Introduction of GTI

4G Evolution and 5G Innovation

2018
Kicked off GTI in 2011

Kicked off GTI 2.0 in 2016

GTI 1.0
2011 ~ 2015

GTI 2.0
2016 ~

We become

Move forward

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

◆ 4G Development
◆ 5G R&D and Commercial Preparation
◆ Cross-industry Opportunity
1. Continuing TD-LTE Global Development

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

2. Propel 5G Development

• Promote advantage of TDD and the deeper convergence of TDD/FDD
• Promote 5G unified standard and end-to-end ecosystem
• Explore 5G cross-industry market and opportunities
Achievements of GTI

01
Successfully built global end-to-end TD-LTE ecosystem

02
Successful global commercialization of TD-LTE

03
Successful convergence of TDD/FDD and initiation of joint operation

- 105 TD-LTE commercial networks in 55 countries, and 91 TD-LTE commercial networks in progress
- 36 converged TDD/FDD networks
- 2.709 million TD-LTE base stations
- 1.15 billion TD-LTE subscribers
- 6457 TD-LTE terminals, 62.6% supporting TDD/FDD

Source: GTI, TDIA and GSA
As of Q3, 2017
132 operators have joined GTI

166 vendors have joined GTI Partner Forum

Europe: 63
North America: 4
South America: 16
Asia: 30
Oceania: 7
Africa: 12

Test: 2
Terminal&Chipset: 1
Organization: 29
Module&Antenna: 13
Infra: 57
Solution: 4
Instrument: 12
IPX Providers: 15
5G Vertical Industry: 10
Other: 2

2 MEMBERS ARE IN PROCESS

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

- BAIC
- GAEI
- Jinan Towngas
- Philips Lighting B.V.
- Taiyo Yuden
- Changhong
- Goertek
- LeAutolink
- SAFT SA
- WapWag
- CloudMinds
- Haier
- Neusoft
- Shougang Automation Information
- Wireless Car
- EVE Energy
- Hisense
- Oviphone
- Xiaomi
- Feitian
- IESLab
- Canny Robot
- Feitian
- BOCO
- Ehang
- BOCC
GTI Leaders Committee
Provide guidance to GTI:
Chairmen / CEOs from influential operators become GTI Leaders Committee Members

Sunil Bharti Mittal
Founder and Chairman
Bharti Enterprises

Shang Bing
Chairman
China Mobile

Chang-Gyu Hwang
Chairman & CEO
KT

Masayoshi Son
Chairman & CEO
SoftBank Group Corp

Vittorio Colao
Chief Executive
Vodafone
GTI Steering Committee
Decision-making body of GTI:
Executives from main operators become GTI Steering Committee Members

Mr. Craig Ehrlich
Chairman of Steering Committee
GTI

Mr. Abhay Savargaonkar
CTO
Bharti Airtel

Mr. Li Zhengmao
Executive Vice President
China Mobile

Dr. Tang Pen San
Managing Director
Arete M

Mr. Ted Matsumoto
Senior Advisor to CEO
SoftBank

Dr. John Saw
Group CTO
Sprint

Mr. Sung-Mok Oh
Head of Network Group
KT

Mr. Andy Macleod
Director of VF Network
Vodafone

Mr. Paul Berriman
Group CTO
PCCW-HKT-UKB

Mr. Mathew Oommen
President Network, Global Strategy, and Service Development
RJIL

Dr. Masashi Usami
Executive Director and General Manager of R&D Strategy Division, Technology Sector
KDDI

Mr. Natee Sumethason
Assistant Vice President
AT&T/DRVLA
**GTI Partner Forum Leadership Committee**
Executives from main industry partners become GTI PFLC members

**Roles of PFLC members**
- **Strengthen** the cooperation between GTI operator members and Partner Forum members
- **Enhance** the participation of Partner Forum members
- **Facilitate** the communication between GTI Steering Committee and Partner Forum members

<table>
<thead>
<tr>
<th>Mr. Chen Shanzhi</th>
<th>Mr. Magnus Ewerbring</th>
<th>Mr. James Wang</th>
<th>Mr. Deng Taihua</th>
<th>Mr. Howard Tsao</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVP</td>
<td>CTO, Asia-Pacific</td>
<td>Senior Vice President,</td>
<td>President of Huawei</td>
<td>CTO, Broadband Networks,</td>
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<td>Datang</td>
<td>Ericsson</td>
<td>Greenpacket</td>
<td>Wireless Solution,</td>
<td>ITRI</td>
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<td></td>
<td>Huawei</td>
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<tr>
<td>Mr. Zhang Qi</td>
<td>Mr. Ben Lin</td>
<td>Mr. Frank Stewart</td>
<td>Mr. Edward George</td>
<td>Mr. Yunsang Park</td>
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<tr>
<td>VP, GM of TD-LTE</td>
<td>Executive VP/ CTO,</td>
<td>General Manager,</td>
<td>Tiedemann</td>
<td>Senior Vice President</td>
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<td>Business Line</td>
<td>Sercomm</td>
<td>Cellular Products</td>
<td>Qorvo</td>
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<td>Nokia</td>
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<tr>
<td>Mr. Hang Gang</td>
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<td>VP of TDD</td>
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<td>ZTE</td>
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Marketing Work of GTI

GTI Summit
Exhibition
GTI Awards
Investor Conference

On-line Promotion
Website / Industry Briefing / Video / Brochure
GTI 2.0 Technical Work

GTI established **5 Programs** to continuously promote 4G evolution and 5G development with concrete deliverables

<table>
<thead>
<tr>
<th>Program</th>
<th>Objective</th>
<th>Projects</th>
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<tr>
<td><strong>4G &amp;Evolution</strong></td>
<td>Facing the rapid development of data requirements on new service &amp; applications, efficient utilizing LTE to enhance performance and service capability</td>
<td>Massive-MIMO</td>
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<td>Uplink Enhancement</td>
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<td>Smooth Evolution</td>
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<td><strong>5G eMBB</strong></td>
<td>Defining 5G eMBB requirements/use case, validating system solution, defining product requirement and promoting commercial deployment among GTI partners and with wider industry partners</td>
<td>Sub 6GHz</td>
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<td>New Device Architecture</td>
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<td><strong>IoT</strong></td>
<td>Promoting development of cellular IOT technology and its commercialization</td>
<td>Pilot and Trial</td>
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<td>Wireless Solution</td>
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<td>Network Architecture</td>
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<td>Chipset and Module</td>
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<td><strong>IoV</strong></td>
<td>Cooperation with other international organizations, like 5GAA, and automotive industry to better promote the development of V2X</td>
<td>Device Certification</td>
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<td>Open Platform</td>
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<td>Market &amp; Business</td>
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<td><strong>Cloud Robot</strong></td>
<td>Enabling the development of Cloud Robot and jointly exploring the market</td>
<td>Whitepaper</td>
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<td>Prototype demo</td>
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<td>5G integration</td>
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A series of products and technique outputs have been released to further guide the TD-LTE ecosystem development.

**Terminal**
- Promote Multi-Mode Multi-Band devices
- LTE Device Technical Specification
- GTI Mobile Hotspot Technical Requirement
- Multi-Mode Multi-Band White paper
- TDD_Power_Class2_Whitepaper

**Spectrum**
- Guide TDD spectrum utilization and allocation
- TDD Spectrum White Paper
- LSA White Paper
- GTI Future Spectrum White Paper

**Network**
- Promote converged LTE TDD/FDD network products
- TD-LTE Radio Network White Paper
- FDD-TDD Convergence White Paper
- TD-LTE Carrier Aggregation White Paper
- GTI Massive MIMO White Paper

**3.5GHz**
- Build 3.5GHz industry ecosystem
- Synchronization White Paper
- 3.5GHz White Paper

**Business & Service**
- Drive the embedded devices and global roaming
- GTI-GSMA Consumer Electronics White Paper
- GTI Business Modeling and Funding for TDD Operator White Paper
- GTI 4G Wireless Broadband Industry
GTI Official Website (www.gtigroup.org) provides the efficiency and concentricity of sharing the latest TD-LTE development status, GTI operation progress, and highlighted GTI events.

GTI website owns 6 intensive channels:

- **About Us**- introductory area for GTI
- **Events**- valuable GTI events, videos and documents update
- **News**- GTI news and industrial news edited and selected by GTI Secretariat
- **TD-LTE Development & Evolution**- delivers key message, including industry database, publications and latest TD-LTE product introduction.
- **5G Innovation Program**- general introduction, relevant industry events and news.
- **Working Space**- GTI file center
Meeting Plan 2018

**GTI Summit (3)**
- **Jan/Feb**: 
  - Time: 27th Feb. (MWC)
  - Venue: Barcelona, Spain
  - GTI Summit (Including GTI Awards)
- **May/Jun**: 
  - Time: TBD (MWCS18)
  - Venue: Shanghai, China
  - GTI Summit
- **Sep/Oct**: 
  - Time: TBD (MWC America)
  - Venue: San Francisco, USA
  - GTI Summit

**Workshop (4)**
- **Mar/Apr**: 
  - Time: 22nd - 23rd Feb. (MWC)
  - Venue: Barcelona, Spain
  - The 21st GTI Workshop
- **May/Jun**: 
  - Time: TBD (MWCS18)
  - Venue: Shanghai, China
  - The 22nd GTI Workshop
- **Sep/Oct**: 
  - Time: TBD (ITU Telecom World)
  - Venue: South Africa
  - TD-LTE Technology and Spectrum Workshop
- **Nov/Dec**: 
  - Time: TBD
  - Venue: TBD
  - The 23rd GTI Workshop

**Exhibition (4)**
- **Jan/Feb**: 
  - Time: 26th Feb. - 1st Mar (MWC)
  - Venue: Barcelona, Spain
- **May/Jun**: 
  - Time: TBD (MWCS18)
  - Venue: Shanghai, China
- **Sep/Oct**: 
  - Time: TBD (ITU Telecom World)
  - Venue: South Africa
- **Nov/Dec**: 
  - Time: TBD (PT EXPO China)
  - Venue: Beijing, China

**Others (2)**
- **Jan/Feb**: 
  - Time: TBD (MWC)
  - Venue: Barcelona, Spain
  - GTI Night
- **May/Jun**: 
  - Time: TBD (MWCS)
  - Venue: Shanghai, China
  - 5G Spectrum Forum
How to join as GTI Operator Member (with TDD spectrum)?

1. Submit the application form to Secretariat
   GTI_Secretariat_list@lte-tdd.org

2. Secretariat reviews the application form and send the Letter of Intent (LOI) to applicant.

3. The applicant signs the LOI for participation into the GTI.

4. The applicant receives an official confirmation from GTI Secretariat.

How to join as GTI Operator Member (without TDD spectrum)?

1. Submit the application form to Secretariat
   GTI_Secretariat_list@lte-tdd.org

2. Secretariat reviews the application form and send the declaration form to applicant.

3. The applicant signs the declaration form for GTI SC’s approval

4. The applicant receives an official confirmation from GTI Secretariat.

How to join as GTI Partner Forum Member?

1. Submit the application form to Secretariat
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ANNEX
GTI Work Summary 2017

- Program 5G eMBB
1. Highlights in 2017
   - Overview of 5G program
   - White Paper and Prototype
   - PoC Verification

2. Objective for 2018
   - 5G Key Solutions and Experience
   - Commercial Industry Promotion
   - Integration of 5G and vertical Industries
White papers and Reports

**RAN**
- Sub-6GHz 5G Spectrum Whitepaper
- Proof of Concept of 5G System Whitepaper
- Sub-6GHz 5G Radio Access Network Whitepaper
- Sub-6GHz 5G Deployment Whitepaper

**Core Network**
- 5G Core Network Whitepaper
- 5G Network Architecture Whitepaper
- 5G Network Slicing Whitepaper

**Device**
- Sub-GHz 5G Device Whitepaper
- 5G New Device Type Research Report
- 5G Device RF Component Research Report
1. **Business Driver & Opportunities**
   - Overview the factors and use cases to drive initial 5G deployments
   - Discuss the key challenges to 5G deployment with operator forecast

2. **Spectrum Availability**
   - Overview the candidate sub-6GHz spectrum for 5G deployment worldwide and the development status
   - Overview 3GPP standardization progress with example trial results

3. **Deployment Scenarios**
   - Investigate the possible 5G deployment scenarios for initial phase and the next step
   - Preliminary investigation on possible migration scenarios from 4G to 5G with different architecture options

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*Contributors: Sprint, Ericsson, CMCC, MediaTek*
1. **Key performance requirements**
   - Key performance requirements indexes need to be identified in 5G early trial.
   - For instance, Capacity, Coverage, Mobility, Latency, etc.

2. **NR Key Technologies & Features**
   - Essential features in compliant with 3GPP standards enabling the competence of 5G NR.

3. **NR RAN Architecture and System Solutions**
   - Substantial RAN solutions in early trial to identify issues may possibly hurdle 5G commercialization.
   - Including NG-RAN Architecture, Hardware Introduction, Solutions of Capacity, Coverage and Mobility.
   - Sharing examples of trial results from cooperation with GTI partners.

Contributors: Huawei, Ericsson, ZTE, Qualcomm
1. Key System Requirements & Network Architecture

2. Key Functions
   - Separation of Control Plane and User Plane
   - Flexible and Efficient User Plane Selection
   - Edge Computing
   - Network Slicing
   - QoS Framework
   - Multiple Access
   - Interworking and Migration
   - IMS Voice
5G Device Whitepaper

- Target eMBB scenario for Sub-6GHz 5G pre-commercial device
- Define the technical requirements & Focus on the hot topics for 5G device Design and Implementation

1. Form Factor of 5G Device
   - 5G potential applications
   - Form factor of device

2. Communication Functions & Performance Requirements
   - System & Performance Requirements
   - Physical & Upper Layer Requirements

3. Hot Topics
   - Multi-Mode Multi-Band
   - Network Access Capability
   - Inter-RAT Interworking
   - Voice Solution
   - RF Performance
   - Demodulation Performance
   - Power Consumption
   - Test Requirements
5G Prototypes

5G System Prototype

Sub-6GHz 5G FPGA Prototype Device

5G RF Components
5G PoC Verifications and Field Trials

5G eMBB 3.5GHz PoC Trial Plan & Spec

**Lab Test**
Hardware/OTA Test, functions and performance

- 5G BS prototype

| Frequency | 3.4-3.6GHz |
| BW        | 100MHz     |
| Power     | 200 w      |
| antenna elements | 192/128  |
| Path      | 64TR       |

- 4T8R/2T4R

**Field Test**
- Key performance of 5G:
  - 4G/5G coverage, latency, data rate, capacity...
- Trial Area near Ningbo University

- Beijing, 5 sites/vendor
- Shanghai, 7 sites
- Guangzhou, 7 sites
- Suzhou

- * in different scenarios

Results on coverage, latency, data rate are shared during workshop or by whitepaper
Overview

1. **Highlights in 2017**
   - 5G E2E Solutions Discussion
   - White Paper and Prototype
   - PoC Verification

2. **Objective for 2018**
   - 5G Key Solutions and Experience
   - Commercial Industry Promotion
   - Integration of 5G and vertical Industries
Promoting maturity of 5G networks, terminals, chips and instruments

3.5GHz Commercial Product
Based on Large Scale Trial Requirements, promote the maturity of the middle band commercial products

5G Chipset and Terminals
• Build up 5G chipset verification system
• Accelerate joint research on 5G terminals

>6GHz RF Components
• Joint R&D on 5G high band RF component
5G field trial is conducted to validate the key solutions for networking and operation.

**Networking**
- 1. Spectrum
- 2. Bandwidth
- 3. Type of base stations
- 4. Multi-antenna solutions
- 5. Transportation and CU/DU deployment
- 6. Core network
- 7. Uplink solutions...

**Network planning**
- 1. SA/NSA performance
- 2. Coverage performance
- 3. inter-working with 4G
- 4. ...

**Operation & optimization**
- 1. smart network optimization
- 2. energy consumption
- 3. ...

- E2E solutions such as Voice, interoperability, Slicing, MEC...
- Key performance of 5G coverage, data rate, latency...
5G eMBB Program aims at promoting the integration of 5G and vertical industries, proposing solutions meeting new applications/business models requirements.
Thank you