

# GTI Industry Briefing

April, 2018 | No. 32

*Edited by GTI Secretariat  
April, 2018*

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## GTI Summit 2018 Drives the 5G+AI Development and Fuels the Innovation

**GTI Summit 2018**, with the theme of **“5G+AI, Fuel the Innovation”**, was successfully held on 27th Feb., 2018 in Barcelona, Spain during Mobile World Congress 2018. Delegates from governments, organizations, operators, vertical and partners attended this summit to discuss how 5G and AI will enable the future innovations to create the intelligent world.



**Mr. Craig Ehrlich, Chairman of GTI**

*In 2017, GTI made a great progress in 4G & Evolution, 5G eMBB, M-IoT, Innovative Business and Application. GTI will continuously promote 4G Evolution and 5G cross-industry joint innovation’*



**Mr. Liu Lihua, Former Vice Minister, MIIT of China**

*Give full play to the GTI and other international platforms an important role to build a win-win global cooperation ecosystem.*



**Mr. Pearse O'Donohue, Director of "Future Networks", EC DG CONNECT-E,**

*The European Commission is committed to providing a convenient development policy for the industry and is willing to work with industry to develop 5G and achieve 5G commercialization as soon as possible.*

**World leading operators actively drive 5G development and explore 5G use cases closely with verticals to pave the way for a smarter society.**



**Mr. Shang Bing, Chairman, China Mobile**

*China Mobile will also actively promote 5G+AI innovation to pioneer 5G smart network for intelligent operation, and to enable the intelligent connectivity and applications for all aspects of life. 5G Innovative Application Campaign was kicked off to provid 5G end-to-end environment world widely, to prepare 5G service innovation for 5G pre-commercial showcase in 2019*



**Mr. Alex Jinsung Choi, SVP Research & Technology Innovation, Deutsche Telekom**

*Deutsche Telekom stated that in the customer-centric 5G network, addressing and knowing well about customer demand is critical and DT's 5G network slicing will be the tailored network solutions for the diversified industry demands*



**Dr. Hiroshi Nakamura, EVP & CTO, NTT DOCOMO**

*NTT DOCOMO shared the vision of wonderful future life in 2020s with intelligent connectivity and innovative use cases, which 5G and AI will bring. NTT DOCOMO would like to co-create enhanced user experience and new market using 5G and AI with partners across industries, and will open AI Agent API to help co-create new value.*



**Mr. Abhay Savargaonkar, CTO, Bharti Airtel**

*Bharti will take opportunities to build the 5G network to support the industry pillars of “DIGITAL INDIA” by providing superior user experience diversified applications.*

### ORAN

AT&T, China Mobile, Deutsche Telekom, NTT DOCOMO and Orange jointly founded the world-wide ORAN Alliance to empower the next generation RAN with deeply imbedded intelligence, much higher efficiency, lower cost, greater agility and flexibility, and zero-touch automation.



# GTI Summit 2018 Drives the 5G+AI Development and Fuels the Innovation

Verticals expect the fast development of 5G and AI technology, which will bring new opportunities and innovation applications to all aspects of society.



**Mr. Christoph Voigt, Chairman, 5GAA (5G Automotive Association)**

He believed that the 5G+AI will make the autonomous driving a reality with ultra-low latency, high-reliability, and intelligent driving system



**Mr. Marc Segura, Global Head of Service Robotics, ABB**

He emphasized robots, wireless connectivity and intelligent digitalization will play critical roles in the Fourth Industrial Revolution. 5G+AI will enable paradigm shift in manufacturing which deliver faster time to market, higher flexibility, higher productivity and lower cost.



**Mr. Wang Jiye, Vice President, CEPRI of State Grid Corporation of China**

He shared the 5G+AI requirements including high speed, Ubiquitous perception, always on-line, intelligence to achieve the smarter future of internet of energy.

End-to-end industry are putting more efforts to bringing 5G into a reality.



Ms. Wang Zhiqin  
Vice President  
**CAICT**



Mr. Serge Willenegger  
SVP & GM, 4G/5G Industrial IOT  
**Qualcomm**



Mr. Xu Huijun  
EVP & CTO  
**ZTE**



Mr. Tommi Uitto  
SVP, Global Product Sales  
**Nokia**



Mr. Yang Chaobin  
Vice President of Huawei R&D &  
President of 5G Product Line  
**Huawei**



Mr. Magnus Ewerbring  
CTO, Asia-Pacific Group Function  
Technology and Emerging Business  
**Ericsson**

## 5G Terminal Forerunner Plan

China Mobile released “5G Terminal Forerunner Plan” with 20 industry partners to promote the maturity of 5G chipset, component and terminals, and to improve the time to market of 5G pre-commercial products.



# GTI 21st Workshop Addresses Key Issues on TDD Evolution and 5G Development

The 21st GTI Workshop was held with a great success during Feb. 22-23, 2018 in Barcelona, Spain. Over 180 industrial leaders, experts and representatives from global top-class operators and industrial partners attended the 21st GTI Workshop, including BT, KDDI, Orange, SoftBank, Telefonica and Vodafone, to discuss and share their views on **how to promote TDD technology evolution, speed up 5G development and M-IoT end-to-end maturity and how to facilitate the business and service development with cross-industry partners.**



At the opening speech, Madam Huang Yuhong, the General-Secretary of GTI, summarized the latest progress of GTI technical work and the development of industry in 2017, and also introduced GTI work plans in 2018 from aspects of 4G & Evolution, M-IoT, 5G eMBB, Innovative Business and Application, highlights of which are as following:

- ✓ **Achievements of 2017:** With joint efforts, GTI has released 12 White Papers and Technical Reports and 7 Commercial Products and Prototypes on 5G, M-IoT and Innovative Business & Application, promoting industry maturity and guiding its development.
- ✓ **Position of GTI 2.0:** GTI will keep standing in TDD camp and focus on industrialization and commercialization of 4G evolution and Sub-6GHz 5G system; led and driven by major operators and join force with mid-size and small operators to benefit from a robust ecosystem; work closely with the industry and reach out to the verticals.
- ✓ **Work plan of 2018:** Ensure TD-LTE migration to 5G in a highly cost-effective way; propel 5G end-to-end technologies and products for scalable trials; promote M-IoT maturity via cross-industrial collaboration to ensure commercial success; promote cross-industry development and incubate innovative applications.

NB-IoT Qsite  
& NB-IoT Universal Module



Cloud Robot



5G NR TS38.521 RF testing



# GTI Awards 2018 Winners Unveiled

GTI Awards were presented at the GTI Night 2018 held on Feb 23rd, 2018 in Barcelona, Spain. A great many high-level representatives from global operators, industry partners and organizations attended the event.



In total, 1 operator and 8 industrial partners across chipsets, network infrastructures, components, test systems and verticals won awards.



## Innovative Breakthrough in Mobile Technology

- ✓ Ericsson - 5G NR Radio Dot System
- ✓ Huawei - 3GPP 5G Pre-commercial System: 5G end-to-end products and solutions
- ✓ Keysight - NB-IoT Massive UE emulation Test System
- ✓ Nokia - AirScale System Module and AirFrame
- ✓ Qualcomm - Snapdragon™ 845 Mobile Platform
- ✓ Qorvo - 5G RF Front End QM19000

## Innovative Mobile Service and Application

- ✓ CloudMinds & Huawei - Wireless Real-time Blind Guiding Helmet
- ✓ ZTE - QCell + MEC Indoor Distribution and Positioning System

## Market Development

- ✓ Bharti Airtel    ✓ ZTE



## Honorary Award

Hong Qiu (Qualcomm)   I-Kang Fu (MediaTek)   Lawrence Tao (Qorvo)   Tomohiko Furutani (SoftBank)

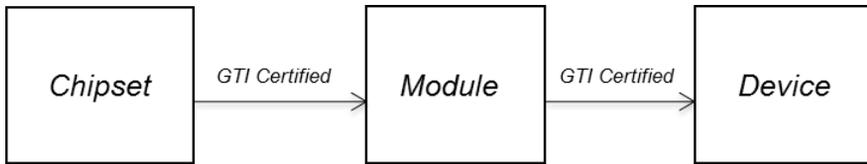
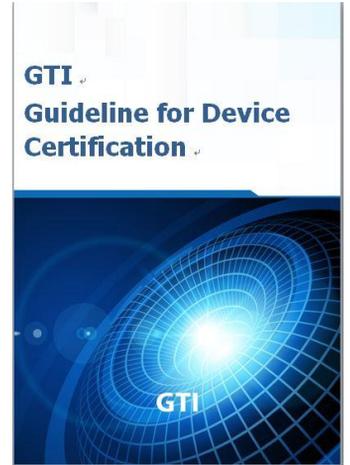


Founded in 2012, the GTI Awards program aims to acknowledge achievements and success of industry players in 4G commercialization and its evolution and 5G development across a wide range of market segments.

# GTI Embarks on Device Certification

GTI has published the Guideline for Device Certification in early March, which introduces the GTI certification architecture and defines the certification work flow. The release of this guideline means the official launch of GTI Device Certification.

GTI certification will provide industry with reliable and full-scale quality assessment of products and satisfy industry’s requirement for low-cost and high-efficient tests. Based on three-layer certification, GTI shall focus on the certification of IoT chipsets, modules and devices at the present stage.



GTI certification for IoT products will be carried out based on “Device Certification Project” in “IoT Program”(PM3-PJ5). Besides GTI Certification Office, there are Test and Certification (T&C) Standard Task, Test Platform Task and Test Execution Task which will be responsible for test specification and certification criteria definition, test system validation, test lab accreditation and test execution respectively.

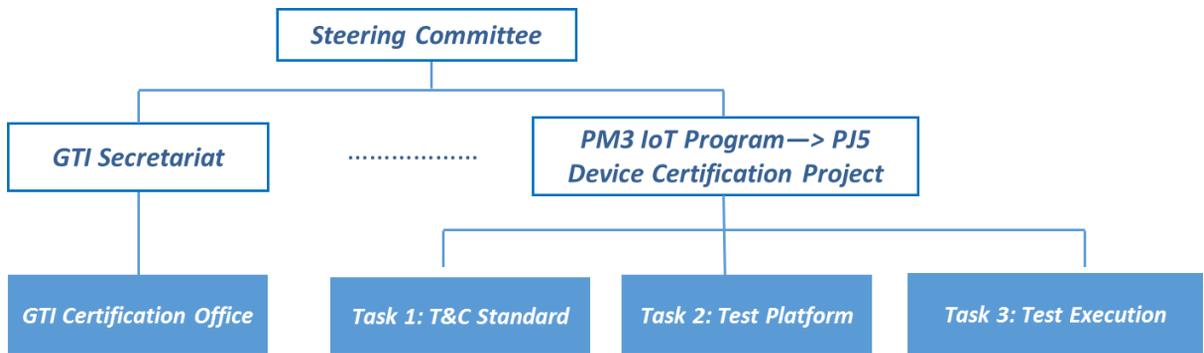


Figure 1 GTI Certification Organization Architecture for IoT products

Currently, the test specification and certification criteria for NB-IoT chipset have been officially released. The certification results for NB-IoT chipset are in the expectation. T&C standard task will also kick off the discussion of test specification and certification criteria for NB-IoT module and device subsequently.

# The Progress on 5G Conformance Test and Certification

The conformance test specifications for 5G are being busy drafted since the approval of 5GS work item in June 2017 in 3GPP RAN5. Currently, the 5GS work item has completed 10%. For NSA Option 3 the estimated completion is about 15% and around 10% for the other options. According to the deliverable phases defined in RAN5, it's targeted to complete NSA option3 phase 1 in Q2 and SA Option 2 phase 1 in Q4 this year.

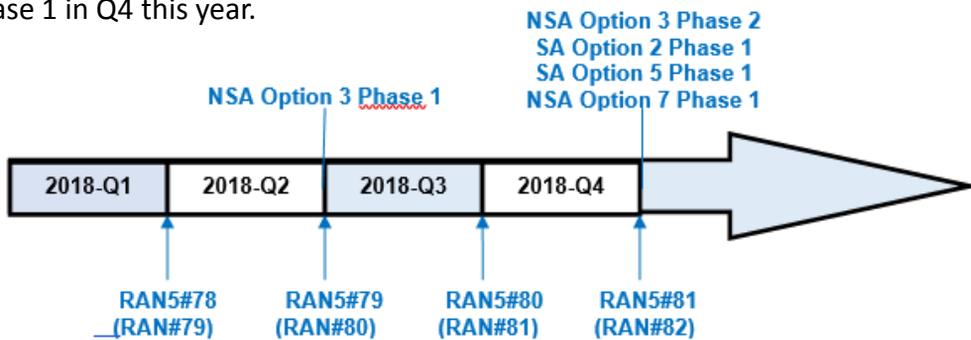


Figure 1: RAN5 delivery plan. Refer to R5-181348

Following the progress in RAN5, GCF has approved the umbrella work item proposal of conformance test for 5G devices in the end of 2017. The umbrella work item covers both the Non-Stand Alone (NSA) option 3/7 and Stand Alone (SA) option 2/5.

Based on the umbrella work item, GCF further finalized the structure of 5G work items. The 5G conformance certification will contain various test areas, including radio reception and transmission, demodulation performance, radio resource management (RRM), radio access protocols, core network protocols, IMS and positioning. The formation of 5G work item structure is an important milestone for 5G device certification, based on which GCF kicks off the discussion of certification criteria for 5G device in April 2018.

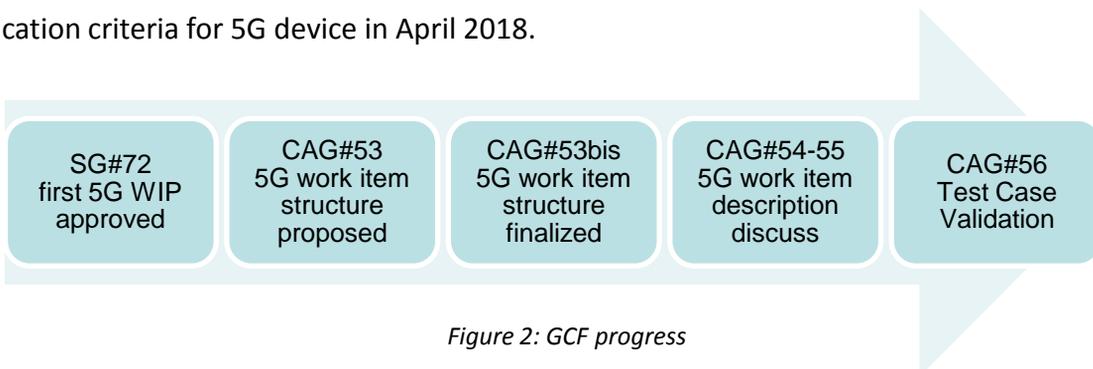


Figure 2: GCF progress

Aiming to the mature and high quality 5G devices, the industry is trying best to facilitate the standardization of test and certification solution on schedule. The main contributors include but not limited to China Mobile (Rapporteur of GCF 5G WI and Co-Rapporteur of RAN5 5G WI), Ericson (Rapporteur of RAN5 5G WI), CAICT, CATT, China Unicom, Huawei, Motorola, Qualcomm, R&S and SAMSUNG.

# Huawei Launches Full Range of 5G End-to-End Product Solutions

At World Mobile World Congress (MWC) held in Barcelona, Spain, Yang Chaobin, President of Huawei 5G Product Line, unveiled a full range of end-to-end (E2E) 3GPP-compliant 5G product solutions. This release covers the core network, the bearer network, base station, and terminals. Huawei's 5G product solutions are entirely based on 3GPP standards, with full range, full scenario, and all-cloud being the defining characteristics. The featured products are also the only available options within the industry to provide 5G E2E capabilities.



**5G Base Station:** Various forms to suit the deployment requirements in all scenarios and offer ubiquitous xGbps user experience

**5G Bearer Networks:** Diverse active and passive solutions using 5G microwave and IPRAN to fully meet 5G networks' ultra-large capacity requirements

**5G Core Networks:** Enabling all-industry digitalization through all-cloud architecture, on-demand deployment, and smooth evolution

**5G Terminal:** World's only commercial product with small size and low consumption to provide fiber-like access experience of wireless home broadband

2018 will be remembered as the first year that marks the beginning of the 5G era. Using a full range of leading and mature 5G E2E full-scenario product solutions, Huawei has realized the continuous deployment of 5G sites in more than 10 countries, such as China, Korea, Canada, Germany, UK, and Italy. In typical densely-populated urban areas, these product solutions have provided ubiquitous Gbps-level access rate, hundreds of Mbps of indoor access experience, and over 20 Gbps cell capacity.

The countdown has begun for large-scale 5G commercial launch worldwide. Huawei is making the most comprehensive preparations.

# China Mobile Holds Hand with ZTE, Demonstrates Their 5G Strength at Mobile World Congress 2018

China Mobile, collaborating with ZTE and Qualcomm, demonstrated the world's first end-to-end Interoperability Data Testing (IoDT) test based on the latest 3GPP 5G NR standard and revealed the test results of the world's first sub-6GHz 5G field trial at Mobile World Congress 2018 in Barcelona, Spain, thereby demonstrating its great strength in 5G field.

World's First End-to-End IoDT Test Based on the Latest 3GPP 5G NR Standard, The successful interoperable connection of the end-to-end 5G NR IoDT system serves as a significant industry milestone towards pre-commercialization of 5G NR technologies at scale, driving rapid development of 3GPP standards-compliant networks and devices.



In February 2017, China Mobile, ZTE and Qualcomm declared that they would perform the world's first end-to-end interoperability tests based on the 3GPP 5G NR standard. In November, the three parties jointly implemented the end-to-end interworking among 5G new air-interface systems based on the 3GPP R15 standard in the 5G joint innovation central lab of China Mobile.

The system interworking test employed ZTE's sub-6 GHz 5G new air-interface pre-commercial base stations. The base stations successfully interworked with Qualcomm's 5G new air-interface prototype terminals, with the peak rate of a single UE up to 1.4 Gbps and the latency of only 0.04 ms.

The interworking success of the 5G new air-interface system is a vital milestone for large scale pre-commercialization of the 5G new air-interface technologies, pushing 5G networks and terminals meeting the 3GPP standard. In 2018, the three parties will perform more 5G field tests.

-Li Zhengmao, vice president, China Mobile Communications Corporation, said, "China Mobile is committed to promoting the unified global 5G standard with industry partners. The achievement of end-to-end 5G NR interoperable connection testing, compliant with the 3GPP 5G NR standard, is an important milestone of 5G standard to productization and pre-commercialization from standard. China Mobile is committed to working with other industry leaders, including Qualcomm Technologies and ZTE to promote that the 5G products continue to mature and the 5G industry marches to success."

-Xu Huijun, chief technology officer and executive vice president, ZTE, said, "ZTE is aiming to become one of the first suppliers of commercial 5G equipment and solutions. During the course of 5G technology verification and product-based development, ZTE is actively verifying a multitude of key technologies, solutions and network models together with industry partners. The world's first 5G NR interoperable data connection, completed by China Mobile, Qualcomm Technologies and ZTE showcases our committed effort and periodical results."

-"Achieving the world's first end-to-end 5G NR interoperable data connection is true testament to our 5G leadership, driving toward the timely launch of standard-compliant commercial networks," said Cristiano Amon, executive vice president, Qualcomm Technologies, Inc., and president, QCT. "Qualcomm Technologies is committed to the continued success of China's wireless industry and we are excited to collaborate with ZTE and China Mobile to accelerate the path to 5G in China."

# Nokia and Qualcomm Complete Key Foundation Tests of 5G New Radio Network and Devices

Nokia and Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated, have successfully completed interoperability testing in the 3.5Ghz and 28Ghz spectrum compliant with the global 3GPP 5G NR Release 15 standard - which was formally confirmed in December - and using the commercially available Nokia AirScale base station and device prototypes from Qualcomm Technologies.

Focusing on the commercialization of 5G technology, with New Radio as its foundation, Nokia and Qualcomm Technologies testing at Nokia's 5G center of excellence in Oulu, Finland, will provide the basis for 5G NR field trials with operators in 2018. Nokia, Qualcomm Technologies and operators\* including BT/EE, Deutsche Telekom, Elisa, KT, LGU+, NTT DOCOMO, Optus, SKT, Telia and Vodafone Group are already committed to working together in verifying and trialing 5G NR technology. This will be based on the successful interoperability tests of the flexible 5G NR interface from Nokia and Qualcomm Technologies which will support a wide array of 5G services and various deployment scenarios.

In line with Qualcomm Technologies' and Nokia's announcement in September 2017 to collaborate on 5G NR and with the success of these recent tests, Nokia and Qualcomm Technologies continue working closely in driving the industry, leading to widescale 5G deployments in 2019 based on 3GPP standard-compliant 5G infrastructure and devices. This will enable timely commercial network launches in 2019, in particular in the United States, China, Japan, Korea and Europe.

Marc Rouanne, President of Mobile Networks, Nokia said: "These tests by Nokia and Qualcomm Technologies are important to the progress of 5G. Importantly, they demonstrate how we have quickly applied the 3GPP Release 15 specifications that were set in December, using our AirScale base station - which has been shipped to more than 100 customers - together with a prototype Qualcomm Technologies UE. Now, we can look forward to commencing standards-based, over-the-air 5G NR trials with operators."

Cristiano Amon, president of Qualcomm Incorporated, said: "The successful completion of an end-to-end interoperable connection based on the global 5G NR standard is a significant step on the path to launching 5G NR commercial networks and devices starting in 2019. We look forward to further collaboration on standard-compliant field trials with Nokia and global operators on the path to commercialization."



# CMCC, Datang and Keysight Demonstrate 5G-NR Technology in MWC 2018

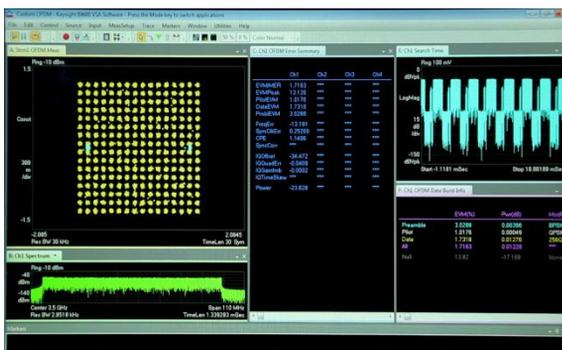
After R15 standard is determined in December 2017, To speed up the development of 5G-NR technology, Operators, Equipment manufacturers, test vendors and terminal manufacturers will build a complete 5G ecosystem. As an important member of 5G ecosystem, CMCC, Datang and Keysight work together to identify typical parameters, adapt network requirements, accelerate industrial process.

In the 2018 MWC, Datang and Keysight brought advanced demonstration in the field of 5G which based on Datang's base-station and Keysight's UE simulation platform.

The demonstration is composed of two parts. The first part is the display of spectrum analyzer. The Datang's base station sends the waveform of NR based on the new parameter set and frame structure. The main parameters are as follows:

- Frequency: 3.5GHz C band
- Carrier bandwidth: 100MHz
- SCS: 30kHz
- Time slot structure: 0.5ms
- Modulation: 256QAM

The spectrum analyzer provided by Keysight demodulates the synchronization channel and the service channel according to the agreed signal format. It can display the signal bandwidth, subcarrier interval, frame structure, EVM and so on.



The second part is the peak rate display of Keysight's UE simulation platform. Datang's base station sends multi-stream data, supporting synchronization, control, data channel and pilot transmission and Keysight's UE which supporting synchronous search, single user 4 streams, 256QAM, LDPC decoding and other functions reception. From the demo, we can see that terminal rate can support 2Gbps based on the 100% downlink resources.



# Global Cross-industry Players Inaugurate 5G Slicing Association

As the founding members, China Mobile, Deutsche Telekom, Digital Domain, Fraunhofer FOKUS, Huawei, CEPRI of SGCC, Tencent, TIM and Volkswagen AG announce the inauguration of the “5G Slicing Association”. The association will address requirements from vertical industry and the potential application scenarios of 5G network slicing on the way to defining new business models. The initiative will study key technical issues, cooperate with slicing related standards development organizations (SDOs) and foster test beds and trials to verify 5G network slicing capabilities.



5G networks will provide much higher speeds, lower latencies, and new levels of reliability and overall network performance and efficiency compared to previous generations. Importantly too, 5G can be an important tool for productivity and enabler for digital transformation in many vertical industries. With the rapid growth in application types, such as augmented reality, virtual reality, autonomous driving, smart factory, 5G networks must become smarter, more flexible and more tailored to vertical customers' requirements.

As a key innovation in 5G technology, network slicing provides agile and customizable capabilities that allow the efficient construction of service guaranteed dedicated networks for different applications. By adapting the 5G network to different business needs, network slicing has the potential to open up new technological and business opportunities for both the ICT industry and other vertical industries. The members of this association will closely collaborate to realize the full potential together. The main activities of the association include:

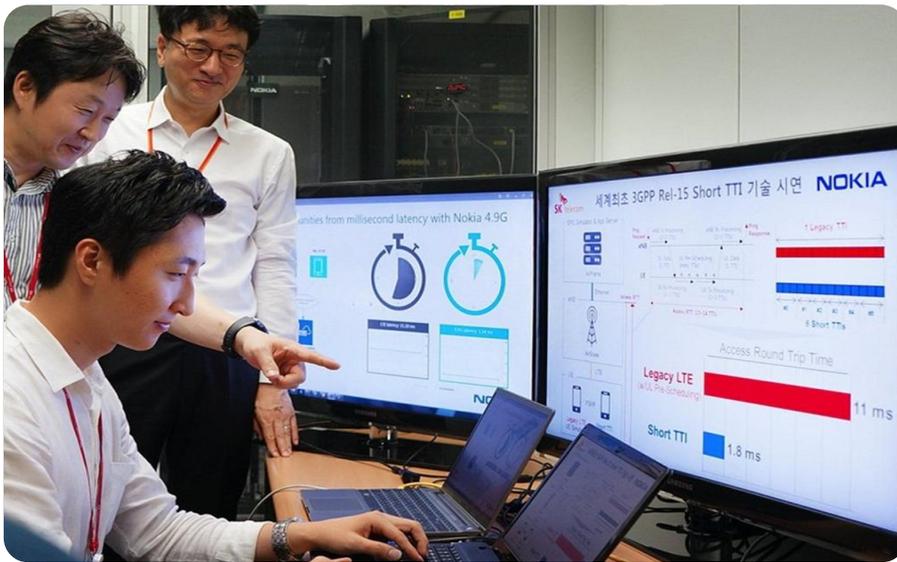
- Development of an industry-wide, technical understanding for slicing
- Study and definition of slicing use cases for diverse industries and derive requirements
- Orchestrate E2E slicing SDOs and provide inputs to related standards
- Fostering of business-driven slicing test beds and trials

The 5G Network Slicing Association is a global association and welcomes more partners who are engaged in the action of digitalization of industries, including the ICT industry, vertical industry and even the broader eco-system and value chain. The 5G Network Slicing Association is closely working together with the GSMA Network Slicing Taskforce (NEST) which is prepared to bring the requirements into the standardization.

# Nokia and SKT Conduct Trial of LTE-based Video and Voice Applications to Enhance Public Safety

Nokia and SK Telecom (SKT) are conducting a major trial of LTE public safety technologies in South Korea to establish the application of first responders in sharing mission-critical voice, video and other data simultaneously in real-time with multiple members of first response teams.

Nokia has deployed its ViTrust public safety solution - which includes LTE radio access, Cloud Packet Core and other commercially available technologies in the network trial in the Pyeongchang, Jeongsun and Gangneung areas of South Korea. The trial is being conducted with first responder teams to enhance communications and response time in emergency situations.



Working with local vendors to deliver services for the trial, Nokia is deploying its Mission-Critical push-to-talk (MCPTT) technology to allow a single user to simultaneously connect with multiple first response personnel on a network. Using enhanced Multimedia Broadcast Multicast technology, HD-video and other data can be transmitted efficiently to all devices even in high-traffic situations, to give all first responders a clear and complete view of an emergency and its needs.

The trial involves one of the world's first public safety networks to interwork with SKT's existing evolved packet core system. This interworking will ensure network reliability, coverage and availability ensuring public safety workers can communicate at all times.

Sang-soo Shim, Senior Vice President of Infra Business at SK Telecom, said: "We are pleased to be leading the way with this important Public Safety LTE trial. Working with Nokia we have been able to ensure fast deployment of technologies and enable the delivery of services that will transform the way public safety workers operate."

Andrew Cope, head of Korea at Nokia, said: "This trial with SKT is a breakthrough for Nokia in the South Korean market. Using our innovative ViTrust public safety LTE solutions and field proven Nokia Cloud Packet Core solution we could rapidly deploy the network, to interwork with SKT's existing network and evolved packet core."

# ZTE Unveils 5G Full Series of Base Stations at MWC 2018 for Commercial 5G Deployments

26 February 2018, ZTE Corporation, unveiled its full series of new-generation 5G base stations at Mobile World Congress 2018. It marks a milestone for the technological innovation of wireless base stations, facilitating global commercial 5G deployments.



## • New-Generation 5G High/Low Frequency AAUs

The new generation of ZTE 5G high/low frequency AAU supports the 3GPP 5G NR and mainstream 5G spectrum used in the industry. Adopting key 5G technologies, such as Massive MIMO, Beam Tracking, and Beam Forming, it is fully applicable to the diversified scenarios of commercial 5G deployments.

ZTE's 5G high/low frequency AAU has passed the national 5G test in China, and has been applied in 5G tests by operators around the world. Compared with the previous generation of products, the new 5G high/low frequency AAU is fully compliant with 3GPP standards and commercially available already.

Characterized by the highest level of integration, smallest volume, lightest weight, and a high bandwidth, the ZTE 5G low-frequency AAU creates a new record of the peak throughput in a single cell, reaching 19 Gbps, in the low-frequency eMBB test scenario during the national 5G tests in China.

The ZTE high-frequency AAU is the smallest high-power AAU in the industry. Its compact and easy-to-install design made ZTE the first to complete the 5G tests at the high frequency of 26 GHz in China.

## • NG BBU with Industry's Largest Capacity

At MWC 2018, ZTE released the first NG BBU in the industry. As the upgraded version of the IT BBU, which is the world's first SDN/NFV-based 5G wireless access product released in 2017, the ZTE NG BBU is the most powerful 2U NG BBU with the highest capacity.

With advanced SDN/NFV virtualization technologies, the ZTE NG BBU is compatible with 2G, 3G, 4G, and 5G, and also supports C-RANs, D-RANs, and 5G CUs/DUs. It has multiple interfaces and supports pre-maintenance. The NG BBU-based 4G/5G hybrid network and multi-mode network help operators flexibly deploy vertical services and achieve multi-scenario deployments, thereby accelerating network deployment and optimization while reducing TCO.

## • First 4G/5G Dual-Mode RRU in the Industry

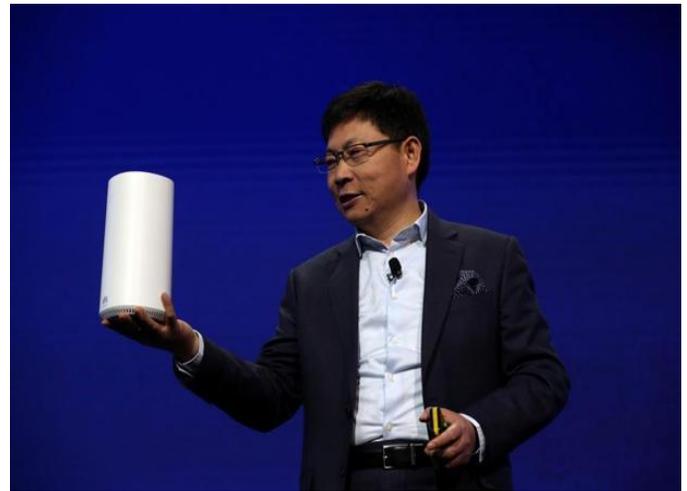
The industry's first dual-mode dual-frequency 4G/5G RRU, released by ZTE, supports 4G single-mode, 5G single-mode and 4G/5G convergence, ensuring the smooth evolution of operators' networks to 5G. Featuring compact design and easy installation, it greatly helps operators save hardware costs and improve network stability. Meanwhile, the single-fiber solution can reduce the fiber rental costs by 75% and significantly decrease operators' TCO without affecting the transmission of big data.

Based on the self-developed high-performance 5G soft-baseband chips and digital intermediate-frequency chips, the ZTE new-generation 5G base stations can provide an extremely high capacity, and support multiple systems and key 5G technologies.

# Huawei Releases First 5G Customer-premises Equipment

At Mobile World Congress 2018, Huawei Consumer Business Group (CBG) launched its HUAWEI 5G customer-premises equipment (CPE), the world's first commercial terminal device supporting the globally recognized 3GPP telecommunication standard for 5G. This device marks a milestone as Huawei sets the stage for the next generation of wireless connectivity.

To ensure peak performance from its 5G CPE, Huawei uses its self-developed Balong 5G01 chipset – the world's first commercial chipset supporting the 3GPP standard for 5G, with theoretical downlink speeds of up to 2.3Gbps. It supports 5G across all frequency bands including sub-6GHz and millimeter wave (mmWave) to offer a complete 5G solution suitable for multiple use cases. The Balong 5G01 makes Huawei the first company offering an end-to-end 5G solution through its network, devices and chipset-level capabilities.



The HUAWEI 5G CPE has two models, low frequency (sub6GHz) 5G CPE and high frequency (mmWave) 5G CPE respectively. The HUAWEI low frequency 5G CPE is small and lightweight, compatible with 4G and 5G networks, and has proven measured download speeds of up to 2Gbps 20 times that of 100Mbps fiber. This provides an ultra-fast experience, allowing users to enjoy VR video and gaming experiences, or download a TV show within a second. The HUAWEI high frequency 5G CPE is available in indoor and outdoor units.

5G networks set new standards for high speed, wide bandwidth, low latency wireless connections, with a peak downlink rate of 20Gbps, support for one million devices per square kilometer and latency as low as 0.5ms. 5G promises an enhanced connection between people and the Internet of Things, raising the potential for the number of devices that can be connected and the amount and type of data that can be shared between them.

Huawei CBG has developed a 5G device strategy which utilizes the high-speed, low-latency, big-connectivity qualities of 5G to create richer, more varied connected experiences for users. This strategy includes smartphones, mobile Wi-Fi, industrial modules and other devices to connect people and objects in their homes, vehicles and beyond.

In 2017, Huawei began testing 5G commercial networks with partners. Huawei completed interoperability testing and started offering the first round of 5G commercial networks in 2018.

# Nokia Launches ReefShark Chipsets that Deliver Massive Performance Gain in 5G Networks

Nokia has unveiled its new ReefShark chipsets, which leverage in-house silicon expertise to dramatically reduce the size, cost and power consumption of operators' networks and meet the massive compute and radio requirements of 5G.

Incorporating Nokia Bell Labs artificial intelligence (AI) innovations as well as Nokia's extensive capabilities in antenna development for mobile devices and base stations, ReefShark chipsets leverage silicon developed by Nokia in Oulu, Espoo and Tampere, Finland as well as Sunnyvale, California.

ReefShark chipsets for radio frequency (RF) units such as the radio used in antennas significantly improve their performance. This results in halving the size of massive MIMO antennas. ReefShark chipsets also reduce power consumption in baseband units by 64%, compared to such units in use today.

The ReefShark chipsets for compute capacity are delivered as plug-in units for the commercially available Nokia AirScale baseband module. AirScale is software upgradeable to full 5G functionality, and these plug-in units triple throughput from Nokia's already market-leading 28 Gbps today, to up to 84 Gbps per module. Additionally, AirScale baseband module chaining supports base station throughputs of up to 6 terabits per second, which will allow operators to meet the huge growing densification demands and support the massive enhanced mobile broadband needs of people and devices in megacities.

AI in 5G networks enables real-time radio monitoring and optimization and the ability to apply techniques such as network slicing to meet the service level demands of new business cases. Nokia is developing technology with common interfaces and toolkits allowing service providers to implement machine learning applications in their networks.

Nokia is working with 30 operators using ReefShark and will ramp up field deployments during the third quarter of 2018.

Neil McRae, BT Chief Architect, said "By incorporating ReefShark into our network we will leverage the huge network performance improvements that will allow us to unleash the full potential of 5G."

Henri Tervonen, CTO of Nokia Mobile Networks and head of R&D Foundation said: "With ReefShark, Nokia has created a clear competitive advantage. Its combination of power, intelligence and efficiency make it ideally suited to be at the heart of fast arriving 5G networks."

## **About the Nokia ReefShark chipsets**

- Incorporate leading system design and nanometer chip technology
- Decrease massive MIMO antenna size by half
- 64% reduction in power consumption in the baseband unit.

## **The ReefShark chipsets comprise:**

- ReefShark Digital Front End for LTE and 5G radio systems supporting massive MIMO
- ReefShark RFIC front-end module and transceiver: massive MIMO Adaptive Antenna solution
- ReefShark Baseband Processor: All-in-one compute heavy design, capable of supporting the massive scale requirements of 5G. This is the brain power of baseband processing.

# Huawei Collaborates with Vodafone and Bosch to Enable Smart Cars to Communicate with Each Other

For the first time in Europe, Huawei, Vodafone Germany, and Bosch have successfully tested the extended usage of Cellular vehicle to everything (C-V2X R14) in combination with Bosch's Adaptive Cruise Control (ACC) driver assistance system. The three companies have been performing trials of the new, high-performance technology for the past year on the A9 freeway in Bavaria, Germany, using a pre-standard 5G network. The real-time integration of C-V2X with ACC driver assistance system will deliver more efficient and safer driving.

Known as C-V2X (vehicle to everything), the technology makes it possible for a car to communicate with other vehicles and its surroundings using mobile connectivity. C-V2X is a real-time alert system that connects cars and gives them early alerts when another vehicle is changing lanes on the freeway or suddenly brakes. When integrated with ACC as in the tests performed, the technology not only warns the driver, but also automatically accelerates or brakes in response.



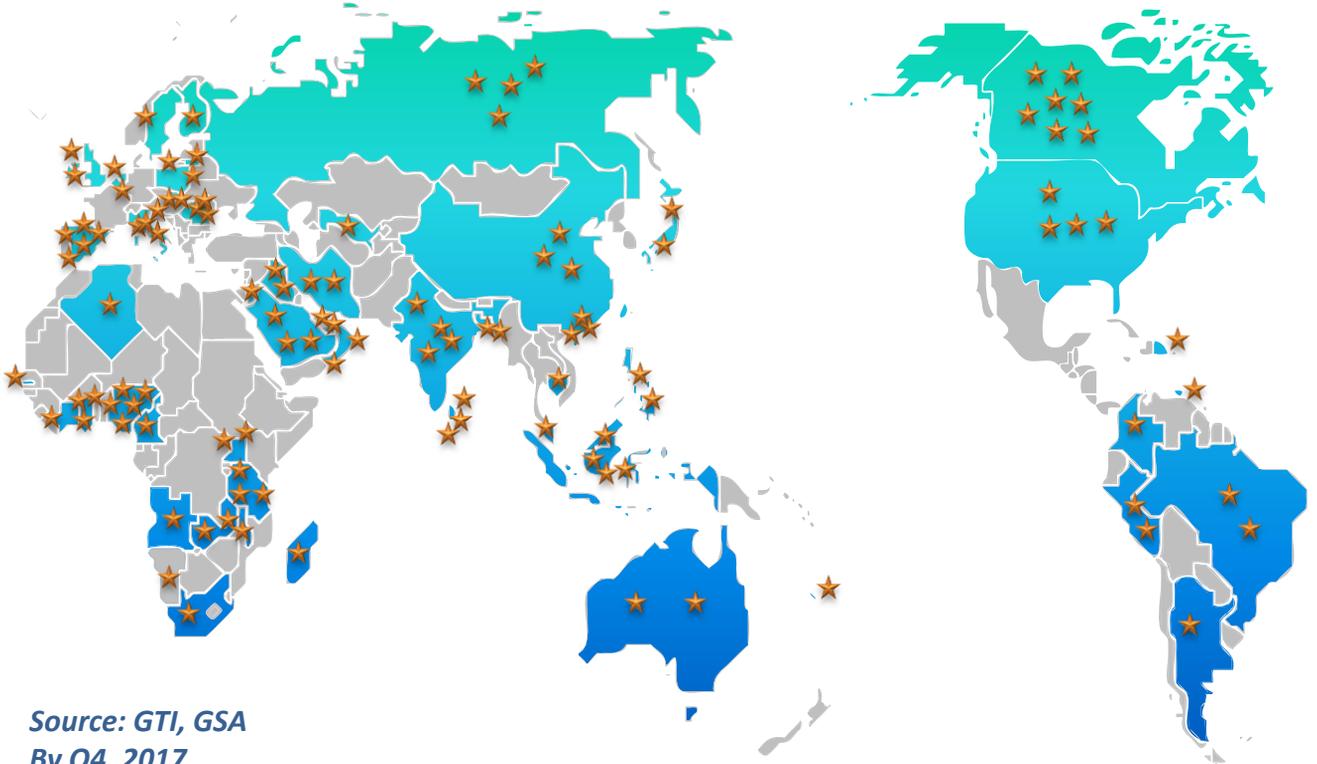
The new mobile technology system paves the way for automated driving. Achieving the goal of fully connected traffic will involve teaching vehicles to communicate with each other and exchange data directly. Direct communication between vehicles provides information about what is happening in parts of an intersection not visible to the driver, over the crest of a hill, or on the freeway beside or behind the driver's own car. In addition, the technology will increase energy efficiency and reduce emissions. Overall, traffic becomes smoother and more efficient. Thanks to the foresight provided by the technology, vehicles can go with the flow.

# TD-LTE Global Market Overview

## Global Deployment as the Mainstream Mobile Broadband Technology

**111** TD-LTE commercial networks have been launched

Additionally, over **134** TD-LTE commercial networks are in progress or planned



Source: GTI, GSA  
By Q4, 2017

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

**504+** suppliers have launched **7094+** TD-LTE terminals, including **5662+** TD-LTE Smartphones.

TD-LTE Device Type	Quantity	TD-LTE Device Type	Quantity
USB modems	162+	Smartphones	5662+
MiFi/CPE	847+	Mobile Tablets	189+

\*Source: GTI, GSA, TDIA  
\*Note: Four Main Types Of The TD-LTE Terminals

# GTI Achievements and Breakthroughs in 2017

## Breakthroughs and Accomplishments In 2017

**13 Whitepapers and Technical Reports** on RAN, Core Network, Device and Applications & Service;  
**7 Commercial Products and Prototypes** on 4G & Evolution, 5G, IoT and Applications & Service



### White Papers and Technical Reports



#### GTI Sub-6GHz 5G Spectrum Whitepaper

It presents recent progress of global 5G spectrum and the suitability of the frequency bands under consideration for 5G to provide ambitious services and adequate coverage, especially assisting the GTI groups for their product design and initiatives identified and addressing GTI members to view towards overall 5G spectrum planning for sub-6GHz and refarming of the bands from 2G/3G/4G.



#### GTI Sub-6GHz 5G Deployment Whitepaper

This whitepaper overviews the business motivation and spectrum availability for 5G deployment at sub-6GHz spectrum, and it also investigates some possible deployment scenarios for initial 5G commercialization, which gives a general guidance to Sub-6GHz 5G Deployment.



#### GTI Proof of Concept of 5G System Whitepaper

To addresses outstanding aspects which are seen fundamental to corresponding work carried out for PoC with inclusion of three subclasses: key performance indexes need to be identified in PoC task, substantial features enabling the competence of 5G NR, verification configurations and cases of PoC.



#### GTI Sub-6GHz 5G Radio Access Network Whitepaper

This whitepaper overviews the NR key technologies and procedures just standardized by 3GPP for Rel-15 NR Work Item. From fundamental technical components and frame structure to the system procedure, this white paper aims to provide a high level picture on how 5G NR system operates, which will be the start point to facilitate GTI members to further investigate the possible requirements or recommendations for 5G commercialization.



#### GTI Sub-6GHz 5G Core Network Whitepaper

This white paper overviews the 5G Core Network functionalities, also introduce the network architecture from service aspect and the support of virtualized deployments. The new QoS framework designed for 5G will also be captured within this white paper. It serves as the foundation for GTI members to further develop the vision and recommendations to drive entire 5G ecosystem toward the commercialization.



#### GTI 5G Network Architecture Whitepaper

The adaptable 5G network with a centralized and distributed cloud-based network architecture would enable the delivery of high-bandwidth, low-latency experiences and enhanced productivity to form a connected world. This whitepaper shows solutions and proposals for 5G network architecture and give suggestions to the industry.



#### GTI 5G Network Slicing Whitepaper

A guidance to provide solutions for 5G network slicing by comprehensive introduction to the main challenges and problems to be solved and clarify different requirements for 5G network in different use cases, including eMBB, URLLC and mMTC.



# GTI Achievements and Breakthroughs in 2017

## Breakthroughs and Accomplishments In 2017



### White Papers and Technical Reports



#### Device

#### GTI Sub-GHz 5G Device Whitepaper

This Whitepaper targets eMBB scenario for Sub 6GHz frequency band and contains the key requirements and the hot topics of 5G pre-commercial device, e.g. Form Factor of 5G Device, Multi-Mode Multi-Band, Network Access Capability, etc. This Whitepaper will benefit 5G industry partners to identify market needs and facilitate development of 5G device industry.



#### GTI 5G New Device Type Research Report

Rely on the technical features of 5G, the difference of future form factor of 5G device and the differentiation scenario, this report analyses service performance and characteristics in more than 10 kinds of user scenarios on 5G and provide the requirements of network capability to guarantee use experience. In the future, this report will further enhance the connection between form factor devices and 5G network to better guide the industry.



#### GTI 5G Device RF Component Research Report

This report, specifically for the analysis of 5G devices RF component, is analyzed in two parts respectively, sub-6GHz and mmWave. Meanwhile, it analyzes the industry present situation, key technology, design challenges, alternative processes, R&D progress and etc. of the core RF devices. The black-tech which will influence the evolution director of 5G devices RF component is also discussed.



#### GTI NB-IoT Module Test Specification

To define the test cases and test method for NB-IoT module, including interconnection testing, power consumption testing, RF performance testing and positioning testing, and to promote the maturity of NB-IoT module development.



#### Applications and Service

#### GTI Enabling AI Vision with 5G Networks Whitepaper

This article will analyze the development trend of cloud AI Vision technology development and its applications. Explore network requirements of AI Vision applications and put forward the great driving force of cloud AI Vision in the era of 5G network.



#### GTI 5G Cloud Robotics Whitepaper

To introduce key concepts, technologies and business forecast of cloud robotics, in the era of 5G mobile communication systems, in order to facilitate further discussions and business investigations between robot players and telecom players.



# GTI Achievements and Breakthroughs in 2017

## Breakthroughs and Accomplishments In 2017

### Commercial Products and Prototypes

#### 5G System Prototype

In 2017, GTI took the lead in releasing **5G System Prototype** and **Trial Guideline** which puts forward the basic index requirements of the low frequency equipment. These two 5G system prototypes by Huawei and ZTE are the first product matched with the Trial Guideline, which have been used in the field trial. In 2018, there will be more related products.



**3.5GHz, 64TxRU, 100MHz BW, 200w Tx Power**

#### Sub-6GHz 5G FPGA Prototype Device

GTI successfully promoted the maturity of the world's first batch of sub-6GHz 5G FPGA prototype device by Qualcomm, Intel, Spreadtrum and MediaTek :

- Support 100MHz bandwidth in 3.5GHz
- Compliant with the NR Layer1 architecture in 3GPP R15
- Support PDSCH/PUSCH CP-OFDM
- Support 256QAM and 4x4 MIMO



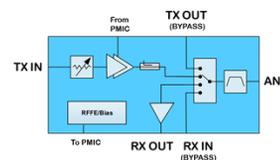
### Promoted 5G RF Components Commercialization

#### World's 1st Sub-6GHz 5G Device RF FEM Prototype

- High-integration: power amplifier, filter, switch, LNA
- Optimize the matching within RF FEM
- Reduce RF front-end insertion loss
- Optimize the RF performance of device

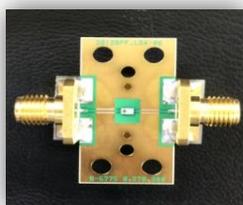


Qorvo  
(3.5mm x 6mm)

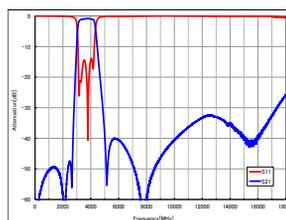


#### World's 1st Sub-6GHz 5G Device High Power Multilayer Ceramic Filter Prototype

- High power capacity: +33dBm, 10000h (Passband)
- Insertion Loss (typical value): 1.29dB
- Support HPUE to improve network coverage and user experience



Taiyo Yuden  
2.0mm x 1.25mm x  
0.65mm Max



Test Result

# GTI Achievements and Breakthroughs in 2017

## Breakthroughs and Accomplishments In 2017

### Commercial Products and Prototypes

#### Promoted Maturity of IoT Universal Module

In 2017, GTI promoted the maturity of **IoT Universal Module** which is the bridge of communication capability and service capability.

- The **Technical Requirement of IoT Universal Module** is published for the very first time giving specific guidance to the whole industry
- Jointly developed the world's smallest **NB-IoT Universal Module** (16mm\*18mm)



#### Why Universal Module?

- ✓ Break the fragmentation of IoT industry to further expand IoT market
- ✓ Make the integration of C-IoT technology and terminal more convenient and ease the application in vertical industry
- ✓ Lower the cost of terminals

#### Prototype Device of Cloud Robot

With joint efforts, GTI has developed the Cloud Robot prototype device with Softbank, **Mr. CUBE** and **Mr. WOODEN BOX**, which are autonomous robots based on the ROS (Robot Operating System) and COTS (Commercial Off-the-shelf) components, intended to become new office automation equipment, universal like air and water.

Simple yet practical configuration and sufficient payload makes Mr. CUBE Mr. WOODEN BOX are ideal platform to explore possibilities of Cloud Robotics in 5G era.



Mr. CUBE



Mr. Wooden Box

#### Commercialization of High Power UE

High Power UE on Band 41 can significantly improve coverage and user experience at cell edge, meanwhile saving 15%-30% investment for operators.

In 2017, GTI promoted the **4 types of B41 HPUE** to be released. In the future, more is coming.



Samsung GS8



Samsung GS8+



LG G6



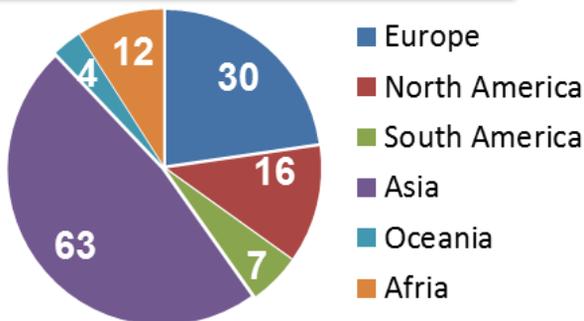
ZTE-MAX

※ To meet in deferent requirements in deferent market, **Band 40 HPUE** is under Standardization

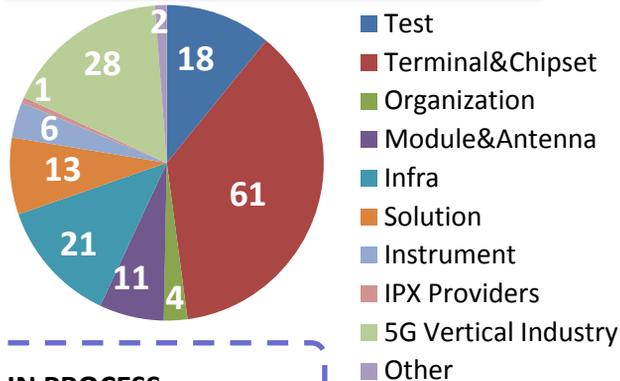
# GTI Members Updates and Activities in 2018

## 132 Operators and 165 Partners Joined GTI by Q1, 2018

132 Operators



165 Industry Partners



**3 MEMBERS ARE IN PROCESS**

### Vertical Industry Partners

Including IoT, IoV, Communication Capability, Industrial Internet, Cloud Robot, VR/AR

- ✓ BAIC
- ✓ Changhong
- ✓ CloudMinds
- ✓ EVE Energy
- ✓ Feitian
- ✓ BOCO
- ✓ GAEI
- ✓ Goertek
- ✓ Haier
- ✓ Hisense
- ✓ IESLab
- ✓ Ehang
- ✓ Jinan Towngas
- ✓ LeAutolink
- ✓ Neusoft
- ✓ Oviphone
- ✓ Canny Robot
- ✓ Philips Lighting B.V.
- ✓ SAFT SA
- ✓ Shougang Automation Information
- ✓ iStaging
- ✓ Taiyo Yuden
- ✓ WapWag
- ✓ Wireless Car
- ✓ Xiaomi
- ✓ Bettershine

## GTI Activities

	Jan/Feb	Mar/Apr	May/June	Jul/Aug	Sep/Oct	Nov/Dec
<b>Summit</b>	Time: 27 <sup>th</sup> Feb. (MWC) Venue: Barcelona, Spain <b>GTI Summit</b> (including GTI Awards 2018)		Time: TBD (MWCS18) Venue: Shanghai, China <b>GTI Summit</b>		Time: TBD (MWC America) Venue: San Francisco, USA <b>GTI Summit</b>	
<b>Workshop</b>	Time: 22 <sup>nd</sup> -23 <sup>rd</sup> Feb. (MWC) Venue: Barcelona, Spain <b>The 21<sup>st</sup> GTI Workshop</b>		Time: TBD. (MWCS18) Venue: Shanghai, China <b>The 22<sup>nd</sup> GTI Workshop</b>		Time: TBD (ITU Telecom World) Venue: South Africa <b>TD-LTE Technology and Spectrum Workshop</b>	Time: TBD Venue: TBD <b>The 23<sup>rd</sup> GTI Workshop</b>
<b>Exhibition</b>	26 <sup>th</sup> Feb. -1 <sup>st</sup> Mar (MWC) Barcelona, Spain		TBD (MWCS18) Shanghai, China		TBD (ITU Telecom World) South Africa	TBD (PT EXPO China) Beijing, China
<b>Others</b>	Time: 23 <sup>rd</sup> Feb (MWC) Venue: Barcelona, Spain <b>GTI Night</b>		Time: TBD. (MWCS) Venue: Shanghai, China <b>5G Spectrum Forum</b>			

## Appendix 1 – Welcome to Join GTI (to operators)

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### More Information about GTI

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

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### How to Join GTI

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#### 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](mailto:GTI_Secretariat_list@lte-tdd.org) and/or [GTI@lte-tdd.org](mailto: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.

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#### 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](mailto:GTI_Secretariat_list@lte-tdd.org) and/or [GTI@lte-tdd.org](mailto: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)

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## More Information about GTI Partner Forum

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*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

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1. Fill out the application form (download from <http://gtigroup.org/joinUs.html>), and return to GTI Secretariat:  
[GTI\\_Secretariat\\_list@lte-tdd.org](mailto:GTI_Secretariat_list@lte-tdd.org) and/or [GTI@lte-tdd.org](mailto: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](mailto:GTI@lte-tdd.org)