GTI Industry Briefing

April, 2019 | No. 34

Edited by GTI Secretariat April, 2019

Contents

Top News

GTI Summit 2019 with the Theme of "5G, Closer than Ever" Successfully Held @MWC19	01
The 24th GTI Workshop Accelerates 4G Evolution and 5G Pre-commercial Development	03
GTI Awards 2019 Winners Unveiled during GTI Night	04

Industry

ZTE Showcases Highest Power Tri-band UBR and Dual-band FDD Massive MIMO Products	05
Datang and Huawei Complete 5G NR Interoperability and Development Testing	<u>06</u>
Ericsson and UNESCO Launch New Global AI Skill Development Initiative for Youth	_07
"Spider-Man(TM): Far From Home" Reached New Heights with 5G Powered by Nokia and Intel	_08
Huawei Redefines Video Experience with 5G Live Networks and Foldable Phones	_09
ZTE and Qualcomm Demonstrate Live 5G Services Based on 5G End-to-end Commercial Equipmen	<u>t 10</u>
AI in Network Operations Gains Traction with Service Providers	11
Nokia 5G Maturity Index Reveals Best Practices As Operators Make Critical 5G Network Decisions	12
Smart Communications: Full Transition to Digital Indoor System for 5G Readiness	<u>13</u>
Ericsson Enhances 5G Platform for Smooth Network Evolution	_14
Huawei and China Mobile Jointly Built the World's First 2.6GHz 4G&5G Integrated Network	15
Nokia Expands Anyhaul to Support Operator Network Investment for 5G Rollouts	16

Market

TD-LTE Global Market Overview	17
M-IoT Global Market Overview	18

GTI

GTI Breakthroughs and Achievements in 2018	19
GTI Members Updates and Activities in 2019	25

Appendix

Appendix 1 – Welcome to Join GTI (to operators)	26
Appendix 2 – Welcome to Join GTI Partner Forum (to non-operators)	27

Top News

GTI Summit 2019 with the Theme of "5G, Closer than Ever" Successfully Held @MWC19

GTI Summit 2019, with the theme of **"5G, Closer than Ever**", was successfully held on the 26th February during Mobile World Congress Barcelona 2019. Delegates from governments, organizations, operators, vertical and partners attended this summit to drive acceleration of 5G commercialization and explore new opportunities enabled by joint innovation.



Mr. Craig Ehrlich, Chairman, GTI

5G is believed to be a key enabler for innovative services and applications in next few years that should reshape our society and various verticals in a way we have never seen before. As 5G is around corner, our world is filled with even much more possibilities and inspirations that will take innovation to another level.



Mr. Zhang Feng, Chief Engineer, Ministry of Industry and Information Technology of China Called on all parties in the world to adhere to the principle of mutual complementarity and mutual benefit, build a globalized 5G industrial chain, ensure the security of network infrastructure, promote the integrated development and application of information and communication technologies, and continuously inject new



Mr. Mats Granryd, Director General, GSMA

5G, along with AI, Big Data and IoT will bring faster, richer and more immersive experiences, which will not only help increase revenue of the industry, but also improve efficiency and productivity for effective utilizing of limited resources.



Mr. Li Zhengmao, EVP, China Mobile

impetus into world economic growth.

China Mobile will build a leading end-to-end network infrastructure to accelerate the 5G commercial process, and work together to build an open and win-win innovation ecosystem. Accelerate application demonstration and create a batch of 5G services with commercial capabilities to lay the foundation for 5G commercialization.

GTI Summit 2019 attracted many top leaders from operators and vendors, like Sprint, Huawei, Samsung, Qualcomm and Nokia, driving 5G with verticals to pave the way for early 5G commercial use.



Mr. Abdullah AlSwaha, Minister of Communication & Information Technology, KSA

Addressed that under the Vision 2030, the Saudi government is working hard to foster a new economic development model and will vigorously develop 5G to make full use of information digital technology to create an intelligent city and realize innovative applications such as e-tourism, e-education and e-health.



Mr. John Saw, CTO, Sprint

In the first half of 2019, Sprint will continue to promote 5G commercialization in 9 cities including Chicago, Dallas, Atlanta, Kansas City, New York, Washington and Los Angeles, and will provide nationwide 5G networks in the future.

The Debut of 5G 2.6GHz End-to-end Products

At the summit, GTI, in collaboration with 17 industry partners including China Mobile, Huawei, Nokia, Ericsson, ZTE and Qualcomm, successfully held the debut ceremony of the 5G 2.6GHz End-to-end Products, to release a great many end-to-end pre-commercial products including infrastructure, chips, modules, test instruments as well as mobile phones. The release will further accelerate the maturity of the 2.6GHz industry chain, promote the 5G commercial process, and foster 5G to create new driving force for economic and social development.



GTI Summit 2019 with the Theme of "5G, Closer than Ever" Successfully Held @MWC19

Top leaders from vendors focus more on 5G and expect that 5G will fuel progress in the industry.



Mr. Ken Hu, Deputy Chairman, Huawei

Addressed that the pace of 5G is getting closer and closer, and the innovation capability enabled by 5G will promote the ICT industry to reach a new level. Huawei expects GTI will play a more active role in boosting the development of the Sub-6GHz industry chain, the application of the ICT industry, and sharing the practical experiences for 5G development from leading operators such as China Mobile.



Mr. Dong Jin Koh, President and CEO, IT & Mobile Communications of Samsung Electronics He emphasized that the year of 2019 will be a turning point for the industry, a moment when a new generation of technology opens the door to truly intelligent experiences that make our lives richer and our businesses more successful. But it's a transformation that would not be possible without 5-G. With 20 times the speed of today's networks and 10 times the capacity, 5G will fuel progress in the industry for many years to come.



Mr. Cristiano R. Amon, President, Qualcomm

Said that Qualcomm will put more focus on manufacturing, vehicles, cloud computing etc. in the era of 5G. With the advent of the 5G invention era, many new vertical areas and devices will be affected, as well as new business models, new services, and new ways to attract customers.



Mr. Marcus Weldon, CTO of Nokia and President of Bell Labs

He said it's time to rebalance or harmonize the value creation and value extraction. The human interaction with "digital" will change and the "augmented digital" will shift modernization. The possibility and desirability of fundamentally will improve the human condition through applied reason, especially by developing and making widely available technologies to eliminate aging and to greatly enhance human intellectual, physical, and psychological capacities.



5G Device Forerunner Initiative Achievements Release

The first batch of achievements of "5G Device Forerunner Initiative" were released at the last part of the summit, which includes a total of four chips from Qualcomm, MediaTek and UNISCO, as well as nine devices from Huawei, ZTE, OPPO, vivo, Samsung, Xiaomi and China Mobile. Some products have already taken the lead in supporting SA/NSA at the same time. The maximum peak value in the Sub-6GHz band has reached 4.67Gbps, which are the most advanced 5G devices in the industry.

Top News

The 24th GTI Workshop Accelerates 4G Evolution and 5G Pre-commercial Development

The 24th GTI workshop was held with a great success during 21st-22nd February in Barcelona, Spain, attracting more than 200 industrial leaders and experts from nearly 30 operators and over 60 partners/organizations to discuss and shared their views on key issues and latest progress in 4G evolution and 5G pre-commercial development.



The workshop has placed much focus on the most concerned industrial topics about 4G evolution, M-IoT, 5G eMBB and Private Network of Innovative Business and Application. During the workshop, experts from multiple companies around the globe shared their valuable experiences in network performance enhancement with Massive MIMO, Massive MIMO, NB-IoT trial and device solutions, 5G end-to-endE2E pre-commercial progress, 5G device key technologies and certification, as well as 5G S-Module and vertical industry device. Furthermore, the workshop also presented a great opportunityspecial session to learn about the progress, use cases and technologies of to talk about the 5G private network.

During the workshop, some of the latest technologies and devices on 2.6GHz, 5G general test equipment, 5G chipset and 5G S-module were also demonstrated, which will be definitely accelerating the progress of 5G commercialization.



GTI Awards 2019 Winners Unveiled during GTI Night

GTI Awards 2019 was presented at the GTI Night held on 22nd February, 2019 in Barcelona, Spain. A great many high-level representatives from global operators, industry partners as well as organizations attended the event.

A total of 2 operators and 9 industrial partners across terminal, chipsets, network infrastructures, test systems and verticals won awards on "Innovative Breakthrough in Mobile Technology", "Innovative Mobile Service and Application" and "Market Development" for remarkable contributions made in each area. In addition, 9 individuals were granted "Honorary Award" for their technical or marketing efforts that have brought significant credit to the industry and GTI.



Innovative Breakthrough in Mobile Technology Award

- ✓ Qualcomm Snapdragon 855 Mobile Platform
- ✓ Huawei Kirin 980
- ✓ ZTE E2E Stand Alone 5G Portfolio
- ✓ Samsung 5G Pre-Commercial Device
- ✓ Keysight PropSIM F64 5G Performance Test Solution
- ✓ Ericsson Operator Integrated Private LTE system
- ✓ vivo NEX 5G MMMB smartphone prototype

Innovative Mobile Service and Application Award

- ✓ Nokia MEC Application
- ✓ Tendency, Huawei, China Mobile (Zhengzhou) Large-scale Commercialized NB-IoT Connected **Electric Vehicles**

Market Development Award

- ✓ Huawei Massive 5G Commercialization
- ✓ Reliance Jio Rapid 4G LTE Network Development









Bosco Choi (Anritsu) Victoria Wang (Ericsson) Taylor Tan (Huawei) I-Kang Fu (MediaTek) Diane Dingwei Lu (SIMCom) Kathleen Leach (Sprint) Paul Cooper (Qorvo) Thomas Eyring (Rohde & Schwarz) Bernard Bureau (TELUS)



Honorary Award

4

Industry News

ZTE Showcases the Industry's Highest Power Tri-band UBR and the Next-Generation Dual-band FDD Massive MIMO Products

ZTE Corporation released the industry's highest power Tri-band Ultra-broadband Radio (UBR) and the new-generation dual-band Frequency Division Duplex (FDD) Massive multiple-input and multiple-output (MIMO) at Mobile World Congress (MWC) 2019 in Barcelona, Spain.



ZTE's Tri-band UBR is the industry's first Radio Frequency (RF) module that integrates three mainstream frequency bands of 900M, 1800M, and 2,100M. Tri-Band UBR supports GSM, UMTS, FDD-LTE, and NB-IoT and helps minimize the number of site devices. The product is set to facilitate the industry's smooth evolution to 5G New Radio (5G NR).

The Tri-band UBR features ultra-wideband power amplifiers with an output power of 4* 80 W for 1800M and 2100M and 2*80W for 900M.Coupled with ZTE's self-developed chipset, optimization of ultra-wideband self-developing algorithm and high-efficiency power amplifier circuit scheme, the power amplifier's efficiency has been significantly improved.

The ultra-wideband power amplifier enables the flexible power distribution between the two frequency bands. With an output power of 2*80 W in 900M, it can meet the needs of large-capacity macro coverage scenarios. Tri-Band UBR is also able to achieve rich frequency bands and large output power without doubling the size of the device.

The cutting-edge Tri-Band UBR features 20% reduction in volume, 30% reduction in weight, and 60% reduction in installation time, compared with traditional independent frequency band Radio Remote Units (RRU) devices with equal output power. The Tri-band UBR significantly lowers the requirement for installation space and site rental costs, maximizing the space for 5G deployment.

As for Dual-band FDD Massive MIMO (large-scale antenna array), it supports 1800M and 2100M at the same time. In addition to replacing the output of the combination of two RRUs and the directional antennas, it also enables operators to unlock network potential and substantially increase the throughput of 4G stations in highly-loaded cells where the capacity is difficult to be increased.

Based on 128 smart antenna elements, dual-band FDD Massive MIMO features 3D MIMO narrow beams for eight independent directions, shaping flexible beamforming in vertical and horizontal planes, while increasing vertical coverage gain and improving user experiences at the cell edge.

Dual-band FDD Massive MIMO also provides 32T32R and supports 3-carrier configuration. A single device can achieve 2Gbps throughput and a spectral efficiency improvement of 3 to 6 times in a commercial environment. Dual-band FDD Massive MIMO has an output power of 200W, which is a significant improvement over the previous generation, providing better coverage while the windward side reduced from 999*699 to 1400*360, decreased by 28%.

Throughout the years, ZTE has spared no effort in providing customers with the best wireless products and solutions. Based on its rich experience in 4G, ZTE is well-positioned to empower the development of 5G while maximizing the value for customers.

Datang and Huawei Complete 5G NR Interoperability and Development Testing

Recently, Datang Mobile Communications Equipment Co., Ltd. and Huawei Technologies Co., Ltd. collaborate on NR Interoperability and Development Testing (IODT) in 3.5 GHz band and 2.6GHz band based on 3GPP Release 15 specifications by using Balong 5000, dedicated to accelerating the commercial deployment of NR in 2019. This is the first batch of interoperability testing between 5G commercial base stations and terminal manufacturers from different factories in China.

The testing utilized 3GPP 5G NR spec. compliant base stations from Datang Mobile and user equipment (UE) from Huawei, Balong 5000 5G terminal chip to be exactly. Testing covers Standalone Network(SA) and Non-Standalone Network(NSA) scenarios. The used specification is the NR specification of September, 2018, which implements new frame structures, new coding, new waveforms, and synchronization mechanisms.

Today, for the End-to-end testing, the throughput of Downlink (4 layers, 256QAM) exceeds 1.6Gbps. The throughput of Uplink (2 layer, 64QAM) is around 188Mbps. Also, Huawei and Datang implemented mobility capability testing including inter-cell handover.

Datang and Huawei complete the 5G NR IODT based on 3GPP Release 15 specifications, achieving interoperability between base station and user equipment, passing the relevant test cases of the Ministry of Industry and Information Technology Department. These make a positive contribution to 5G industry, which means 5G industry take a step towards commercial maturity. Datang and Huawei will work in hand on 5G NR commercial deployments in 2019.



5G IoDT filed test ongoing

Ericsson and UNESCO Launch New Global AI Skill Development Initiative for Youth

Ericsson and UNESCO (United Nations Educational, Scientific and Cultural Organization) have formed a new partnership to educate and empower the next generation, with the partners to develop a new digital skill learning program that has specific emphasis on scaling up Artificial Intelligence (AI) skill development for young people.



With the rapid deployment of advanced technologies such as mobile broadband, cloud, IoT, automation and AI, a new set of skills is required to enter the workforce. There is an unprecedented opportunity to harness technologies and use them to advance not only economies but also to combat some of the world's looming challenges. Next-generation 5G services are set to play a key role in accelerating digitalization and the impact of technologies like AI.

The impact of AI is also felt across the education sector where it has the potential to increase access, automate process, curate learning and improve outcomes in education. It will continue to bring new opportunities for enhanced learning, new forms of learning and offer more flexible lifelong learning pathways.

With this background, Ericsson and UNESCO are combining their respective strengths to create opportunities to scale up skill development in AI and other key digital skills for young people. Under the AI for youth initiative the partners will:

- Develop and manage a repository of AI and other key digital skill training courses that will be available globally
- Build capacities of master trainers from selected countries around the globe with advanced knowledge of AI skill development
- Support master trainers to mobilize AI hub centers and hackathons to train young people on developing AI applications

The initiative was launched at Mobile Learning Week 2019, UNESCO's flagship education conference held at UNESCO Headquarters in Paris from March 4 to 8. The event brings together education and technology experts from around the world with focus on AI and sustainable development. As part of the event, UNESCO member states were invited to join the initiative and support the scaling up of AI skill development for young people.

Sony Pictures' "Spider-Man(TM): Far From Home" Reached New Heights with 5G Powered by Nokia and Intel

In advance of the release of Sony Pictures' highly anticipated motion picture Spider-Man(TM): Far from Home, in theaters in July 2019, Sony Pictures Virtual Reality (SPVR), Nokia and Intel let attendees of Mobile World Congress in Barcelona become Spider-Man with the new Spider-Man: Far From Home VR experience, powered by 5G. As everyone's favorite friendly neighborhood superhero enters a new dimension, SPVR, Nokia, and Intel are creating immersive, transformational experiences that take storytelling to new heights and engage audiences like never before; showcasing how 5G will drive new business opportunities in media and entertainment.



In a Mobile World Congress Barcelona exclusive, attendees can get first-hand experience of what it feels like to be Spider-Man, choosing their suits before they swing, run, stop, jump, climb and web sling through a canyon of skyscrapers and race against players in real time from both the Nokia (3A10) and Intel booths (3E31) via 5G and edge cloud technology. This experience showcases how 5G will unleash a new generation of immersive media experiences that will reshape the media industry and change the way we create, consume and share content.

Sony Pictures has partnered with Intel and Nokia to explore how 5G and edge cloud technologies can enable innovative high-throughput, high-definition, immersive experiences of its iconic Spider-Man for its fans, allowing them to engage with existing and new audiences. While other VR applications have served a single user, this multi-player experience employs some of the key capabilities of 5G, offering low-latency to ensure seamless collaborative gameplay and high capacity to operate at massive scale with mobility.

This multi-player VR experience utilizes the Nokia 5G Future X architecture, which is the only globally available end-to-end 5G solution. The experience's 5G radio connection uses Nokia AirScale and Intel[®] 5G Mobile Trial Platform, as well as edge cloud using Nokia AirFrame powered by the Intel[®] Xeon[®] Scalable family of processors. The VR experience was developed by CreateVR.

Huawei Redefines Video Experience with 5G Live Networks and Foldable Phones

Huawei kicked off this year's Mobile World Congress with its Day0 Forum in Barcelona. With the theme of building a fully connected intelligent world, the forum included industry insights of the latest trends.

At the 5G is ON industry insights, Huawei Executive Director and President of the Carrier Business Group Ryan Ding demonstrated the 4K video-on-demand service on a Huawei 5G foldable smartphone via a Vodafone Spain 5G live network powered by Huawei.



Huawei Launches 5G Simplified Solution

Huawei released the 5G Simplified Solution at Mobile World Congress 2019. Huawei is dedicated to taking complexity and creating simplicity. 5G Simplified Solution can help operators build 5G network with superior performance and user experience, simplified and fast deployment and low operating cost.



Yang Chaobin, President of Huawei's 5G Product Line, claimed that "We are setting a new record in the history of mobile communications. 5G will develop in a fast-paced, large-scale, and wide-ranging way. 2019 is expected to be the year of 5G large-scale commercialization, and Huawei 5G Simplified Solution will help operators build 5G network with superior performance and user experience, simplified and fast deployment."

The 5G Simplified solution is oriented to diversified deployment scenarios such as traditional macro, antenna limited, street hotspots, and indoor. It contains serialized 5G Massive MIMO, Book RRU, LampSite, etc. The most innovative of these is the blade AAU.

From a network perspective, the radio access network to the core network, 3GPP defines a complete standard interface. The 5G base station support both NSA and SA architectures. The same core network platform can also support 4G EPC and 5G Core at the same time. From the perspective of the terminal, the NSA and SA terminals can access the same 5G network at the same time, and complex signaling and data processing are left to the network for processing.

Therefore, NSA or SA is no longer a dilemma for operators. The same 5G network, the two architectures coexist harmoniously, and the NSA base station can be smoothly evolved to the SA base station through software upgrade.

ZTE and Qualcomm Technologies Demonstrate Live 5G Services Based on 5G End-to-end Commercial Equipment

ZTE is demonstrating 5G network services based on an end-to-end sub-6GHz commercial system, in collaboration with Qualcomm Technologies, Inc. The live demonstration verifies ZTE and Qualcomm Technologies' strong 5G technology capabilities to achieve end-to-end 5G commercialization.

The demonstration over 5G NR radio utilizes a real-world end-to-end 5G NR network built with ZTE's commercial core network and radio base station equipment, as well as a ZTE 5G smartphone powered by the world's first commercial 5G mobile platform—the Qualcomm[®] Snapdragon[™] 855Mobile Platform paired with the Snapdragon X50 5G modem, as well as Qualcomm Technologies' RF transceiver and RF front-end solutions. Fully compliant with 3GPP R15, the demonstration is based on NSA networking mode, the N78 5G band and harnesses the LTE B1 band as an access anchor.



For this demonstration, ZTE provides a comprehensive end-to-end solution, including the One for All base station platform solution at the wireless side to support 2G/3G/4G/5G on a single site as well as multimode baseband units (BBU) that provide the maximum 2G/3G/4G/5G processing capacity and the largest number of interfaces in the industry.

Furthermore, the demonstration adopts ZTE's "Common Core" core network with a full convergence of 2G/3G/4G/5G/fixed networks and UME, a converged network management solution for intelligent operation and maintenance.

"The collaboration between ZTE and Qualcomm Technologies at MWC 2019, on the demonstration of 5G services based on ZTE's 5G mobile device and system, is a testament to our efforts for 5G commercialization," said Xu Ziyang, CEO at ZTE. "It indicates a great step towards making 5G a commercial reality."

"The 5G NSA live demo at MWC, based on the commercial infrastructure from ZTE using Qualcomm Technologies' 5G modem and RF front-end, gives us a glance of 5G user experiences expected on commercial devices in 2019," said Frank Meng, chairman of Qualcomm China. "We look forward to continuing working with ZTE and other leading companies across the ecosystem in accelerating the rollout of 5G networks and devices."

In the process of promoting 5G commercialization, ZTE has been actively working with industry partners on the verification of key technologies and solutions, as well as network deployments. ZTE is also leading in test progress and performance. Backed up with 5G tests and cooperation with more than 30 operators around the world, ZTE is ready for the upcoming 5G commercialization and rollouts.

Al in Network Operations Gains Traction with Service Providers

By 2024, Ericsson predicts there will be 1.5 billion 5G subscriptions for enhanced mobile broadband and 4.1 billion global cellular IoT connections. The volumes of data generated from this activity will be staggering.

To handle this complexity new cognitive technologies, such as Artificial Intelligence (AI), are making it possible to derive value from this data and shift network operations from being reactive to datadriven, predictive, and proactive operations.

Recent AI-based use cases in the Middle East and Asia are an indication that these technologies are gaining traction. Ericsson and Saudi Arabian operator Mobily worked on three intelligent operations-based use cases, utilizing AI, automation and the power of data.

The use cases focused on how Mobily can achieve faster rollout of network services and manage growing network complexity with the introduction of 5G and IoT technologies.

The conceptual solution is based on the Ericsson Operations Engine, a new AI-based managed services offering launched in January 2019. With Mobily, Ericsson is demonstrating how anomaly detection can uncover hidden patterns of site problems, proactively detect sleeping cells and network performance degradation and preventing it from becoming a user issue.



Telecom Egypt and Ericsson completed the successful deployment of AI to its full-stack telco cloud infrastructure. The objective is to operate telco cloud environment intelligently and efficiently to enable cloud Automation and orchestration. Together with the Egyptian operator, Ericsson has demonstrated how AI can be used to monitor internal traffic between NFVi layers, providing a fast way to identify faults and generate suggestions for resolution.

Having completed proof of concept trials, the companies are expanding their co-creation partnership to industrialize AI use cases.

And in India, Ericsson and Bharti Airtel are collaborating to proactively address network complexity and boost user experience supporting the service provider's experience-centric operations management.

In 2018, Ericsson also implemented an innovative method for radio access network design based on machine learning for Softbank in Japan, cutting lead times by 40 percent compared to traditional network design methods.

Al and automation are essential to building and managing the ever-increasingly complexity of current and future networks. These capabilities are evolving operations from being network-centric, to user experience-centric. The Al-based Ericsson Operations Engine addresses this increasing network complexity, including service providers' need to handle growing volume of devices, multiple technologies (4G, 5G, IoT), and more diverse service requirements.

Ericsson has invested significantly in AI and automation and in 2018 established a Global Artificial Intelligence Accelerator (GAIA) in India to focus on AI research and development.

Nokia 5G Maturity Index Reveals Best Practices As Operators Make Critical 5G Network and Service Investment Decisions

On 21st February, Nokia announced the results of the Nokia 5G Maturity Index, produced in partnership with Analysys Mason, which provides operators with best practices for planning and deploying 5G services. The industry's first benchmark of 5G operator maturity revealed that two-thirds of operators expect 5G to create new revenue streams, while more than 70% of operators are focused on 5G to help improve existing consumer services. The research also found that those operators most advanced in 5G transformation are focused on six to eight use cases.



Key findings of the Nokia 5G Maturity Index:

- The most popular 5G use cases identified by operators include: multi-gigabit mobile connectivity, connected cars and autonomous vehicles, tactile internet experiences such as augmented and virtual reality, critical healthcare monitoring, smart city apps like lighting, and smart home services
- Most operators plan a limited commercial launch of 5G services by 2019-20
- Operators planning early 5G commercial launches are the furthest ahead with network virtualization and cloud-based deployments.
- Operators rated as the most advanced in 5G closely align their technology and business development and link digital transformation with 5G.

To take advantage of the promise of this next generation of network technology, Nokia continues to build out its 5G Future X portfolio and today has announced enhancements to its packet core and radio access network solutions. Nokia's end-to-end portfolio helps operators meet their immediate priorities of enhancing the customer experience and reducing Total Cost of Ownership (TCO), as well as supporting their strategic objective of developing new 5G-based revenue streams.

Nokia cloud packet core (CPC) is augmenting its Cloud Mobility Manager (CMM) and Cloud Mobile Gateway (CMG) products with new 3GPP Release 15 5G Core standalone networks functions and also enhancing the previously announced non-standalone core capabilities. With its cloud-native architecture and these augmented capabilities, the CPC solution provides operators a seamless upgrade path, combined with the deployment flexibility to support both virtual and physical high-performance network functions, to deliver services across multi-technology wireless (2/3/4/5G, unlicensed, shared) and fixed access deployments. The new Nokia AirScale all-in-cloud base station for both 4G and 5G virtualizes real-time functions in the cloud. This enables real-time processing to be hosted at the network edge, close to the radio site to meet extremely low latency demands, with capacity where it is needed. The new architecture enables operators to launch and monetize the lowest latency applications/services with ultra-low latency. With AirScale Cloud RAN's built-in flexibility operators can locate functions depending on their needs in a given area - depending on desired application needs and latency targets.

The Nokia AirScale future-proof site solution provides multiple features for simpler, faster and lowercost rollout of 5G in smart cities using a common Future X architecture for deployments of all mobile technologies and spectrum bands. Capabilities such as the world's first liquid-cooled 5G base station, including liquid-cooled 5G massive MIMO adaptive antenna, eliminate the need for expensive cooling systems, reducing site space, lowering energy consumption and cutting carbon emissions by up to 80%.

Smart Communications: Full Transition to Digital Indoor System for 5G Readiness

Before 2019 Mobile World Congress, Smart Communications announced that they were building the 5G oriented DIS (Digital Indoor System) in Smart Tower, to provide ubiquitous high-quality user experience while supporting smooth evolution to 5G. This is a significant step to embrace the arrival of upcoming 5G era.

Smart Tower is a 36-story skyscraper in the heart of Makati CBD and is the headquarters of Smart Communications. Currently the indoor network are supported by DAS which provides 2G, 3G and LTE services. SMART Tower houses thousands of Smart employees and are in constant need of data services to fulfill both their professional and personal needs throughout the day. With a highly tech savvy workforce, a Digital Indoor System provide the best network in capacity and user experience. As SMART Tower also houses the Innovation Lab focusing on next generation technology and use cases such as 5G, the DIS will ensure that when needed, the DIS will smoothly evolve to support 5G network supporting eMBB, uRLLC and eMTC use cases.



The existing DAS networks have been strained to satisfy these service requirements. For example, DAS does not support smooth capacity expansion as reconstructions are required to introduce multi-antenna solutions, which is a key component to 5G. DAS also requires tremendous O&M efforts and takes a long time to construct, making it unsuitable to meet the requirements of fast deployment.

As one of Huawei's DIS-based solutions, LampSite Pro is easy to deploy. It provides huge capacity, supports multi-mode multi-band applications, and E2E visualized O&M. These features give it unique strengths to tangibly improve coverage and eliminate blind holes in the offices scenario, helping provide ubiquitous MBB experience to end-users. Data obtained from a DIS deployment in one of the major entertainment arena demonstrated significant uplink and downlink traffic increment by 100+%, indicating an efficient release of long-suppressed traffic. The downlink rate at the user end was constant even with the increase of user traffic, with peak data rate of 300+Mbps recorded, showing a significantly improved user experience.

Additionally, this digital indoor system has the capability to evolve into future-oriented 5G networks without the need for additional cabling.

Ericsson Enhances 5G Platform for Smooth Network Evolution

Ericsson is evolving its 5G Platform with portfolio additions across core, radio access and transport areas, as well as service orchestration. These add-ons make the platform more dynamic and flexible, enabling service providers to smoothly evolve their networks and deploy 5G at scale.



One core network for 4G and 5G

The wide portfolio of Ericsson's 5G Platform is now further strengthened with a broad range of product launches, adding to previous introductions such as the unique Ericsson Spectrum Sharing, to facilitate an efficient, flexible and smooth evolution to 5G networks. Building upon an early focus on IoT, Ericsson's 5G Platform now also serves as the most complete platform for enhanced mobile broadband and fixed wireless access use cases.

To ensure smooth evolution to 5G for service providers, Ericsson evolves the Cloud Core portfolio with seven new products supporting both 5G Standalone and Non-Standalone, as well as earlier generations to ensure seamless legacy services' continuity. The Dual-mode 5G Cloud Core solution is cloud native for automated capacity management, efficient and robust operations. It also delivers a high-performance user plane to cope with 5G use case needs and includes open APIs for innovation on 5G capabilities like network slicing and edge computing.

Ubiquitous transport for 5G services

With early 5G deployments underway in dense urban areas, the next step is to improve 4G performance and build 5G coverage outside of cities. This will continuously require a combination of fiber and microwave-based transport solutions. For this reason, Ericsson is enhancing the capacity of its microwave portfolio and adding a new MINI-LINK 6200 family of 5G-ready Long Haul solutions supporting up to 10Gbps capacities. The company is also expanding its router and fronthaul portfolios to offer service providers flexible and modular solutions suited to their deployment needs.

New radios and virtualized Radio Access Network (vRAN)

The advent of 5G highlights not only the need for new frequency bands but also for optimized site construction and a greater ability to add radio capacity with precision for service providers. Ericsson addresses this by launching nine new dual band, triple band, and high-performance Massive MIMO radios. Ericsson achieves an important milestone with the virtualization of the 5G NR software that manages data traffic flow for a large number of users. This new functionality enables service providers to introduce an architecture where data traffic processing intelligence is higher up in the network, providing additional flexibility for some deployment scenarios.

Automated service orchestration for simplified operations

The evolution of Ericsson Dynamic Orchestration solution introduces network slicing automation comprising creation, testing and deployment of network slices for fast introduction of 5G services. The solution also implements AI-powered closed-loop automation for hybrid networks (including physical, virtual and container-based network functions) in a multi-vendor environment to identify service impact and adapt the network in real-time to deliver the best end-user experience.

Huawei and China Mobile Jointly Built the World's First 2.6GHz 4G&5G Integrated Network in Chengdu

China Mobile Sichuan and Huawei recently jointly built the world's first 2.6GHz 4G and 5G integrated network demonstration area. The program has been successful, due to Huawei's pioneering and innovative SingleRAN technology. It realizes co-site, co-coverage and concurrent of 4G and 5G with only single deployment of Massive MIMO. This technology achieves "one deployment for 4G & 5G, benefiting both RATs": 4G networks maintain the leadership, 5G networks pioneer the industry, and existing investments are protected to a maximum extent. This deployment will be the mainstream of evolution to 5G networks.



Operators face multiple challenges related to the upcoming commercial deployment of 5G. Currently, some of the most pressing issues are how to maintain 4G networks' leading position, how to use 4G resources to rapidly deploy high-quality 5G networks, and how to improve the efficiency of network operation and maintenance.

China mobile's innovative 4G and 5G integrated network uses pioneering Huawei 5G AAUs. Both the filter and working bandwidths support 160 MHz, which maximizes spectrum resources usage. In addition, 100 MHz NR and 60 MHz LTE TDD can be deployed on the same AAU module. This allows integrated 4G and 5G networks to be set up quickly, enabling quick provision of 4G and 5G services at the same time, and maintaining the leading user experience. In the future, remote one-click upgrades can achieve quick support for 160 MHz NR, which would avoid repeated site visits and deployment work.

A large quantity of sites was enabled in the demonstration area to form a continuous area with 4G and 5G co-coverage. On this live network, 4G(LTE TDD 60 MHz) was enabled with 3CC CA. The 4G network's quality was stable with significantly improved network capacity, the average data rate for a single 4G user reached 110 Mbps. The 5G network also had stable performance, with data rates reaching a new high of 800 Mbps for a single 5G user (tested with the CPE). Two months after deployment, 4G traffic in the demonstration area has increased by 30%, and performance indicators such as MR coverage and call completion rate are rising steadily.

5G is now. China Mobile Sichuan and Huawei will continue their research into planning, constructing, maintaining, and optimizing 4G and 5G integrated networks. The two companies will use the findings from this research to build high-quality 5G networks and prepare network infrastructure for future commercial use of 5G networks.

Nokia Expands Anyhaul Transport Portfolio with 25 Gbps Speeds to Support Operator Network Investment for 5G Rollouts

In advance of Mobile World Congress, Nokia announced a raft of enhancements to its Anyhaul transport portfolio that help operators prepare their networks for 5G by delivering throughput speeds of up to 25 Gbps to base stations. The launches span microwave, optical, IP and broadband technologies within a carrier Software Defined Networking (SDN) transport architecture. This simplifies the integration of transport with cloud-based radio access and core networks, thereby enabling an automated end-to-end 5G network slicing and service provisioning system.



Nokia Anyhaul is the industry's most extensive range of transport solutions. These solutions can be rapidly and dynamically provisioned to support the massive connectivity, extreme low latency and very high throughput demands of 5G services. Programmability and automation dynamically create transport network slices to quickly and cost-effectively match diverse application and user needs with end-to-end service delivery guarantees.

The Nokia Anyhaul portfolio enables operators to deploy the optimal mix of transport technologies to create a flexible fabric that matches their unique network and business needs.

A new release of the Nokia Wavence microwave portfolio supports carrier aggregation to combine frequency bands in the traditional uWave or mmWave frequencies or even with existing third-party microwaves to achieve 5G-ready microwave throughput beyond 10 Gbps. The 2+0 E-Band systems ensure 20 Gbps throughput, as a single radio can provide 10 Gbps with the new 2 GHz channel bandwidth. These E-Band ultra-broadband radios are ready to be deployed in small form factor hardware variants to provide fiber-like backhauling for small cells. The Wavence family includes a new compact 5G-ready transceiver called UBT-C for optimal last mile connections.

The new Nokia 1830 Versatile WDM Module (VWM) Translation Line Unit (TLU)-200 provides high density wavelength translation at 10 Gbps and 25 Gbps speeds. Purpose-built for Cloud RAN and Edge Cloud requirements, it simplifies operations and improves reliability of fronthaul connectivity for 4G Common Public Radio Interface (CPRI)/Open Base Station Architecture Initiative (OBSAI) and 5G eCPRI data.

A new, compact interconnect router, the Nokia 7250 IXR-e, is purpose-built to support 5G and edge cloud requirements at or near base stations with 1/10/25/100 GE interfaces. The 7250 IXR-e features a compact architecture with efficient cooling and optimized space efficiency for minimal installation costs. It complements the previously released 7250 IXR-R6, which also supports 5G requirements and 1/10/25/100 GE interfaces.

A proof of concept of Nokia Broadband Anyhaul 25G Passive Optical Network (PON) demonstrates the viability of building on existing fiber infrastructure to offer 25 Gbps speeds. Co-existing with 2.5G and 10G PON technologies, 25G PON enables more radio access sites to be connected on the same fiber to reduce costs. Nokia successfully trialed 25G PON proof of concept with T-1 operators in North America and Japan in January 2019.

TD-LTE Global Market Overview

Global Deployment as the Mainstream Mobile Broadband Technology



- ◆ **156** TD-LTE commercial networks in **77** countries have been launched
- ◆ **151** TD-LTE commercial networks in **78** countries are in progress or planned
- **3.63** million TD-LTE base stations
- **2.2** billion TD-LTE subscribers

Source: GTI, TDIA, GSA By Q4, 2018

M-IoT Global Market Overview

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



Commercial Launches 60 NB-IoT 23 eMTC

New Released Whitepapers and Technical Reports



GTI Sub-6GHz 5G Pre-Commercial Whitepaper (v1.1)

GTI Sub-6GHz 5G Pre-Commercial Whitepaper (v1.1)

This whitepaper will serve as a platform to share and present the results of the tests and the strategies of the deployment, thus provide a reference to industry partners, so as to jointly promote the 5G industry maturity, drive its scale commercialization, and embrace the property of 5G ecosystem.

Multiple Operators Coexistence in the Same 5G Frequency Bands Whitepaper

Multiple Operators Coexistence in the Same 5G Frequency Bands Whitepaper

This whitepaper introduces the issues of multiple operators coexistence in the same 5G frequency bands and target to study the coexistence conditions and requirement for multiple operators in adjacent TDD 5G bands without interference to each other.

GTI 5G mmWave Spectrum Whitepaper

GTI 5G mmWave Spectrum Whitepaper

This whitepaper updates the global situation regarding the 5G mmWave spectrum, promotes a GTI view on proper technical requirement for coexistence with the existing services. We conclude a GTI proposal of the future 5G mmWave spectrum strategy for developing the products and deliver our view towards WRC-19 AI 1.13.

GTI 5G MEC Deployment Strategy Whitepaper

GTI 5G MEC Deployment Strategy Whitepaper

This whitepaper will serve as a platform to share the latest MEC industry progress, initiate 5G MEC deployment strategy discussions and provide key solutions, finally introduce the current use cases and trails that will be continuously updated.

GTI Network Slicing Solution Whitepaper

GTI Network Slicing Solution Whitepaper

This whitepaper describes network slicing conceptual architecture. Focus on end-to-end network slice and provide the related key technologies and deployment strategy. Finally share foresight technologies, the trends and use cases of network slicing.

GTI Sub-6GHz 5G Small Cell and Indoor Solution Whitepaper (v1.0)

GTI Sub-6GHz 5G Small Cell and Indoor Solution Whitepaper (v1.0)

This whitepaper describes some typical indoor scenarios in 5G era. According to these scenarios characteristics, requirements and challenges are abstracted and corresponding solutions with necessary key technologies are also provided. Finally provide some indoor deployment options to industry for reference.

GTI 5G E2E Test Instrument Map Whitepaper

GTI 5G E2E Test Instrument Map Whitepaper

This whitepaper summarizes the typical application, stages and test scenarios for Devices, Base station and Core network, regarding these test requirement, and shows corresponding test instrument, solution to the 5G industry.

New Released Whitepapers and Technical Reports



GTI 5G Device Power Consumption Whitepaper (v1.0)

This whitepaper provides the analysis of the factors of power consumption, such as the key components /the 5G feature and the service type/the test solution and the performance requirements of power consumption for 5G device.

5G Device

GTI 5G Device RF Component Research Report (v2.0)

GTI 5G Device RF Component Research Report (v2.0)

The report is expected to help people to develop 5G devices and to promote industrial development. It may also help people to know more about the industrial status of 5G device RF components. Meanwhile, it may also help readers interested in 5G device RF components to gain from the further thinking.

GTI 5G Device OTA Performance Whitepaper (v1.0)

GTI 5G Device OTA Performance Whitepaper (v1.0)

This white paper provides a technical overview of the 5G device OTA performance. As we all know, OTA is the key method to evaluate the antenna performance and the OTA performance of wireless devices and reflect its access and throughput performance in real network.

GTI 5G Sky Office Whitepaper (v1.0)

GTI 5G Sky Office Whitepaper (v1.0)

This whitepaper provides an overview of 5G market status, focusing on laptop market and office software support. According to the observation of potential market demand, the concept and objective of sky office are given.

GTI 5G Device Function & Performance Test Specification

GTI 5G Device Function & Performance Test Specification

This specification targets enhanced Mobile Broadband (eMBB) scenario for 5G Sub-6GHz Chipset, Module and Device products testing. It stipulates the 5G device Function and Performance tests based on test equipment in SA and NSA Mode.

GTI 5G Sub-6GHz Device Test and Certification Whitepaper (v1.0)

GTI 5G Sub-6GHz Device Test and Certification Whitepaper (v1.0)

The whitepaper is expected to give an introduction on the test methodology and certification scheme for 5G chipset, module and device products.

GTI 5G S-Module Whitepaper (v1.1)

GTI 5G S-Module Whitepaper (v1.1)

This white paper provides a technical overview of the 5G Superior Universal Module, which is known as "5G S-Module". It covers the industry status, the requirement, and the technology for 5G S-Module. Compared with v1.0, v1.1 has made some revisions to Section "8.2.2 Pin Layout" and "8.2.3 Pin Size" as per the industry R&D progress.

New Released Whitepapers and Technical Reports

M-loT



GTI Security Test Guide for IoT Device and Certified Devices

The purpose of this document is to enable the suppliers of IoT products , services and components to assess the conformance of their products, services and components to the GTI Security test Guide for IoT device . Completing a GTI Security Assessment will allow an entity to demonstrate the security measures they have taken to protect their products .

GTI IoT Device Solution Whitepaper

GTI IoT Device Solution Whitepaper

To accommodate the rapid development of M-IoT technologies(NB-IoT/eMTC) and give the guidance of M-IoT device development, this whitepaper will present the overview of M-IoT device solutions, which include cost-effective RFFE solution, M-IoT Chipset Requirements and Architecture, Optimized device solution on low power, eSIM based implementation solution, etc.

GTI IoT Network Performance Evaluation Whitepaper

3

4

28

GTI IoT Network Performance Evaluation Whitepaper

In order to evaluate the condition of the NB-IoT network, the whitepaper describes a Network Performance Model. NB-IoT KQI includes RSRP Distribution Percentage, SINR Distribution Percentage, Attach Success Rate, etc. NB-IoT network KQI for Application includes Power consuming, Service Delay, Simultaneous Capacity, etc.

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





GTI Device Certification Achievements

On M-IoT and Applications & Service

Test Specifications

GTI NB-IoT Module Test Specification GTI NB-IoT Interoperability Test Specification GTI Test Solution for MIoT Terminal -Smart Smoke Detector V1.0.0

Certified Test Labs

使用表育育验室 ◎ 中国移动
 GERI Gumi Electronics & Information
 Technology Research Institute

Certified Products

chipsets, modules and devices

http://www.gtigroup.org/e/action/ListInfo/?classid=610

TesTime





5G Data Device



China Mobile House Brand Product-Forerunner One 5G Smart Hub

-Band: 5G n41/n78/n79

- -Connect: WIFI 5; WiGig; BT5.1; USB Type-C; WAN
- -Screen: 5 inch HD touch screen
- -Audio: 3 mic ; 2 speaker
- -System: Android P, AI voice Assistant



TCL-TCL F296

-5G high-speed Internet access terminal with downlink 2Gbps and uplink 1Gbps high-speed rates



Huawei-5G CPE 2.0

-Supports 2.6GHz NR160MHz -Balong 5000 inside -Sub 6GHz: downlink up to 4.6Gbps, uplink up to 2.5Gbps -5G SA & NSA



ZTE-5G CPE

-Band: 5G n41/n77/n78/n79 -Weight: 1kg -WiFi: ac & ax, 4*4 MIMO -10 Gigabit Lan -Sub 6G: downlink up to 2.22Gbps, uplink up to 211Mbps



layers/ uplink 4 layers for MIMO, etc.

-Internal fading

GTI Members Updates and Activities in 2019



Appendix 1 – Welcome to Join GTI (to operators)

More Information about GTI

To find out more information about GTI, please visit <u>http://gtigroup.org</u> 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/about/join/2013-11-11/1419.html), and return to GTI Secretariat: admin@gtigroup.org/about/join/2013-11-11/1419.html), and return to GTI Secretariat: admin@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/about/join/2013-11-11/1419.html), and return to GTI Secretariat: admin@gtigroup.org/about/join/2013-11-11/1419.html), and return to GTI Secretariat: admin@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 <u>http://gtigroup.org</u> 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