GTI Industry Briefing

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GTI Summit 2018 Upheld 5G+AI for an Intelligent and Connected World

GTI Summit 2018 Shanghai, with the theme **"5G+AI, Go Intelligent and Connected",** was successfully held on June 27 during Mobile World Congress Shanghai 2018. Delegates from governments, organizations, operators, verticals and partners attended this summit to explore how 5G and AI will enable the future innovations for an intelligent and connected world.

Mr. Craig Ehrlich, Chairman of GTI
Much of what we are talking about 5G is actually happening and experiencing with some of the players of 4G world. In the future, we will do much more in 5G as evidenced by focus on AI. The combination of 5G and AI will unleash new possibilities and enable more exciting services and application in our society.

Mr. Chen Zhaoxiong, Vice Minister, MIIT of China
It is expected that GTI will play a more important role in 5G innovation development. Accelerate the maturity of 5G industry and promote the integration of next generation of information technology to build a smart society and create a better life.

Mr. Zhao Houlin, Secretary General of ITU
ITU expects GTI 2.0 to leverage its valuable experience in 1.0 phase and continue to serve as an effective platform that brings together partners from telecom industry and the verticals for joint innovation towards 5G.

Mr. Shang Bing, Chairman of China Mobile
China Mobile will proactively keep up with the new trend of everything intelligently connected, practice the Big Connectivity strategy and promote integration of 5G+AI, striving to become a leading operator with digital innovation.

The Summit attracted top leaders from operators like Bharti Airtel, NTT DOCOMO and Verizon, driving 5G development and exploring 5G use cases closely with verticals to pave the way for an intelligent and connected world.

Mr. Sunil Bharti Mittal, Chairman of GSMA & Chairman of Bharti Enterprise
Stated that the exponential demand on connections, data usage, connected devices and transitions in India market can only be met through 5G which is enabled by network with maximum reuse of legacy assets, devices with fine performance and readiness, Digital India Program and ecosystem with industry verticals.

Mr. Borje Ekholm, President and CEO of Ericsson
He believed that the 5G race is on and when use cases and business potential are defined and technologies for smooth introduction are available, 5G will meet consumer expectation and further enable smart tools and people.

Dr. Hiroshi Nakamura, EVP & CTO, NTT DOCOMO
NTT DOCOMO shared its goal of realizing brilliant life and industrial revolution with 5G and AI. Through its 5G open partner program and lab, DOCOMO has been exploring applications in various areas and making significant progress on remote control for construction equipment and remote medical services.

Mr. Ed Chan, SVP & Chief Technology Architect, Corporate Network & Technology, Verizon
Spoke on 5G's multipurpose capabilities for diverse scenarios and the need for building the next platform of innovation focusing on 5G standard, spectrum, technologies and passive infrastructures, asserting that 5G innovations are only limited by our imagination.

Dialogue: "5G in China: the enterprise story"

A joint report by GTI and GSMA was released at the summit. Mr. Mats Granryd, General Director of GSMA was interviewed by the moderator and commented that the report reveals the need for a supportive policy environment to incentivize industry collaboration and empower mobile operators to work with other sectors to innovate and launch new 5G services faster.

GTI Summit 2018 Upheld 5G+AI for an Intelligent and Connected World

Top leaders from verticals expect expedited development of 5G and AI technology to enable opportunities and innovation applications to all aspects of society.

Mr. Pan Weidong, Executive Director & VP & CFO of Shanghai Pudong Development Bank
He envisioned disruptive financial services and new business models enabled by 5G+AI and cross-industry innovation. Financial services disruption to reshape the business model: New customer experience, new customers: intelligent things, intelligent risk management, innovative inclusive-financial-system.

Mr. Li Zhenyu, VP & General Manager of Intelligent Driving Group of Baidu
He elaborated on how the Aollo Open platform and 5G accelerate the construction of a new ecosystem of autonomous driving and intelligent transportation. 5G-V2X + Apollo will achieve "safer, more intelligent, more efficient", and promote commercialization of autonomous driving in China and lead the deployment in the world.

Prof. Markku Tapio Kulmala, Director of Atmospheric Sciences Division of University of Helsinki
He shared the need for 5G in global air quality network for continuous and comprehensive observation to fight the global challenge of air pollution.

Ms. Caroline Chan, Vice President of Intel DCG.
She spoke on the pivotal role of 5G in realizing the "always connected PC" for continuously evolving user experience.

Release: GTI 5G Standard Module Industrial Cooperation Plan

"GTI 5G S-Module (Superior Universal Module) Industrial Cooperation Plan" was jointly released by Mr. Li Zhengmao, EVP of China Mobile and representatives from operators and industrial and vertical vendors, aiming at unifying the demands from verticals for 5G capability, lowering the application barriers and expanding the scale of application.

GTI 22nd Workshop Addressed Key Issues on 4G Evolution and 5G Development

The 22nd GTI Workshop took place during June 25-26 in Shanghai, China, bringing together more than 200 industrial leaders and experts from over 20 operators and 30 partners and organizations to discuss key issues and latest progress in 4G evolution and 5G development.

Eying pivotal topics around 4G evolution, 5G eMBB, M-IoT, Innovative Business and Application, the workshop shared the experiences in **Massive MIMO deployment, NB-IoT commercialization and 5G pre-commercial trials**, as well as exchanged considerations on **5G networking with network slicing, CU/DU deployment, enhanced indoor solutions and the MEC.** Meanwhile, the industry discussed challenges in 5G devices and suggested the launch of certification projects to facilitate chipset R&D and device quality assurance.

Besides, M-IoT and 5G-oriented applications around smart grid, smart city, smart factory and AR/VR were elaborated with innovative business models enabling wider cooperation for new markets.

Throughout the workshop some of the latest achievements such as universal modules, 5G and IoT key components and test solutions were demonstrated and deemed concrete progress of the industry.

Radio Communication Test Station

NB-IoT Rel14 Data Enhancement & Positioning Test & NB-IoT Cyper Security Test

Cellular IoT RF Front-end Solutions

GTI Night Debuted in Shanghai: Achievements Release and Sharing

Despite its regular presence in MWC Barcelona, GTI Night came to Shanghai on June 26th for the first time and gathered representatives from global operators, industry partners and organizations that packed the room.

While enjoying a pleasant vibe and delicacies, attendees witnessed the presentation ceremony for GTI recognized test lab and certified NB-IoT chipsets and modules. Meantime, whitepapers around IoT wireless solution, core network architecture, small-sized eSIM, service layer architecture and security technical implementation guide were released as major achievements of the GTI.

Besides, China Mobile, a founding member of the GTI introduced its latest devices and NB-IoT products, extending wider cooperation and calling upon more GTI members to share accomplishment in future GTI events.

Full list of recognized test lab, certified NB-IoT chipsets and modules

No.	GTI Recognized Test Lab	
1	China Mobile	
2	CTTL	
3	GERI	
4	TesTime	
NO.	**Certification No.**	**Product Identifier**
1	CH-2018-0001	MTK MT2625
2	CH-2018-0002	Hisilicon Boudica120
3	CH-2018-0003	Hisilicon Boudica150
4	CH-2018-0004	UNISOC 8908
5	CH-2018-0005	Sanechips RoseFinch 7100
6	MO-2018-0001	QUECTEL BC26
7	MO-2018-0002	SIMCom SIM7020C
8	MO-2018-0003	CHEERZING ML5530
9	MO-2018-0004	CHEERZING ML2510
10	MO-2018-0005	China Mobile M5310
11	MO-2018-0006	China Mobile M5311
12	MO-2018-0007	GOSUNCN ME3616
13	MO-2018-0008	RUIJIE RG-NB6118
14	MO-2018-0009	SIMWARE SN12-B8

Mobile Industry Works Together to Deliver Complete 5G System Standard on Time

3GPP TSG #80 Plenary Meeting has approved the completion of the standalone (SA) Release 15 5G specifications. After the release of the 5G NR specifications for non-standalone (NSA) operation in Dec. 2017, another essential step of standardization of 5G has been successfully completed. Now, the whole industry is taking the final sprint towards 5G commercialization. The completion of SA specifications which complements the NSA specifications, not only gives 5G NR the ability of independent deployment, but also brings a brand new end-to-end network architecture, making 5G a facilitator and an accelerator during the intelligent information and communications technology improvement process of enterprise customers and vertical industries. New business models will be enabled and a new era where everything is interconnected will be opened up for both mobile operators and industrial partners.

More than 600 delegates from the world's major telecom operators, network, terminals and chipset vendors, internet companies and other vertical industry companies have witnessed this historic moment for 5G.

• Balázs Bertényi, Chairman of 3GPP TSG RAN, said: “The freeze of Standalone 5G NR radio specifications represents a major milestone in the quest of the wireless industry towards realizing the holistic 5G vision. 5G NR Standalone systems not only dramatically increase the mobile broadband speeds and capacity, but also open the door for new industries beyond telecommunications that are looking to revolutionize their ecosystem through 5G.”

• Erik Guttman, Chairman of 3GPP TSG SA, adds: “The agreed completion of the stage 3 freeze milestone for the 5G standalone system has great significance. 5G promises a broad expansion of telecommunications, as an ever more central component of our economies, societies and individual activities. The 5G System opens the way for commercialization of services based on the New Radio and 5G Core Network and their advanced extensible capabilities. The new system provides the foundation for ongoing specialization for support of new business sectors, for unlike 4G and past generations, 5G supports the very specific requirements and individual service characteristics of diverse communications.”

• Georg Mayer, Chairman of 3GPP TSG CT, said: “Two years ago, 5G was seen as a vision or even just a hype – with the closing of Rel-15 3GPP has made 5G a reality within a very short time. The outcome is an amazing set of standards that will not only provide higher data rates and bandwidth to end customers but which is open and flexible enough to satisfy the communication needs of different industries — 5G will be the integration platform for heterogeneous businesses.”

It is firmly believed by the whole industry that, after 34 months of hard and efficient work, the carefully crafted and elaborately designed 5G specifications, a fruit of close collaborations and collective wisdom, will surely meet the high expectations.

O-RAN Founding & Board Meeting: 12 Operators Successfully Co-signed the Constitution Articles of the O-RAN Alliance

O-RAN, originally co-founded by AT&T, China Mobile, Deutsche Telekom, NTT DOCOMO and Orange, has held its first O-RAN Board meeting during MWC Shanghai 2018. Seven new members were also approved including Bharti Airtel, China Telecom, KT, Singtel, SK telecom, Telefonica and Telstra. Together, delegates from these 12 operators successfully co-signed the Constitution Articles of the O-RAN Alliance. This symbolic occasion marks the official foundation of the operator-driven initiative.

Open to all operators globally, the O-RAN Alliance is a world-wide, carrier-led effort to drive embedded intelligence and new levels of openness in the radio access network of next generation wireless systems.

At the meeting, Andre Fuetsch, president of AT&T Labs was elected as chair of the Board and Alex Jinsung Choi, SVP Strategy & Technology Innovation at Deutsche Telekom, was appointed as Operations Officer. In addition, Bharti Airtel, China Telecom, KT, Singtel, SK telecom, Telefonica and Telstra were approved as new Board members. This expands the number of Board Directors to 12. Furthermore, the Board approved the O-RAN architecture with an initial set of 7 working groups, which are:

WG1: Use Cases & Overall Architecture

WG2: Radio Intelligent Controller (RIC) (non-Real Time) & A1 Interface

WG3: RIC (near-Real Time) & E2 Interface

WG4: Open Fronthaul (FH) Interface

WG5: Stack Reference Design and F1/V1/E1/X2

WG6: Cloudification and orchestration

WG7: White Box Hardware

5G Network Slicing Summit at Mobile World Congress Shanghai 2018

China Mobile, Huawei and GSMA jointly hosted the 5G Network Slicing Summit at Mobile World Congress Shanghai 2018. It included guest speakers from 3GPP, 5GSA, Beckhoff, China Mobile, China Southern Power Grid, Huawei, LetinVR Digital Technology, PetroChina Huabei Oilfield Company, State Grid Corporation of China and Tencent, and aimed to address the critical issues in network slicing to promote the maturity of network slicing technology and industry，bring new power to the development of the industry.

The 5G era will soon be upon us, it is estimated that there will be 1.2 billion 5G connections by 2025, covering more people. It promises to usher in an era of incredibly fast, smart networks that will be more responsive and customizable than previous mobile generations offering the ability to cater to the diverse requirements of different vertical sectors. For example, one company may require ultra-reliable services, whereas another may need ultra-high-bandwidth or extremely low latency and the 5G network needs to be able to offer this different mix of capabilities and requirements at the same time. Based on the in-depth cooperation with industry partners, China Mobile has released slice templates for the three major industries, which has caused great repercussions in the industry. The international organization 3GPP introduced the 5G standard, which provides basic ability to support Network slicing. GSMA and 5GSA had set up relevant organizations/working groups to promote the commercial application of Network slicing. Besides, multiple industries partners such as China Southern Power Grid, Huawei, LetinVR Digital Technology, PetroChina Huabei Oilfield Company, State Grid Corporation of China and Tencent raised the actual demand for 5G network slicing. In the important stage of 5G, the representatives of slicing related SDO, operators, vendors and vertical companies share and discuss the latest progress in the summit on the deep cooperation across vertical and communications industry to enable industry digitization. After this communication, the summit will take the cross-industry integration application of network slicing to a new level.

Nokia Successfully Completes 5G New Radio Data Call with 4G and 5G Dual Connectivity in China

Nokia has successfully completed an end-to-end 5G New Radio (5G NR) data call as part of a Chinese Ministry of Industry and Information Technology (MIIT) 5G Technology R&D trial. The 3GPP-compliant dual connectivity call was conducted using a 5G NR system over-the-air on the 3.5GHz frequency band and LTE in the 2.1 GHz frequency band, supported by a 5G user equipment simulator provided by PRISMA Telecom Testing.

For existing 4G operators, dual connectivity will allow them to more rapidly create 5G coverage and services by connecting 5G NR to a 4G radio that is connected to an existing Cloud Packet Core. The successful 5G NR data call is an important step toward the verification of 5G in the sub-6 GHz frequency bands, which is required for wide-area coverage and massive IoT connectivity, in preparation for commercial deployment in China in 2020.

China, the world's most populous country, will be one of the first adopters of 5G and a leader in the technology, which will deliver new possibilities for consumers and industries alike. For example, consumer entertainment will be enhanced by super-fast downloads of HD videos in seconds, and new virtual reality experiences will be made possible. 5G will also enable connectivity for billions of IoT devices, driving new levels of automation and the ability to leverage artificial intelligence to transform industries and economies.

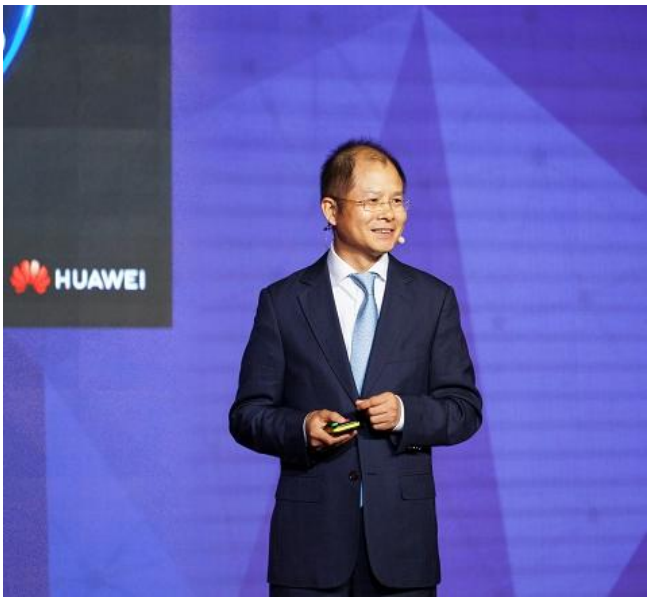
The end-to-end data call used the Nokia AirScale Cloud RAN, Nokia AirScale baseband unit, Nokia 5G Massive MIMO Active Antenna, Nokia Cloud Packet Core and Nokia home subscriber service together with a 5G end user equipment simulator provided by PRISMA Telecom Testing. The Nokia AirFrame data center solution was used to control the Cloud RAN. Nokia will continue to work with MIIT through 2018 trialing 5G in the 4.9 GHz frequency bands.

Marc Rouanne, president of Mobile Networks at Nokia, said: "We are pleased to showcase our end-to-end capabilities in 5G in this successful call and trial with MIIT. Nokia is ready to support dual connectivity with the AirScale radio access portfolio as it is upgradeable via software to 5G and provides single RAN support for 4G, 4.5G Pro and 4.9G as well as legacy technologies. As a result we can help our customers meet their early 5G deployment schedules and initial coverage demands."

Enrico Bendinelli, President of PRISMA Telecom Testing, said: "We are excited about this successful collaboration with Nokia, which lays a fundamental stepping stone in the evolution of 5G. PRISMA Telecom Testing is a key global player in the Radio Access Network testing arena, capable of supporting all 3GPP mobile technologies. With our activities currently spanning from R&D to technology integration and field trials we support our customers through all development stages of the new 5G standard."

Huawei Rotating Chairman Eric Xu: Bringing MBB to a New Level with 5G

Mobile World Congress Shanghai 2018 opened at the Shanghai New International Expo Center on June 27. Huawei Rotating Chairman Eric Xu addressed the audience in his keynote speech titled *Bringing MBB to a New Level with 5G*. Xu expressed his hope that 5G would bring the mobile Internet – especially mobile video – to a level comparable to mobile voice service today, allowing users to enjoy mobile broadband services wherever and whenever they want. Xu also expressed his expectation that 5G would nurture new basic services and drive the sustainable growth of the mobile communications sector.



Xu emphasized that 5G standards are the result of joint collaboration between global organizations. As a major 5G standards contributor and patent holder, Huawei will follow the FRAND principle – Fair, Reasonable, and Non-discriminatory – as it has always done. During the standardization process, Huawei will continue to recommend innovative technologies to other industry players, and will never squeeze other companies or society as a whole.

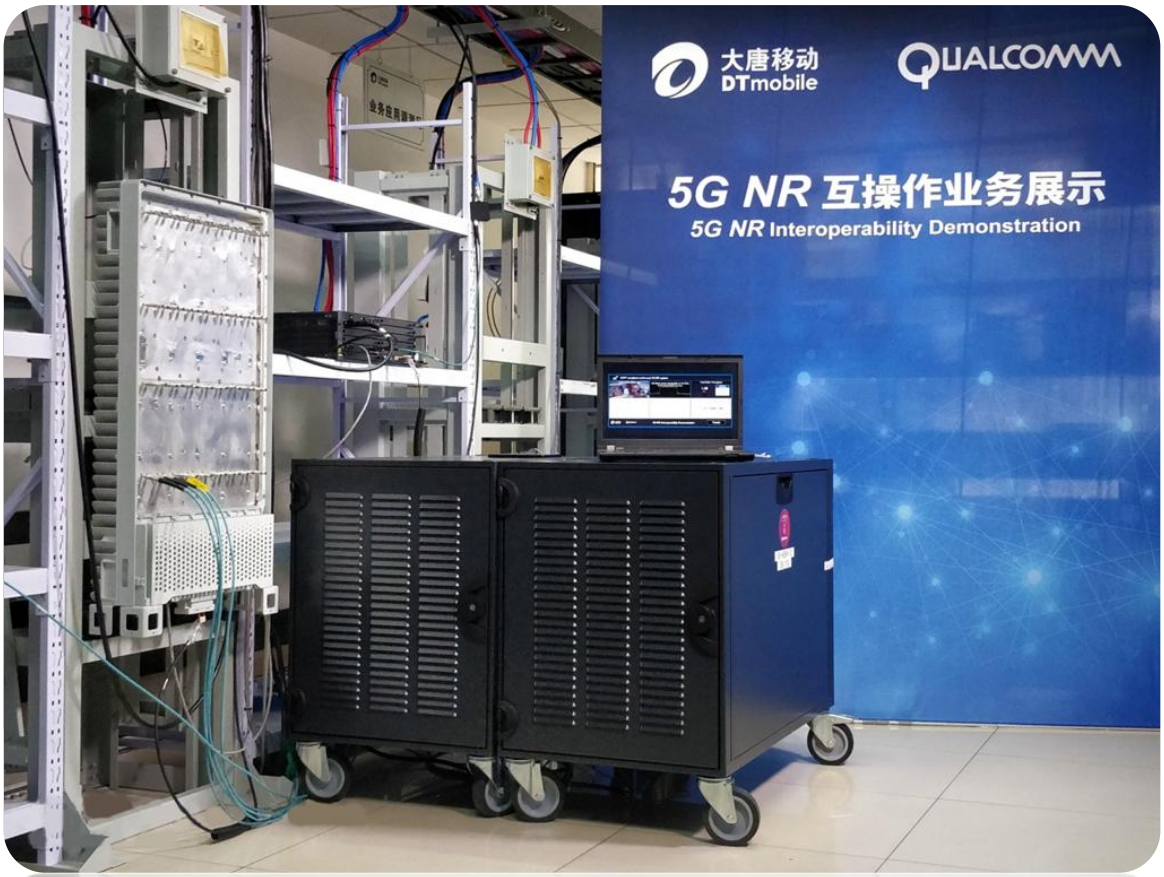
Huawei will work with the industry to deliver the 5G mission

3GPP has completed the standalone R15 5G specification. And 5G spectrum has been made available in some countries. 5G will soon be deployed on a large scale. To help global carriers roll out 5G networks, Huawei will launch E2E NSA 5G commercial systems on September 30, 2018, and E2E SA 5G commercial systems on March 30, 2019. Huawei will also launch a 5G-ready Kirin chip in 2019, and a 5G smartphone in June 2019. These products will allow consumers that want higher speeds to enjoy an incredible 5G experience as soon as possible. Huawei is ready to work with our industry partners, to invest and to innovate, so that together we can succeed in delivering the 5G mission.

Datang and Qualcomm Complete 5G NR Interoperability and Development Testing

In April, Datang Mobile and Qualcomm Technologies announced collaboration on 5G NR Interoperability and Development Testing (IODT) in 3.5 GHz band based on 3GPP Release 15 specifications. The testing utilized 3GPP 5G NR spec compliant base stations from Datang Mobile and user equipment (UE) from Qualcomm Technologies.

Today, Datang and Qualcomm has completed the interworking of physical layer. The throughput of Downlink (4 layers, 256QAM) exceeds 1.3Gbps.



A 5G NR IODT is the foundation to enable the interoperability between the UE, radio access network and core network, and an essential step toward 5G commercialization and deployment at scale. The IODT between Qualcomm Technologies and Datang Mobile will accelerate the rollout of 5G NR commercial deployments in 2019.

China Mobile, Intel and Huawei Complete 5G NR IODT

July 10, China Mobile (CMCC), Intel and Huawei announced that the three parties completed 5G interoperability and development testing (IODT) in compliance with the latest 3GPP Release15 Standard. This was multi-vendor 5G NR IODT with full protocol, full channel, and full procedure finished, which means that 5G network and 5G terminals from different vendors can not only perform functional tests, but also can further implement 5G service tests, support various enhanced Mobile Broadband services such as ultra-high-definition video and VR. This is a key step to end-to-end 5G commercialize system.

The test was conducted at the China Mobile Research Institute. Based on the largest C-band cell bandwidth defined by the 5G NR standard incorporating the latest Massive MIMO multi-antenna technology, the test completed by CMCC, Intel and Huawei successfully verified the rationales of the 3GPP 5G NR standard, and realized the interconnection of the NR-compliant terminal and network. With the 64T64R Massive MIMO configuration integrated in the base station test setup and Intel 2T4R terminal, the data transfer rate is expected to reach as high as 1.5Gbps, which can support 8K video, VR services.

This year, China Mobile plans to carry out 5G trials in several big cities, which can not be achieved without the support of commercial terminals. Huang Yuhong, vice president of China Mobile Research Institute expressed full affirmation of the test progress: "The success of this interoperability test can provide more kinds of terminals for the follow-up China Mobile's 5G scale test, and also providing a large-scale verification of 5G. China Mobile will launch the first pre-commercial terminals in 2019, which will play an important role in such areas as mobile broadband, industry video and smart manufacturing. “

As the world is gaining its pace to meet the goal of 5G deployment by 2020, CMCC, Intel and Huawei will continue to help the industry prepare for the coming 5G era with further cooperation.

Nokia Launches Industry-First Edge Cloud Data Center Solution for the 5G Era

Nokia has launched the industry's first Edge Cloud data center solution to meet the stringent and diverse low-latency data processing demands of Cloud RAN and advanced applications for consumers and industries. The Nokia AirFrame open edge cloud infrastructure expands the Nokia AirFrame portfolio to deliver a layered network architecture that optimizes performance and operator costs as they evolve their networks and prepare for 5G.

The AirFrame open edge cloud infrastructure has been developed for the 5G era, as the next generation wireless technology will create opportunities for operators to support advanced applications for consumers and industries, such as virtual and augmented reality video and real-time industry automation. Technologies such as Cloud RAN will be key to deliver on the 5G promise of ultra-low latency and massive data throughput, and will need to be supported by a highly efficient cloud infrastructure solution.

To balance costs and functionality, 5G will encourage operators to implement a layered cloud architecture. This will include centralized and regional data centers as well as high-processing capabilities deployed at the network edge - closer to where traffic is generated and where space is traditionally limited.

The Nokia AirFrame Open Edge server, which will begin shipping during the third quarter of 2018, extends the Nokia AirFrame data center solution portfolio to make these edge deployments a reality. Designed in an ultra-compact size for deployment even at base station sites, the Nokia AirFrame open edge server will meet the most stringent end-customer data demands. Nokia's comprehensive portfolio of AirFrame data center solutions enables operators to optimize network resources and intelligently distribute workload across the network, based on the type of data traffic as well as latency and throughput needs.

The hardware solution is complemented with a real-time, Open Platform for NFV (OPNFV)-compatible, OpenStack-distribution built to run in small data centers while providing the performance and low latency required by the edge environment. In addition, Nokia cloud-wise services and Cloud Collaboration Hubs will help operators successfully plan and execute their edge cloud deployments.

Marc Rouanne, president of Mobile Networks at Nokia, said: "The edge cloud will play an essential role in delivering the compute power required for 5G. By expanding our AirFrame and 5G Future X portfolio we can provide a network architecture that meets the needs of any operator and their customers. Used with the Nokia ReefShark chipset and our real-time cloud infrastructure software, the Nokia AirFrame open edge server will deliver the right decentralization of 4G and 5G networks. We can work with operators to ensure that data center capabilities are deployed exactly where they are needed to manage demands as they expand their service offering."

Huawei Establishes Industry's First Open Lab for Low Latency Technology Development

During the World Mobile Congress Shanghai 2018, Huawei announced the establishment of the industry's first open lab for low latency technology development at its Shanghai Research Center. This marks a new era of innovations and collaborations in the field of LTE low latency. The opening ceremony of the open lab was attended by many distinguished guests. Such notable representatives include the Vice President of CAICT and the Executive Director of China TTL He Guili, the Director of Huawei Wireless R&D Mgmt Dept Li Zhoujian, as well as other esteemed participants from nine industry partners such as Tencent, NetEase, Alibaba ,Intel, Spreadtrum, and Vivo.

Following data rate and coverage, latency has become a new indicator for user experience measurement and opened up plenty of market opportunities. For example, there are over 2.1 billion mobile gamers worldwide. Mobile gaming is now a $US 46 billion industry and enjoys a 12.5% annual growth. Gamers are willing to purchase value-added low-latency services from game providers, and game providers expect operators to offer differentiated solutions. This makes the monetization of low-latency network capabilities possible. With the acceleration of global digital transformation and the imminent arrival of 5G, LTE technologies have been significantly enhanced in terms of data rate, coverage, and latency since 3GPP Release 15. The introduction of Short TTI and other low latency technologies greatly reduces network latency, meeting the basic requirements of the 5G era. Based on existing LTE networks, 5G applications and business models can be incubated to help pave the way for future evolution.

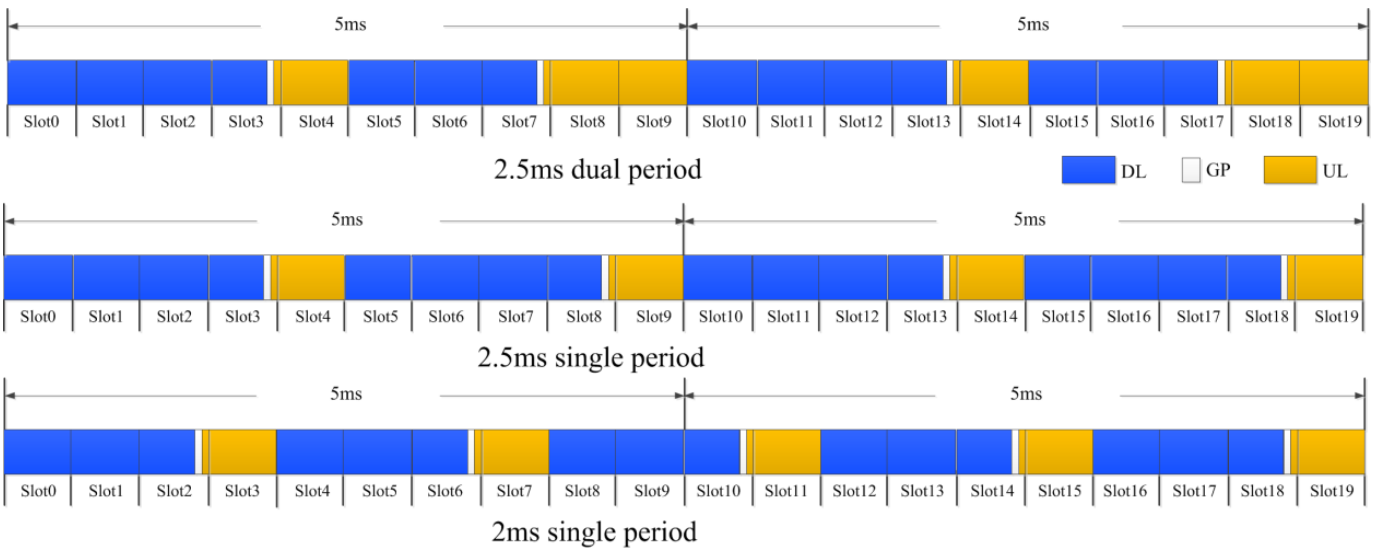
The maturity of the industry chain is crucial. Huawei's open lab for low latency technology development aims to provide an E2E platform for interworking tests, application development, and experience exchange. Huawei, together with industry partners, strives to stimulate the development of the entire low latency industry chain involving network, terminal, chip, and vertical industries. Five industry partners have worked with Huawei's open lab for low-latency technology verification and interworking. The initial research covers applications such as mobile games, mobile payment, and remote driving, which will continue to expand well into the future.

At the opening ceremony of the open lab, Li Zhoujian, Director of Huawei Wireless R&D Mgmt Dept, said: “Industry partners are very welcome to take part in this opening ceremony. Latency is one of the most important factors that influence user experience. Huawei is committed to developing innovative solutions to effectively reduce network latency and improve user experience. We will actively promote the monetization of low-latency network capabilities. With this open lab, we hope to provide an open platform and work closely with industry partners to explore low-latency applications, incubate new business models, and create a better connected world.”

Datang's Proposal of Dual Period Frame Structure for 5G eMBB was Approved by IMT-2020(5G)

3GPP R15 standard was released in December 2017. In subsequent 5G trial, different frame structure proposals conforming to 3GPP standard were put forward. Datang's proposal of 2.5ms dual period frame structure was approved as unified frame structure for eMBB scenario on 3.5GHz&4.9GHz band by IMT-2020(5G) Promotion Group in May 2018, and would be used in scale trial and commercial deployment.

The 2.5ms dual period consists of two concatenated period. The first 2.5ms period includes DDDSU, and the second period includes DDSUU. The 2.5ms dual period has more uplink slots than single period and is the most advantageous in terms of uplink capacity and uplink coverage.



According to link budget and simulation results, the 2.5ms dual period has the advantages as follows:

- 7 SSBs is supported to enhance DL common channel coverage
- Long PRACH is supported to enhance capability of UL access
- Higher uplink capacity
- Higher uplink coverage performance
- Higher uplink data rate of edge user
- lower GP overhead
- appropriate ratio for UL and DL configuration

Huawei Debuted Its C-V2X Strategy and First RSU Commercial Solution

During the Mobile World Congress (MWC) Shanghai 2018, Xu Wenwei, Huawei's Executive Director and President of Strategic Marketing, interpreted Huawei's strategy for cellular vehicle-to-everything (C-V2X). He highlighted, "Huawei has long invested in the IoV, putting emphasis on connections and information and communications technology (ICT) infrastructure. We do not monetize data, nor develop or operate apps. Huawei has positioned itself as a facilitating role in the development of IoV and intelligent digital transportation. Together with customers and partners, Huawei is committed to building an inclusive and multi-beneficial IoV ecosystem spanning different industries."

In view of the global industry development, Mr. Xu called for unified technical standards and unified spectrum planning and distribution. A prosperous and harmonious cross-industry ecosystem can give rise to favorable industry polices and expedite commercial use.

He also proposed that C-V2X can enable coordination among pedestrians, vehicles, and infrastructure, and turn vehicles into the next smart terminal. Meanwhile, automatic driving is also dependent on the multi-lateral coordination, as it makes vehicles smarter, road infrastructure better, and transportation safer.

Veni Shone, President of Huawei LTE Product Line and Vice Chairman of China Intelligent Transportation System Industry Alliance, launched the world's first Road Side Unit (RSU) supporting concurrency of Uu and PC5.

This is Huawei's first C-V2X commercial product. The RSU also has other highlights. It takes the lead in supporting communication encryption over the Uu and PC5 interfaces to ensure safe communications. Wired and wireless access modes are used to flexibly connect road facilities such as signal controllers, facilitating project deployment. The RSU also supports Global Positioning System (GPS) and China's BeiDou Navigation Satellite System (BDS). Owing to the RSU, the latency over PC5 is less than 20 ms, and the PC5 supports 20 MHz bandwidth of the 5.9 GHz frequency band, which is a frequency band deployed by most countries for Intelligent Transportation System (ITS).

Nokia and China Mobile to Set Up Joint AI*5G Lab for Further Research Using AI and ML in 5G Networks

Nokia and China Mobile have signed a MoU to investigate the potential of artificial intelligence (AI) and machine learning (ML) to optimize future networks and enable the delivery of new Edge Cloud and 5G services. The companies will jointly establish a laboratory in Hangzhou, China to develop the demo system to verify technology use cases using Nokia 5G Future X architecture, while China Mobile will lead the research in terms of scenario selection, requirements confirmation, open API standardization and solution definition.

As massive and rapidly changing connectivity and coverage demands are placed on 5G networks by billions of IoT devices and a growing array of consumer services, networks will need to predict and respond to those changes in real-time. Under the new agreement, Nokia and China Mobile will work together to research the application of AI and machine learning to ensure any changes in demand are predicted and network resources are automatically allocated to meet all service demands with consistent high quality and reliability.

At the new laboratory in Hangzhou, Nokia and China Mobile will foster an open RAN and 5G ecosystem working with third parties to leverage AI and machine learning and optimize networks for the delivery of services such as cloud virtual reality gaming. The companies' research will use the Nokia AirScale Cloud RAN, AirFrame OpenRack, open edge server and ReefShark chipsets, as well as Nokia-developed AI middleware to access embedded intelligence. Nokia and China Mobile will also conduct technology field trials and demonstrations.

Yuhong Huang, Deputy General Manager of China Mobile Research Institute (CMRI) said: "China Mobile has been paying attention to the application of artificial intelligence for a long time, and making effort to build an open and collaborative 5G+AI ecosystem. With the signing of this MoU, weare pleased to t initiate the collaboration on the research of big data and machine learning technologies applying to 5G RAN network, and make joint effort in the O-RAN alliance which was kickoffed recently to enhance the intelligence of 5G network, reduce the complexity, and explore the new capabilities of network."

Marc Rouanne, president of Mobile Networks at Nokia, said: "The work we are doing with China Mobile is a prime example of how we can help our customers unlock the potential within their 5G networks using open interfaces and toolkits. The use of AI and machine learning will enable myriad new services opportunities and we are pleased to leverage the capabilities of our 5G Future X architecture to support China Mobile' AI research to optimize future networks and the delivery of many innovative new services."

First End-to-End Multi-Vendor 5G Commercial Network Data Call

Ericsson, Telstra and Intel have taken 5G out of the Lab and into a real-world mobile network environment as we successfully completed the first end-to-end 5G non-standalone (NSA) 3GPP data call on a commercial mobile network at Telstra's 5G Innovation Centre on the Gold Coast Australia in a multivendor setup.

The call was the first of its kind over 3.5GHz spectrum, bringing together the core components from multiple companies required for a real commercial 5G network call. It included Telstra's 5G NSA commercial network, licenced 3.5GHz commercial spectrum, Ericsson's commercial 5G NR radio 6488, baseband and packet core for 5G EPC, a personal Telstra SIM card and the Intel® 5G Mobile Trial Platform for the 5G NR UE.

This milestone quickly follows the July 6 lab-based data call by Ericsson and Intel, together with Telstra and other early-moving 5G service providers at the Ericsson Lab in Stockholm, accelerating efforts to deploy commercial 5G networks.

Telstra's Group Managing Director Networks Mike Wright, says: "Demonstrating this 5G data call end-to-end using my own personal SIM card on Telstra's mobile network is the closest any provider has come to making a 'true' 5G call in the real world-environment, and marks another 5G first for Telstra. We continue to work with global technology companies Ericsson and Intel as well as global standards bodies to advance the deployment of commercial 5G capability in Australia."

Fredrik Jejdling, Executive Vice President and Head of Networks at Ericsson, says: "We're quickly moving towards 5G commercial reality. Achieving the first commercial data call with our partners Telstra and Intel shows the progress we've made from testing the technology in a lab to a 5G commercial network environment. 5G is open for business and Ericsson is helping customers get it done."

Asha Keddy, vice president and general manager, Intel Next Generation and Standards, says: "Along with Ericsson and Telstra, Intel continues to demonstrate its strong 5G technical capability, as showcased by this first 5G data call on commercial infrastructure deployed in Telstra's network. Intel will continue to collaborate on 5G tests and multiple use cases ahead of Telstra's planned 5G commercial launch that will bring powerful, low-latency and high-bandwidth experiences to consumers."

Nokia Bell Labs and NTT DOCOMO Collaborate on 5G Innovations for Future Wireless Applications

Nokia and NTT DOCOMO were collaborating at the Brooklyn 5G Summit to showcase a 5G technology innovation that will deliver massive-capacity to address the increased demand in video data and applications.

Nokia and NTT DOCOMO are working together to create technologies that will support the delivery of enhanced mobile broadband applications for 5G. The widespread availability of applications such as real-time virtual and augmented reality video will enable new capabilities for both industries and consumers. Delivery will rely on ultra-responsive networks with massive wireless capacity in dense deployment scenarios.

At the Brooklyn 5G Summit, Nokia, supported by NTT DOCOMO, will show two technology innovations being developed to address these demands:

•The companies will apply a Nokia Bell Labs-developed compact mmWave phased-array antenna system scalable up to 256-elements using an integrated circuit (RFIC) solution in the 90 GHz frequency band to enable multi-gigabit per second speeds. The test will demonstrate how using 5G New Radio (5G NR) enhancements at higher mmWave frequency bands can manage radio complexity and a larger number of antenna beams, while enabling greater bandwidth. It will also show how using a larger number of antenna elements at higher frequency bands can minimize pathloss to enable coverage similar to that found using lower mmWave bands.

•A joint demonstration will also show how dynamic offloading relocation in a 5G core will enable the low-latency networks required to support time critical mobile broadband applications for future automation and augmented reality.

Nokia and NTT DOCOMO will continue to test these technologies in NTT DOCOMO's research lab at the Yokosuka Research Park in Japan. The companies will investigate how the Nokia Bell Labs developed RFIC solution operating in the 90 GHz frequency band will enhance coverage in a variety of scenarios, including urban, suburban and in-building environments to meet the massive connectivity demands of consumers and businesses in Japan.

Hiroshi Nakamura, EVP and CTO at NTT DOCOMO, said: "These demonstrations at the Brooklyn 5G Summit build on a long collaboration with Nokia. Working together, we want to accelerate the evolution of 5G technologies especially towards pioneering higher frequency bands such as 90 GHz."

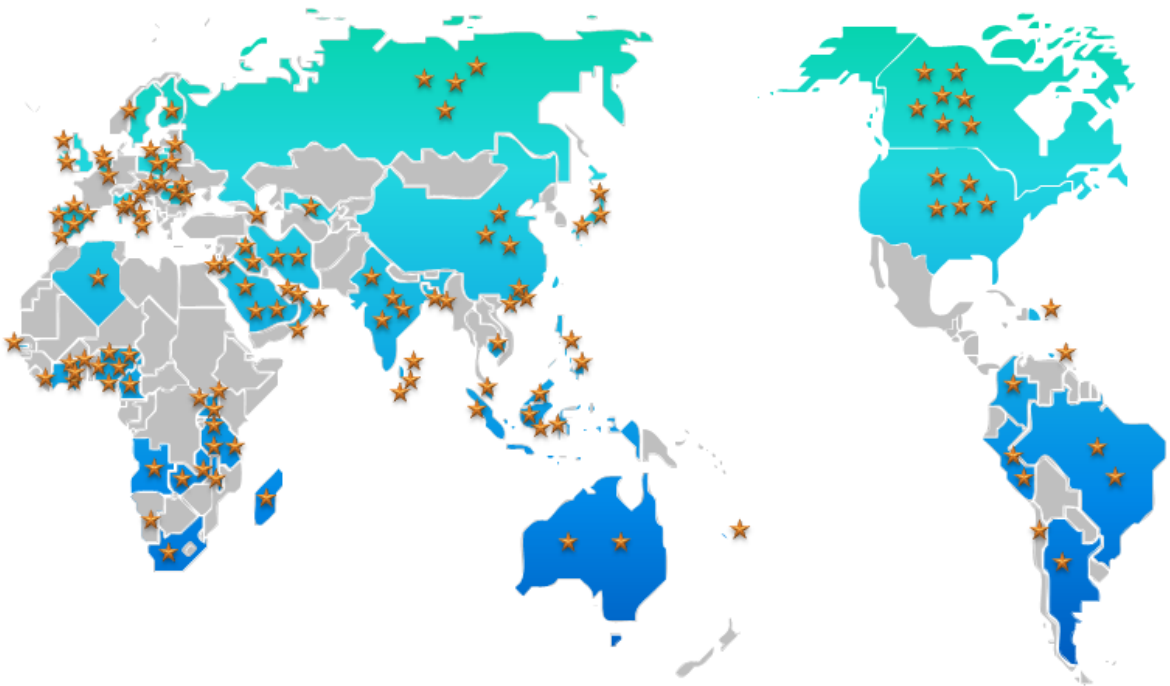
Marcus Weldon, President of Nokia Bell Labs, said: “At Bell Labs, we work with leading operators such as NTT DOCOMO to develop disruptive technologies that will redefine human existence. At the Brooklyn 5G Summit, we will show the world‘s first RF solution that addresses the challenge of delivering optimized coverage for future mmWave frequencies, using a pioneering RFIC design that can be scaled to any array dimension and deliver optimized connectivity to any set of devices.”

TD-LTE Global Market Overview

Global Deployment as the Mainstream Mobile Broadband Technology

122 *TD-LTE commercial networks have been launched*

Additionally, over ***152*** *TD-LTE commercial networks are in progress or planned*



Source: GTI, TDIA, GSA
By Q1, 2018

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

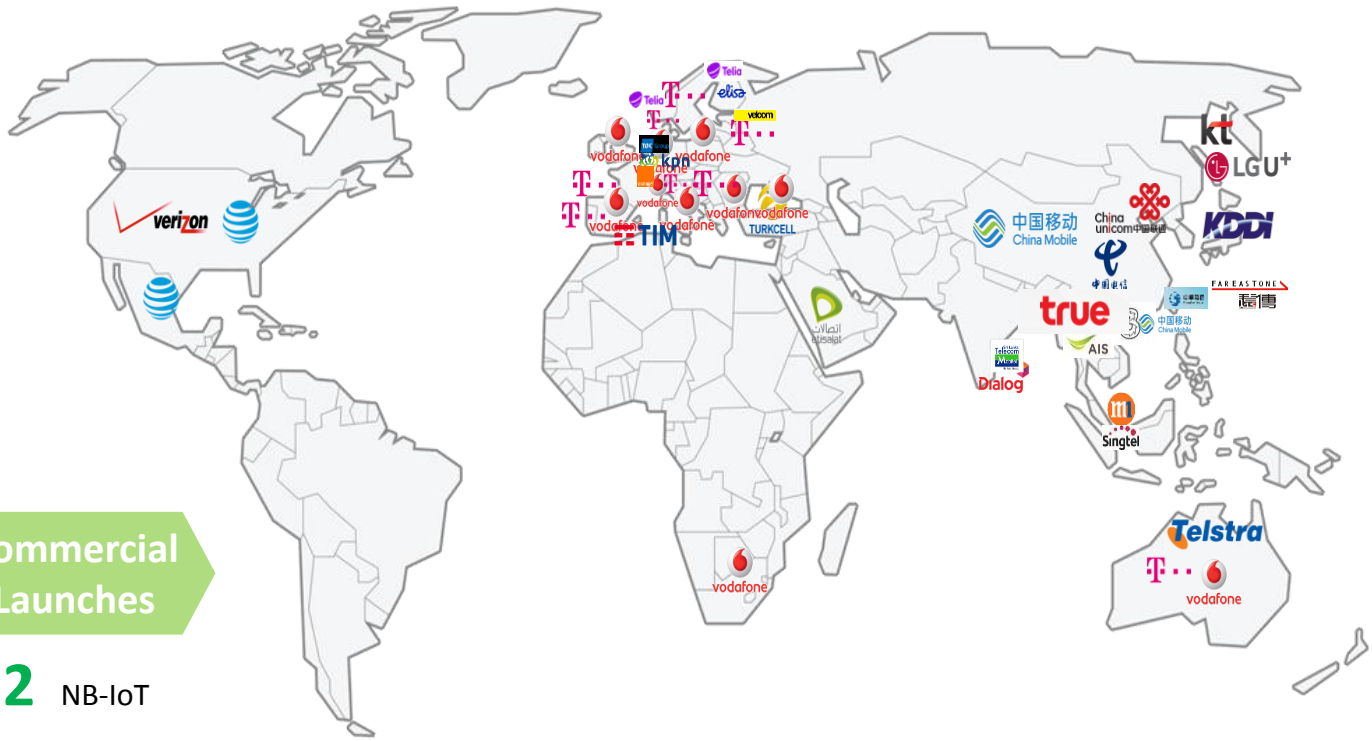
637+ suppliers have launched 8014+ TD-LTE terminals,
including 6045+ TD-LTE Smartphones.

TD-LTE Device Type	Quantity	TD-LTE Device Type	Quantity
USB modems	179+	*Smartphones*	6045+
MiFi/CPE	1233+	*Mobile Tablets*	196+

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

M-IoT Global Market Overview

Maturing M-IoT Industry Facilitates M-IoT Commercial Launches on a Global Scale



Commercial Launches

52 NB-IoT

11 eMTC

Industrial Maturity

RAN/CN

HUAWEI, 大唐电信科技产业集团, NOKIA, ZTE中兴, ERICSSON

Chipset

HISILICON, SEQUANS COMMUNICATIONS, SANECHIPS 中兴微电子, intel, QUALCOMM, RDA, MEDIATEK everyday genius, altair A SONY Company

Module

Fibocom 广和通, ublox, QUECTEL, ZTEWelink, SIMCom

Test Platform

星河亮点 StarPoint, Anite, ROHDE&SCHWARZ, KEYSIGHT TECHNOLOGIES, COBHAM

GTI Latest Achievements and Breakthroughs

Latest Breakthroughs and Accomplishments

9 New Released Whitepapers

GTI IoT Service Layer Architecture Whitepaper

The underlying mobile network is an existing large-scale platform for bearing the IoT services. Getting the underlying transport network capability to be exposed to the IoT applications in a simple way while offering additional and commonly needed functions and guaranteeing a robust protection of the network from inefficient usage will provide differentiated competition for mobile operators' IoT platforms versus other over-the-top offerings.

GTI IoT Security Technical Implementation Guide

The IoT terminal security is the entrance to all data of IoT. At present, the security of IoT presents a top-heavy security posture, and there is no guide to security technology development for IoT terminals in the industry. This whitepaper is devoted to releasing GTI IoT terminal security technical guide to enhance the safety awareness of manufacturers, improve the safety of existing IoT terminals, and promote the safe, stable and healthy development of IoT industry.

GTI IoT Wireless Solution Whitepaper

This whitepaper introduces the development of Cellular IoT technology and the evolution of standards, and focuses on the analysis of NB-IoT and eMTC's experiences in network deployment strategies, network planning and optimization. In the meantime, the whitepaper also makes a detailed comparison between Cellular IoT technologies and other LPWA technologies.

GTI IoT Core Network Architecture Whitepaper

This whitepaper gives a description on IoT use case analysis, core architectural requirement and EPC optimized architecture to support NB-IoT or enhanced MTC devices. This whitepaper also investigates how to leverage NFV and other emerging network technologies to realize optimization of Cellular IoT core network architecture, deployment strategy and service capability exposure architecture.

GTI IoT Small-sized eSIM UICC Whitepaper

With the development of miniaturization of Cellular IoT modules, the module size can be 16x18mm, but the minimum size of eSIM card defined in current international standards is 5x6mm, which cannot meet the demand for module miniaturization. This whitepaper intends to solve such problems and defines smaller eSIM Card Size (2x2mm) to promote the development of Cellular IoT Business.

GTI Guideline for Device Certification V2.0.0

This document is the guideline for GTI Device Certification, which contains GTI certification architecture, definition of certification objects, certification procedure and criteria as well as procedure of test platform validation and test lab accreditation. In addition, the test certification requirements for NB-IoT module are also included in the guideline.

GTI Latest Achievements and Breakthroughs

Latest Breakthroughs and Accomplishments

9 New Released Whitepapers

GTI Sub-6GHz 5G Device Whitepaper

This White Paper is necessary to facilitate the development of 5G chipset/ device and the corresponding test instruments. It targets enhanced Mobile Broadband (eMBB) scenario for Sub-6GHz 5G pre-commercial and commercial products, which is conducted to be the technical references for the development of chipset/ device and the basis for the 5G precommercial and commercial products specs.

GTI Massive MIMO Whitepaper

As a massive-antenna technology in the 4G era, Massive MIMO has been widely regarded as an ever energizing technology since 4G rollout. It takes the unrivaled advantages of LTE TDD spectrum to achieve revolutionary breakthroughs in network performance for operators. This revolutionary technology is a great prelude to the future-oriented network.

GTI NB-IoT Interoperability Test Specification

This document defines the Inter-Operatability test cases for NB-IoT chipsets, modules and devices.

13 Whitepapers and Technical Reports

have been released in GTI Summit 2018 Barcelona

To get the full version of GTI Whitepapers,
-View on the GTI website http://gtigroup.org/Resources/rep/
- Scan the QR code to download GTI APP to view

GTI APP

GTI Latest Achievements and Breakthroughs

Latest Breakthroughs and Accomplishments

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

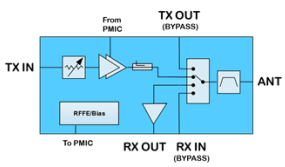



Promoted 5G RF Components Commercialization

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

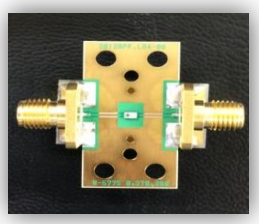
- High-integration: power amplifier, filter, switch, LNA
- Optimize the matching within RF FEM
- Reduce RF front-end insertion loss
- Optimize the RF performance of device

Qorvo
(3.5mm x 6mm)

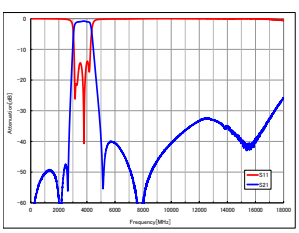


World's 1st Sub-6GHz 5G Device High Power Multilayer Ceramic Filter Prototype

- 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 Latest Achievements and Breakthroughs

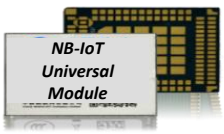
Latest Breakthroughs and Accomplishments

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

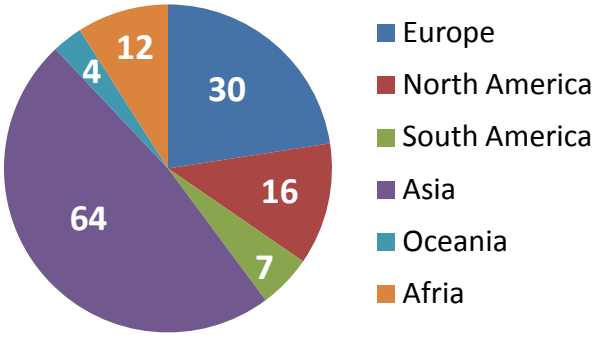
ZTE-MAX

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

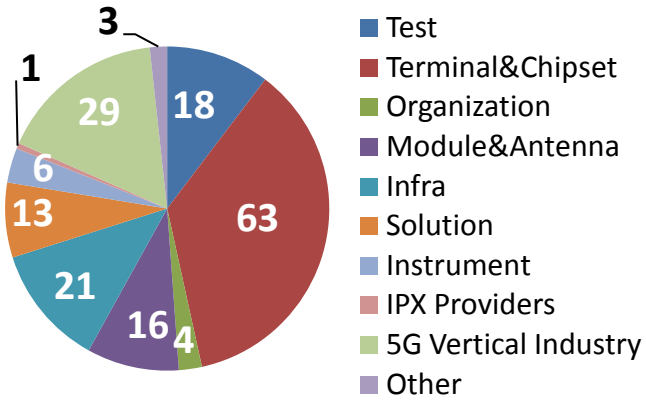
GTI Members Updates and Activities in 2018

133 Operators and 174 Partners Joined GTI by Q2, 2018

133 Operators



174 Industry Partners



Vertical Industry Partners

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

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

GTI Activities

2018	Jan/Feb	Mar/Apr	May/Jun	Jul/Aug	Sep/Oct	Nov/Dec
Summit	Time: 27th Feb (MWC) Venue: Barcelona, Spain **GTI Summit (including GTI Awards 2018)**		Time: 27th Jun (MWCS18) Venue: Shanghai, China **GTI Summit**			
Workshop	Time: 22nd -23rd Feb (MWC) Venue: Barcelona, Spain **The 21st GTI Workshop**		Time: 25th -26th Jun (MWCS18) Venue: Shanghai, China **The 22nd GTI Workshop**		Time: 10th Sep (ITU Telecom World) Venue: Durban, South Africa **TDD Spectrum and Technology Workshop**	Time: 5th-6th Nov Venue: Vancouver, Canada **The 23rd GTI Workshop**
Exhibition	26th Feb. -1st Mar (MWC) **Barcelona, Spain**		25th -26th Jun (MWCS18) **Shanghai, China**		10th-13th Sep (ITU Telecom World) **Durban, South Africa**	TBD (PT EXPO China) **Beijing, China**
Others	Time: 23rd Feb (MWC) Venue: Barcelona, Spain **GTI Night**		Time: 26th Jun. (MWCS) Venue: Shanghai, China **GTI Night**			

Appendix 1 – Welcome to Join GTI (to operators)

More Information about GTI

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

How to Join GTI

GTI Operators (with TDD Spectrum)

1. Fill out the application form (download from http://gtigroup.org/about/join/2013-11-11/1419.html), and return to GTI Secretariat: admin@gtigroup.org;

2. Sign the Accession Form and return the signed copy to 5 initiators;

3. Once the participation process finishes, a GTI website account and associated password will be assigned to the new participant.

GTI Observers (without TDD Spectrum)

1. Fill out the application form (download from http://gtigroup.org/about/join/2013-11-11/1419.html), and return to GTI Secretariat: admin@gtigroup.org;

2. Sign the declaration form and return the hard copy to GTI Secretariat;

3. Once the participation process finishes, a GTI website account and associated password will be assigned to the new participant.

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

More Information about GTI Partner Forum

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

How to Join GTI Partner Forum

1. Fill out the application form (download from http://gtigroup.org/about/join/2013-11-11/1422.html), and return to GTI Secretariat: admin@gtigroup.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:

admin@gtigroup.org