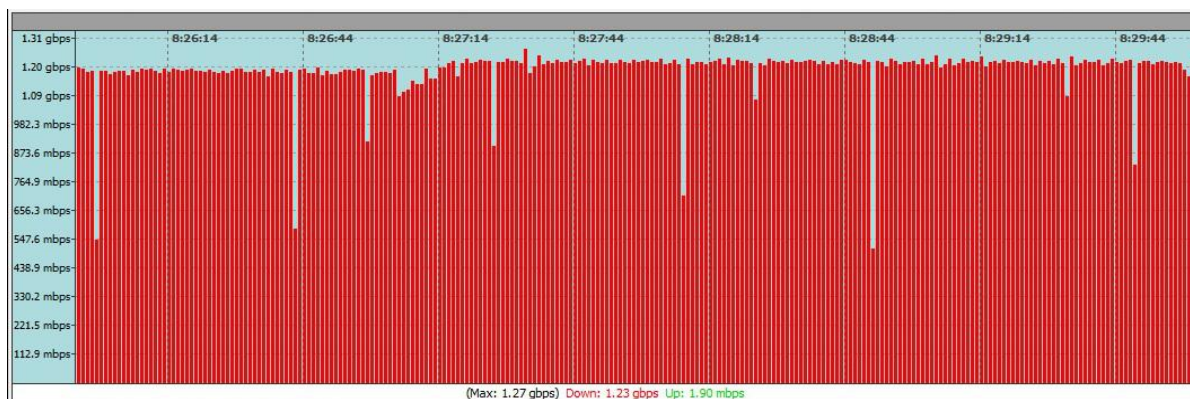
Optus Completes 4.5G Live Network Trial, Achieves 1.23Gbps Download Speeds

Optus (Australia) recently completed a live trial of 4.5G technology resulting in peak download speeds of 1.23 Gbps over the air, and 1.41 Gbps in a cabled scenario.

The successful trial at one of Optus' "Gigasites" in Newcastle aggregated five 20MHz carriers of Optus' TDD spectrum (100 MHz total), and also utilised 4x4MIMO and Higher Level Modulation (256QAM) technologies to enable even higher peak data rates.

Collectively, these technologies are known as LTE-Advanced Pro or "4.5G", and in the trial achieved a peak download speed of 1.23Gbps over the air in live network conditions. Optus used three 20 MHz carriers of its 2300 MHz spectrum, coupled with two 20 MHz carriers of its 3500 MHz spectrum.

Dennis Wong, Optus Networks acting Managing Director said "We continue to utilise our network and spectrum assets to test our network of the future and prepare for 5G. By 2020, 5G will be here and we are committed to identify ways to prepare our network to support this new technology and further improve customer experience".



1.23Gbps peak download speed achieved, as reported in the network monitoring tool

The successful trial is a result of continued innovation and partnership between Optus and Huawei that commenced with the announcement of the world first Gigasite in 2013.

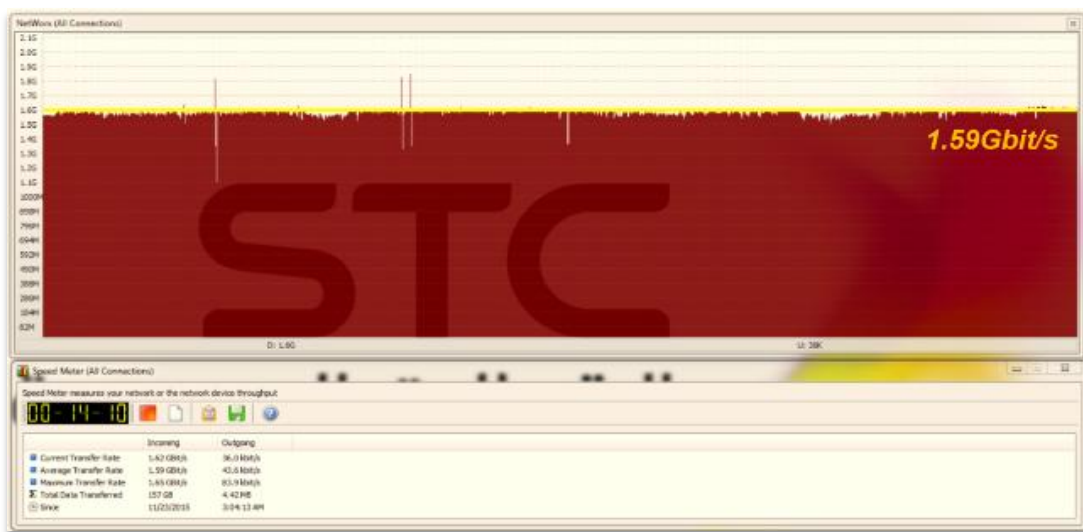
"This field trial in Newcastle is a first and important milestone as a direct result of our local investments in R&D here in Australia. This joint trial represents a significant advance toward fulfilling Huawei's & Optus' commitment to developing 4.5G technology in Australia," James Zhao, Huawei Australia CEO said.

David Wang, President Huawei Wireless Networks said "4.5G and related technologies are the future of our increasingly digitalized world. Huawei together with Optus will strive to foster an open and a better connected Australia."

The continued work on 4.5G, evolving towards 5G technology leverages on the Memorandum of Understanding (MoU) on joint R&D that Optus parent telco Singtel signed with Huawei in 2014.

Huawei Helps STC Complete its First Demonstration of a New 4.5G in the Middle East, Europe and North Africa

Huawei together with Saudi Telecom Company (STC) announced that it has successfully demonstrated the latest 4.5G (TDD+) Technologies, achieving unprecedented network throughputs. This remarkable achievement will enable STC network to deliver the fastest LTE data rates in the Middle East, Europe and North Africa. STC proved, for the first time, that its network will be capable of delivering tremendously higher user throughput, exceeding 1.59 Gbps, as part of its 4.5G network development.



Since its introduction, STC 4G network has witnessed tremendous growth in data traffic, coupled to sharp rise in the number of LTE subscribers and high utilization of the network. This necessitated the need to increase the data throughputs in the network. The use of data hungry applications has also fuelled the need for much higher rates and network capacity.

This achievement demonstrates STC's high-tech network capabilities, following its first LTE-Advance announcement in January 2014. Now, and as a new milestone, STC once again presents the first successful 4.5G (TDD+) trial delivering network speeds that have not been possible until now. This will contribute to the increase in STC's market capabilities in the Kingdom and will support its declared strategy of being first to develop the most advanced network solutions and services to its deserving customers.

This latest outstanding breakthrough in technology capabilities represents another major milestone in both companies long-standing strategic relationship aimed at delivering ever more advanced state-of-the-art telecommunications services.

Huawei and Qualcomm Jointly Demonstrate 4.5G (TDD+) Uplink Technologies

At Mobile World Congress (MWC) 2016, Huawei and Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated, jointly demonstrated 4.5G (LTE TDD+) uplink key technologies, using the Qualcomm Snapdragon™ 820 processor with X12 LTE, and the Qualcomm Snapdragon 652 processor with X8 LTE. Qualcomm Snapdragon is a product of Qualcomm Technologies, Inc. These technologies improve the LTE TDD uplink data transmission rate in typical scenarios by 50% to 100%.

Several 4.5G (TDD+) uplink key technologies, namely UDC, can improve uplink capacity by 50% without adding new spectrum. It accomplishes this by reducing the number of bits transmitted in the uplink channel, which has the added effect of reducing interference.

The combination of uplink carrier aggregation and 64QAM can triple uplink speeds compared to single carrier uplink with 16-QAM.



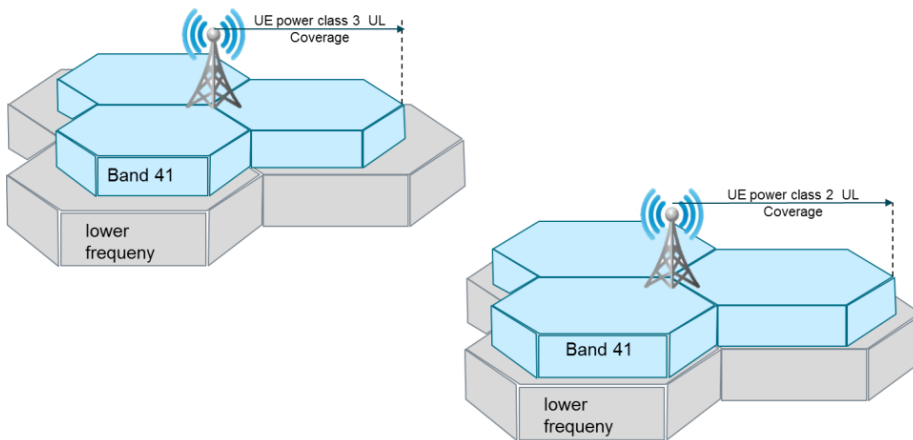
Improved uplink transmission rates provide LTE TDD users with the ultimate user experience, with noticeably improved responsiveness from apps such as WeChat, and various other services including video services. In addition, the Huawei-Qualcomm demonstration is the first ever E2E joint demonstration of 4.5G uplink technology. The commercial smartphones used in the demonstration are equipped with two of the latest Qualcomm Snapdragon processors, indicating the maturity of the 4.5G (TDD+) ecosystem. 2016 will witness the rapid deployment of 4.5G (TDD+) by operators around the world.

As well, the LTE TDD industry could possibly receive a potential additional boost. Recently, a consensus has been reached to have 3.4 GHz to 3.6 GHz frequency bands become globally supported IMT frequency bands based on the conclusion drawn on the World Radio communication Conference 2015 (WRC-15). It indicates that 3.5 GHz band with 500 MHz bandwidth has become the most important IMT frequency band for sub-6G. It is anticipated that three top operators in Japan will deploy commercial networks operating on the 3.5 GHz band on a large scale. With over 6,000 base stations operating on the 3.5 GHz frequency band being deployed by the end of 2016, all hotspot areas in Japan will be covered by 2017, and the penetration rate will reach more than 50% by 2018. The 3.5GHz industry has been growing rapidly due to its wide bandwidth and mature technologies. Qualcomm Technologies' recently-announced Snapdragon X16 LTE modem, which supports the LTE TDD 3.5 GHz bands, can help drive broader adoption and accelerate the growth of the 3.5GHz ecosystem.

High Power UE Category for Enhanced Uplink Coverage in TD-LTE

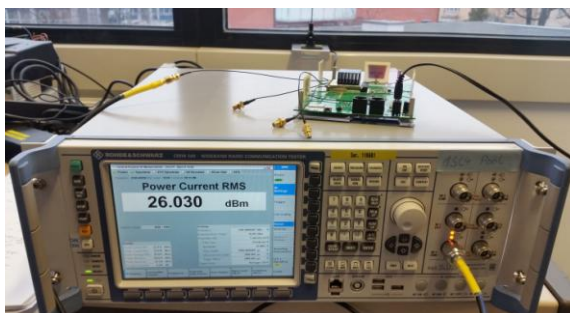
TD-LTE is a technology that is used worldwide and that supports multiple frequency bands. However, compared to the frequency bands used in FDD networks, TD-LTE uses, in general, higher frequencies. Thus, the link attenuation is higher, and this limits the uplink coverage or, in other words, it restricts the maximum cell size in the uplink.

Improved UL performance for coverage is coming, especially in the TDD market. 3GPP has specified a new UE power class 2, supporting 26dBm transmit power, in order to improve the coverage in the uplink. Figure on the left shows such a coverage enhancement, with benefit for users at the cell edge.



LTE support multiple features and permanently evolves by introducing new enhancements, but, for example, if you consider aspects such UL carrier aggregation or 64QAM in the uplink, these two enhancements provide a higher data throughput, but at the cost of a loss of distance or coverage. High power UE, HPUE, is now a strategy to enhance the data throughput at the cell edge. It is applicable only to single carrier operations (i.e. UL CA the same as power class 3 UE) and additionally it is only applicable for TDD Frame Config:1-5 (i.e. only DL/UL Ratio >1). In the case of transmission mode 2 Uplink, it would result in a maximum value of 23dBm per branch transmission. It is expected that this HPUE will be implemented in a way that it is added as a new IE onto UE Capabilities, similar to UTRA FDD capabilities, in the 3GPP protocol.

In current networks, when reaching the cell edge, it is necessary to handover to lower frequency bands TD-LTE networks or even handover into FDD networks, which causes a high overload of signaling. Another aspect is a the larger bandwidth, for example of band 41, which would allow the usage of 3 CC carrier aggregation. Thus, HPUE significantly improves smartphone cell edge user experience and allows users to move from FDD to TD-LTE, or from lower TDD bands to higher frequency TDD bands, in order to benefit from the large bandwidth.



Rohde&Schwarz supports the development of TD-LTE HPUEs supporting power class 2 with its mobile radio testers. A measurement result shows such a high power scenario in a classical RF measurement scenario; the below example with the RMS power measurement in a 20MHz channel bandwidth setup showing a Tx power of 26dBm.

To summarize, HPUE is a promising activity in GTI and will be implemented soon in real devices, in order to enhance the uplink coverage.

In-device Coexistence Interference Analysis Using R&S CMWrun Sequencer Software Tool

The growth in the number of wireless communication modules equipped with multiple RAT transceivers is being driven by the increasing demand of users and the stringent requirements of the new applications and services that require the operation of different RAT in parallel. However, the simultaneous operations of these collocated RAT transceivers result in an adverse effect known as the In-Device Coexistence (IDC) interference issue, where the transmitter of one RAT affects the receiver of another RAT. This generally occurs when two different RAT are operating concurrently in same or adjacent frequency bands, leading to high interference and loss of signal quality. A very common example of such an interference can be observed in the 2.4 GHz ISM frequency band that lies in between the 3GPP frequency bands, resulting in adjacency of operational frequencies with small or no guard band between the two technologies. The WLAN and Bluetooth technologies operate in the ISM band (2400 – 2483.5 MHz), where the lower bound of this ISM band is adjacent to LTE band 40 (2300 – 2400 MHz) operating in TDD mode. And the absence of any guard band between the ISM band lower bound and LTE band 40 causes a great extent of coexistence interference effect in this region. Since the LTE band 40 is working in the TDD mode, the transmitter of the LTE band 40 affects the WLAN and Bluetooth receiver operation and similarly, the WLAN or Bluetooth transmitter affects the LTE band 40 receiver.

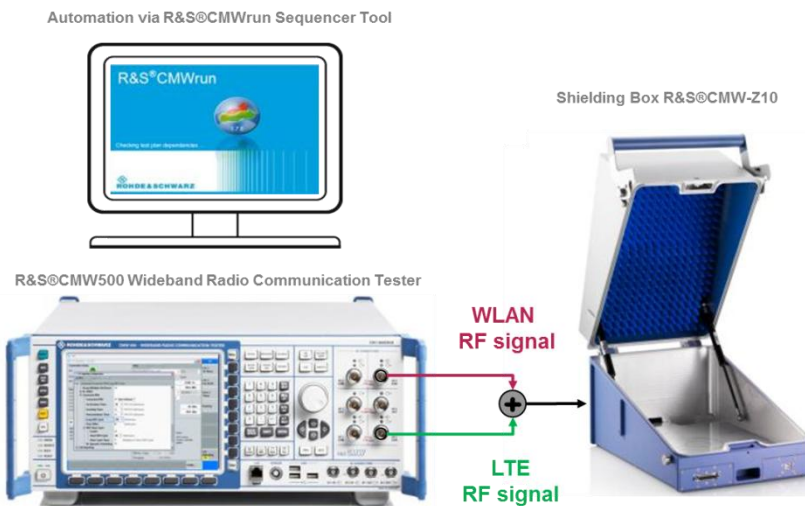


Figure 1: Test setup for performing the IDC measurements

This IDC interference has led to a complicated situation for the different communication standard organizations and device manufacturers. On one side, the device needs to be designed in such a way so as to support the simultaneous operations of multiple RAT, in order to meet the increasing demand of the new applications and use cases. While on the other hand, the issue of IDC interference needs to be resolved, without disrupting the concurrent operations of these RAT. Therefore, it is important to come up with some solutions, which would not only support the parallel operations of the multiple RAT but also mitigate the IDC interference. In order to find such solutions, the first and foremost task would be the analysis and measurement of this interference effect. Rohde & Schwarz, a worldwide leader in the test and measurement industry has come up with an innovative proposal to measure this IDC interference effect using the R&S CMWrun sequencer tool. This tool is an application platform consisting of CMWrun sequencer software tool and other basic set of applications, which is used to connect to the R&S CMW500 wideband radio communication tester and perform all the measurements in an automated fashion. As a result, the IDC interference measurement and analysis can be performed using the R&S CMWrun tool and R&S CMW500 wideband radio communication tester by setting up a prototype test setup as illustrated in Figure 1.

In-device Coexistence Interference Analysis Using R&S CMWrun Sequencer Software Tool

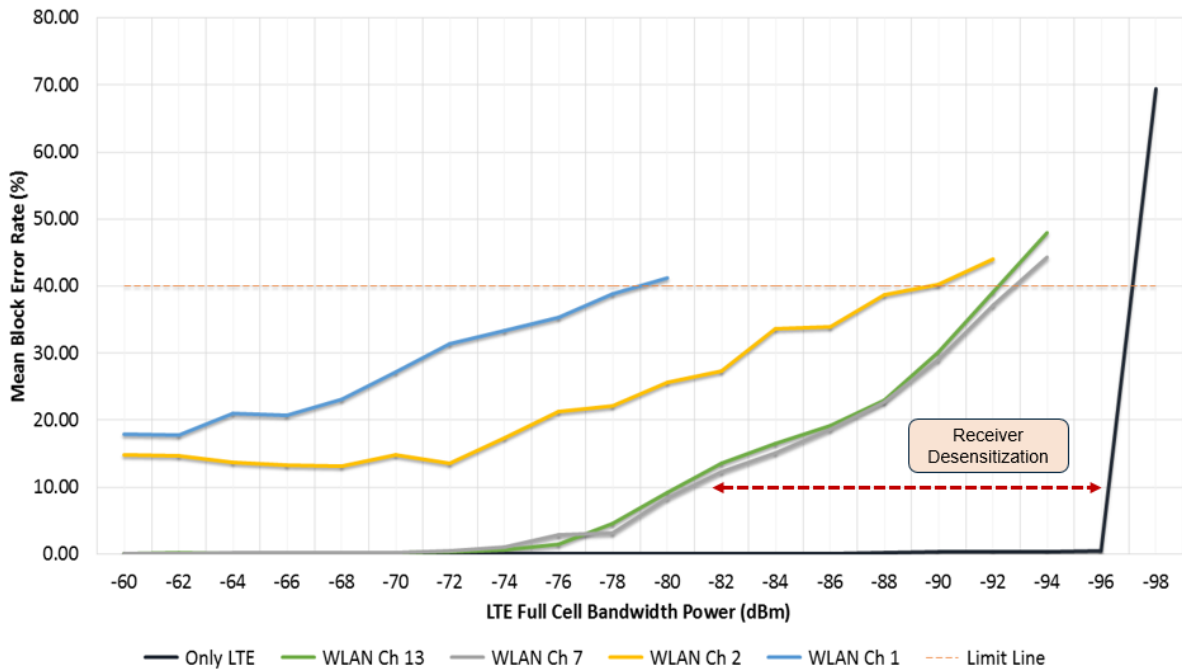


Figure 2: Desensitization of WLAN channel 1 receiver due to TD-LTE band 40

As mentioned earlier, the IDC interference from one radio technology affects the receiving capabilities of the other radio technology due to receiver blocking or desensitization of the victim's receivers. Therefore, the impact of IDC interference can be analysed using the desensitization value of the receiver. This desensitization value is based on the receiver's sensitivity performance which is measured first in absence of the interfering signal and then again in presence of the interfering signal as shown in Figure 2. The figure shows a measurement sample of the IDC interference scenario, where the WLAN transmitter affects the TD-LTE band 40 downlink. The desensitization of the LTE receiver is clearly depicted by the gap in the 10% BLER value, measured in the absence and presence of WLAN technology, and this desensitization value increases as the WLAN operating channel is moved farther away from the TD-LTE band 40. A similar IDC interference analysis can be made using the R&S CMWrun tool, where parameters such as transmit power, time schedule of data packets, etc. can be configured.

China Mobile, Nokia Showed 5G-enabled Ultra-fast Robot Collaboration

- Ultra-low latency system used as a communication platform connecting robots to a central server to enable fast and synchronized collaboration
- 5G will help create a fully automated and flexible production system, increasing overall manufacturing and logistics productivity.

China Mobile and Nokia Networks demonstrate 5G-enabled synchronized collaboration of robots at Mobile World Congress 2016 in Barcelona. 5G networks will address important aspects of industry automation, helping to create fully automated and flexible production systems and increasing overall manufacturing and logistics productivity.

The joint demonstration shows potential 5G applications in machine-to-machine communications in the industrial automation era. The ultra-low latency system is used as a communication platform connecting the robots to a central server, resulting in fast and synchronized collaboration to balance a ball on a moving platform. Once the user moves a ball in any direction, the robots coordinate and react to keep to ball at its pre-defined location.

Closed-loop control applications in industry automation will require virtual zero latency and high reliability to prevent equipment failure, production interruption, or even loss of life. 5G will provide this, meaning manufacturing industries will be better equipped to achieve their productivity targets through a unified, computing infrastructure instead of today's fragmented industrial standards.

Huang Yuhong, Vice President of China Mobile Research Institute, said: '5G, with the key features of ultra high capacity, ultra low latency, high reliability and low power consumption, will make the impossible use cases of today the realities of tomorrow. Autonomous manufacturing with massive use of robots is one such use case. 5G will provide the network infrastructure for the China Manufacturing 2025 initiative.'

Mike Wang, President of Greater China of Nokia Networks, General Manager of Alcatel-Lucent Shanghai Bell and head of the Joint Management Team, Nokia Networks China and ASB said: 'As one of the first 5G strategic partners with China Mobile, we work together on the research, standardization and industrialization of key 5G features. The robots collaboration demonstration is the first time both parties are jointly showing a 5G use case. In the future, we will explore more possibilities that 5G will bring to different industries and our lives, to jointly develop the programmable world.'

Nokia Demonstrates 5G Applications and Capabilities to Help Operators Prepare for New Business Opportunities

•Nokia Bell Labs sets record with demonstrations showing peak wireless data speeds of over 30Gbps to an end user, and over 1 million simultaneous connections in a single cell.

•Nokia showcases capabilities of 5G-enabled autonomous cars, industrial networking, interactive virtual reality and other applications on Nokia's 5G multi-service architecture.

Nokia's complete package of 5G communication technologies are providing the backbone to enable the growing proliferation of devices to connect to the Internet and to one another in order to open up a wealth of new possibilities – from improved manufacturing efficiencies and vehicle safety to a cleaner environment.

With Nokia's 5G multi-service network architecture for mobile and fixed networks, operators can provide services far beyond voice and data applications to address new business opportunities in many different industries. Nokia Professional Services are ready to support customers reach nearly 100% network availability in the 5G era.

Nokia 5G use cases at Mobile World Congress 2016:

•5G Autonomous vehicles: 5G facilitates autonomous driving by providing ultra-low latency connectivity for fast-moving autonomous systems, which require constant and virtually uninterrupted communication flow to improve road safety and reduce congestion.

•5G Industrial networking connecting robots: An ultra-reliable, low latency 5G network rapidly synchronizes interconnected robots steered by remote intelligence. With 5G, manufacturing industries will be better equipped to achieve productivity targets through a unified, computing infrastructure instead of today's fragmented industrial standards.

•5G stadium experience: Fast, live multi-casting with synchronous data transmission across a large number of smartphones. Users will be able to augment and share their real stadium experience with live video feeds from different camera positions and virtually no delay in transmission.

•5G Interactive Virtual reality: Through 1 millisecond latency and high throughput, two mobile virtual reality users will be able to collaborate as if they are in the same physical location. Remote collaboration and telepresence will optimize various business applications and processes, including distance learning, manufacturing and the maintenance and repair of machines.

•5G Massive Capacity: Bell Labs has also developed aggregation technologies that deliver record-breaking peak rates of 30Gbps and provide a more consistent and reliable quality of experience for subscribers. This is achieved by aggregating different mobile and fixed technologies into a single, ultra-capacity stream for the end user. These innovations allow operators to maximize the utilization of their network assets.

•5G Massive Connectivity: Nokia demonstrates the transformations in the cellular network to achieve record-breaking numbers of device connections and connectivity with new technology innovations from Bell Labs. Using new waveforms, connectionless messaging and flexible application-based routing, this ultra-low latency support will usher in the new IoT era with the automation of everything.

•In a proof-of-concept demo, Nokia introduces the concept of 5G-driven 'extreme automation'. This new concept will show how to simplify the operation of a complex array of new 5G use cases.

Openness, Collaboration and Shared Success, Huawei, Nokia, Qualcomm Power into Smart Home

Huawei, Nokia, Qualcomm jointly hosted Smart Home @Wireless summit in Crowne Plaza Fira Centre Hotel Barcelona, Spain on Feb, 23rd during Mobile World Congress Barcelona 2016.

The summit attracted full rooms of guests from operators, analyst, device vendors, heated waves of hot discussions how LTE TDD delivering home broadband connectivity in urban/rural areas and maximizing TDD spectrum use. It does not only reveal the successful story of LTE TDD deployment to build efficient last mile connection with Fiber-like high-speed connection penetration, but also exploit fix wireless access huge potential markets business value for mobile operators.

Easy-Zero print to install residential equipment's optimized operator's OPEX and certainly increase the consumer's adoption. Allows mobile operators to build profitably on the existing installed base of macro radio networks and offers home broadband as an alternative carrier.

LTE TDD's unique multi-Antenna technology equipped with high-gain CPE, improve the coverage greatly even in 3.5GHz frequency band can achieve similar coverage in 3G 1.8G and 2.1GHz frequency band. This year 4X4/8X8 MIMO, Carrier aggregation already in reality, along with LTE-Advanced Pro. introduction, LTE TDD offered massive MIMO/massive CA will have more spectral efficiency improvements.

"We are here to work with industry partner to connect the unconnected, boosting global wise smart home Wireless experiences." Said by Veni Shone, President of Huawei TDD Product Line.

"We're aiming to connect ALL Families using TDLTE via Prosperous ecosystem Circle" Said Aidy Zhang, Vice President, TD LTE, Nokia Networks.

"Qualcomm® Snapdragon X16 LTE modem with enriched feature roadmap will efficiently address Smart Home@Wireless use case" said by Gautam Sheoran, Director, Product Management, Qualcomm Inc.

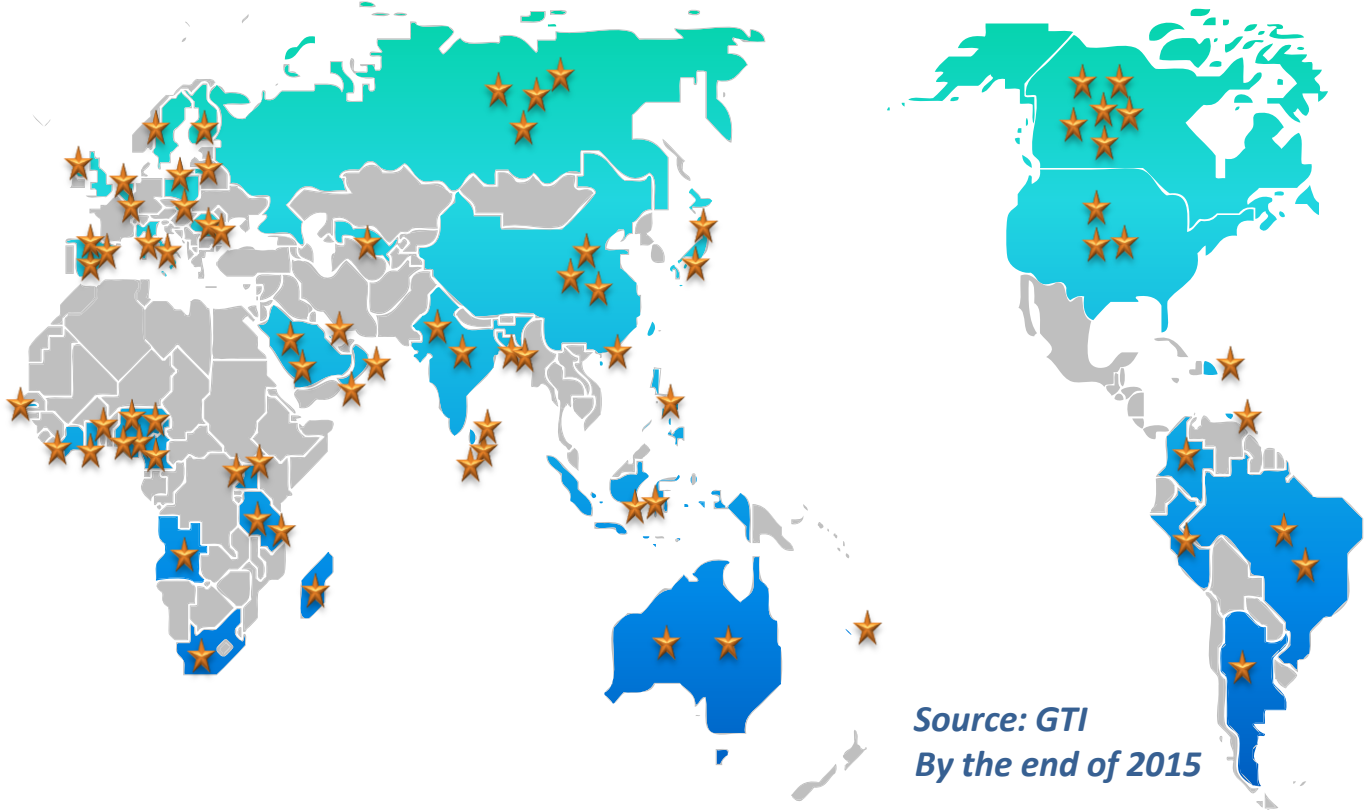
All together, we are demonstrating the determination of industry commitment to support strong ecosystem around LTE TDD to connect ALL families across world. .

TD-LTE Global Market Overview

Global Deployment as the Mainstream Mobile Broadband Technology

76 TD-LTE commercial networks have been launched

Additionally, over 93 TD-LTE commercial networks are in progress or planned



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

410+ suppliers have launched 2695+ TD-LTE terminals,
including 1994+ TD-LTE Smartphones.

TD-LTE Device Type	Quantity	TD-LTE Device Type	Quantity
USB modems	117	Smartphones	1994+
MiFi/CPE	431	Mobile Tablets	82

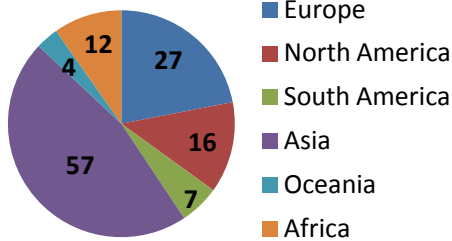
*Source: GTI, GSA, TDIA

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

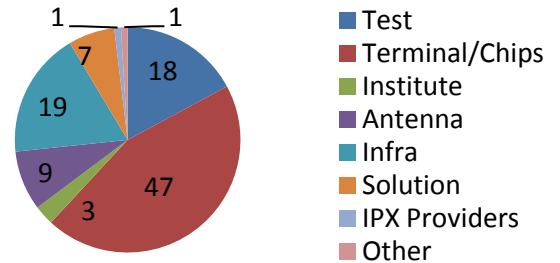
GTI Development Overview

123 Operators and 105 Partners Joined GTI by April 2016

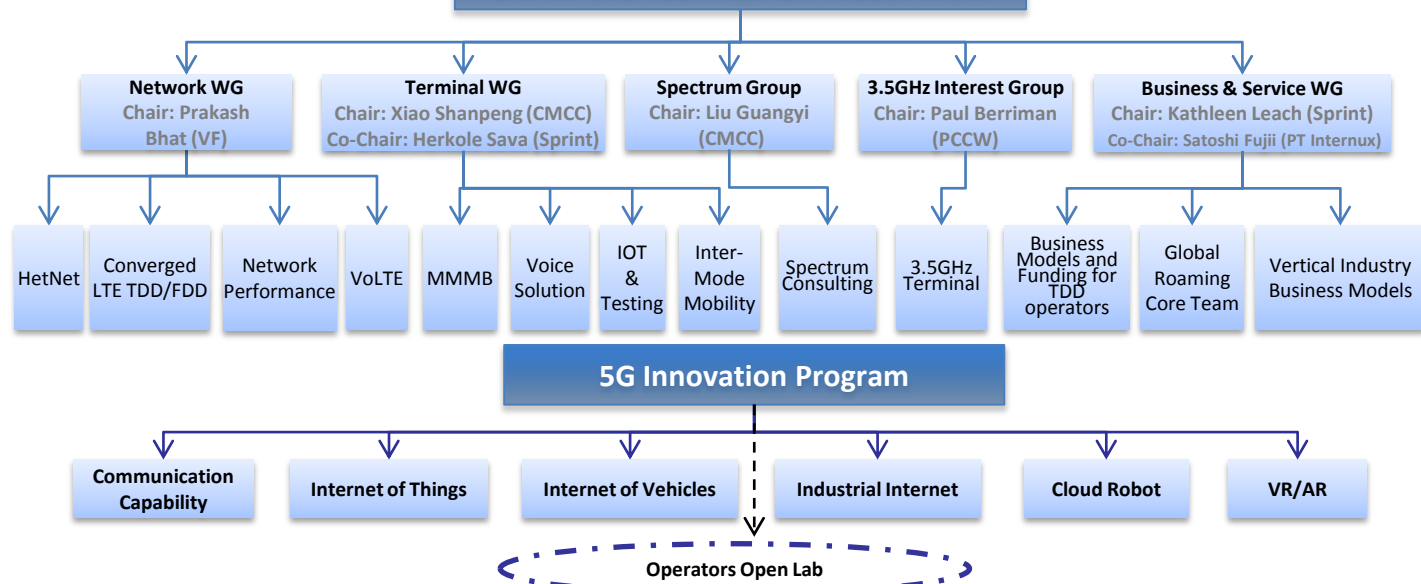
123 Operators



105 Industry Partners



GTI TD-LTE Technical & Product Work



GTI Activities

	2016	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sept/Oct	Nov/Dec
Summit		23 rd Feb (MWC16) Barcelona, Spain GTI Summit			29 th Jun (MWCS16) Shanghai, China GTI Summit		
Workshop		18-19 th Feb (MWC16) Barcelona, Spain ➤ The 15 th GTI Workshop			27 – 28 th Jun (MWCS16) Shanghai, China ➤ The 16 th GTI Workshop	29 th Nov – 1 st Dec Japan ➤ XGP Forum 20 th anniversary Event & 2016 Japan China TDD Forum ➤ The 17 th GTI Workshop TBD, Mid Nov Bangkok, Thailand ➤ The 6 th TD-LTE Technology and Spectrum Workshop	
5G industrial events		18 th -19 th Feb (GTI Workshop) Barcelona, Spain ➤ NB-IOT Ad-hoc	15 th Apr Beijing, China 5G Technology and Testing Workshop	May Beijing, China NB-IoT Partner Forum	28 th Jun (GTI Workshop) Shanghai, China ➤ NB-IoT Ad-hoc ➤ IoV Ad-hoc		12 th – 13 th , Oct (NGMN Industry Conf.) Frankfurt, Germany IoV workshop
Exhibition		22 nd -25 th Feb (MWC16) 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 www.lte-tdd.org or email us.

How to Join GTI

GTI Operators (with TDD Spectrum)

1. Fill out the application form (download from <http://www.lte-tdd.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://www.lte-tdd.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 www.lte-tdd.org or email us.*

How to Join GTI Partner Forum

1. Fill out the application form (download from <http://www.lte-tdd.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