# Introduction of GTI

## *4G Evolution and 5G Innovation*

*2018*

# What is GTI

## Kicked off GTI in 2011


**GTI 1.0**
2011 ~ 2015

*We become*

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

## Kicked off GTI 2.0 in 2016


**GTI 2.0**
2016 ~

*Move forward*

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

# Objectives of GTI 2.0

## 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**

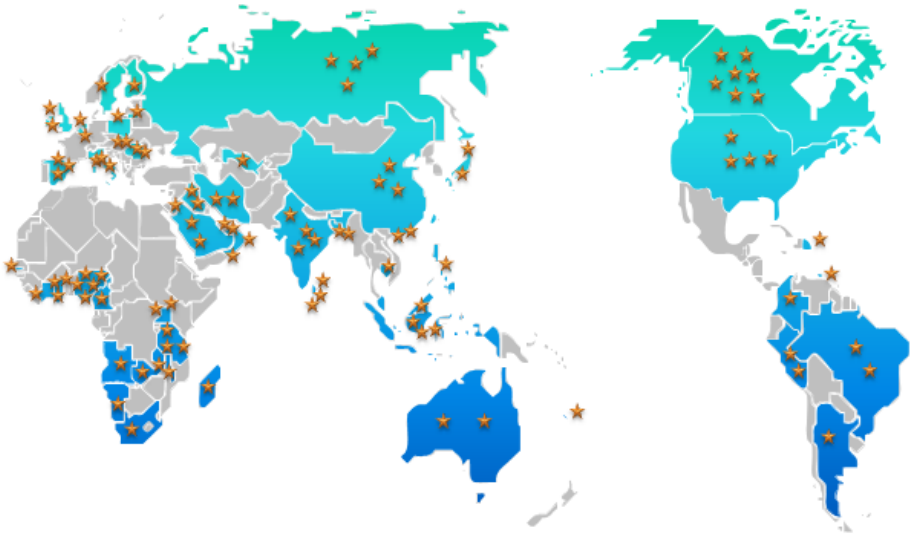
**Successfully built global end-to-end TD-LTE ecosystem**

**Successful global commercialization of TD-LTE**

**02**

**03**

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

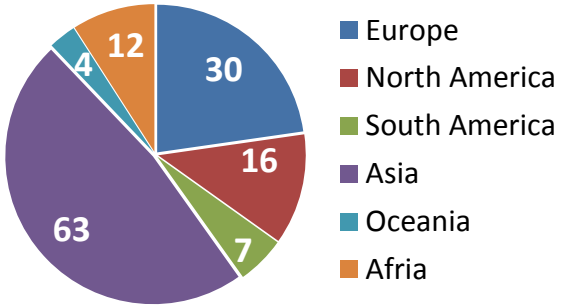


- ***105*** TD-LTE commercial networks in ***55*** countries, and ***91*** TD-LTE commercial networks in progress
- ***36*** converged TDD/FDD networks
- ***2.709 million*** TD-LTE base stations
- ***1.15 billion*** TD-LTE subscribers
- ***6457 TD-LTE*** terminals, ***62.6%*** supporting TDD/FDD

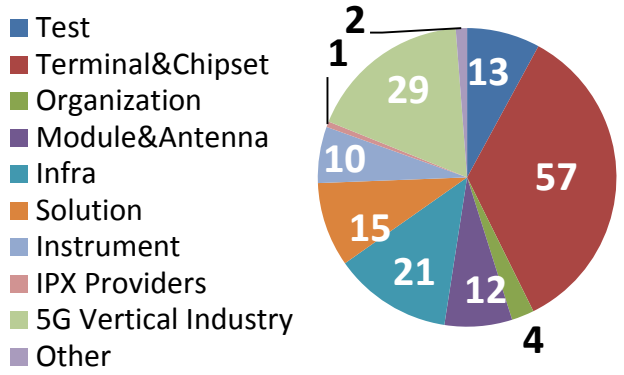
***Source: GTI, TDIA and GSA***
***As of Q3, 2017***

# Who is in GTI

## *132* operators have joined GTI




## *166*vendors have joined GTI Partner Forum




**2** MEMBERS ARE IN PROCESS

## Vertical Industry Partners

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

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

# Organizations of GTI (1/3)

## 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**

# Organizations of GTI (2/3)

## 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

# Organizations of GTI (3/3)

## GTI Partner Forum Leadership Committee

**Executives from main industry partners become GTI PFLC members**

***Roles of PFLC members***

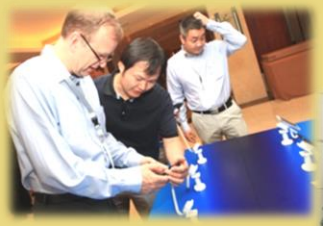
- ✓***Strengthen*** ***the cooperation between GTI operator members and Partner Forum members***
- ✓***Enhance*** ***the participation of Partner Forum members***
- ✓***Facilitate*** ***the communication between GTI Steering Committee and Partner Forum members***

| | | | | |
|---|---|---|---|---|
| **Mr. Chen Shanzhi**<br>EVP<br>**Datang** | **Mr. Magnus Ewerbring**<br>CTO, Asia-Pacific<br>**Ericsson** | **Mr. James Wang**<br>Senior Vice President,<br>**Greenpacket** | **Mr. Deng Taihua**<br>President of Huawei Wireless Solution,<br>**Huawei** | **Mr. Howard Tsao**<br>CTO, Broadband Networks,<br>**ITRI** |
| **Mr. Zhang Qi**<br>VP, GM of TD-LTE Business Line<br>**Nokia** | **Mr. Ben Lin**<br>Executive VP/ CTO,<br>**Sercomm** | **Mr. Frank Stewart**<br>General Manager,<br>Cellular Products<br>**Qorvo** | **Mr. Edward George Tiedemann**<br>SVP, Engineering,<br>**Qualcomm** | **Mr. Yunsang Park**<br>Senior Vice President<br>**Samsung** |
| **Mr. Hang Gang**<br>VP of TDD<br>**ZTE** | | | | |

# 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**

## GTI 2.0 Technical Work

| Program | Objective | Projects |
|---|---|---|
| 4G &Evolution | Facing the rapid development of data requirements on new service & applications, efficient utilizing LTE to enhance performance and service capability | Massive-MIMO<br>Uplink Enhancement<br>Smooth Evolution<br>Innovative Business & Service<br>eMBMS<br>… |
| 5G eMBB | Defining 5G eMBB requirements/use case, validating system solution, defining product requirement and promoting commercial deployment among GTI partners and with wider industry partners | Sub 6GHz<br>New Device<br>Architecture<br>Test Equipment<br>… |
| IoT | Promoting development of cellular IOT technology and its commercialization | Pilot and Trial<br>Wireless Solution<br>Network Architecture<br>Chipset and Module<br>Device Certification<br>Open Platform<br>Market & Business<br>… |
| IoV | Cooperation with other international organizations, like 5GAA, and automotive industry to better promote the development of V2X | |
| Cloud Robot | Enabling the development of Cloud Robot and jointly exploring the market | Whitepaper<br>Prototype demo<br>5G integration<br>Pre-5G demo<br>… |

# Technical & Product Work-Deliverables

**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

5-mode 13 Bands smartphone

## 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

## 3.5GHz

Build 3.5GHz industry ecosystem

## Business & Service

Drive the embedded devices and global roaming

- TD-LTE Radio Network White Paper
- FDD-TDD Convergence White Paper
- TD-LTE Carrier Aggregation White Paper
- GTI Massive MIMO White Paper
- Synchronization White Paper
- 3.5GHz White Paper
- GTI-GSMA Consumer Electronics White Paper
- GTI Business Modeling and Funding for TDD Operator White Paper
- GTI 4G Wireless Broadband Industry

# GTI Website

**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

| 2018 | Jan/Feb | Mar/Apr | May/Jun | Jul/Aug | Sep/Oct | Nov/Dec |
|---|---|---|---|---|---|---|
| **Summit (3)** | Time: 27th Feb.<br>(MWC)<br>Venue: Barcelona, Spain<br>**GTI Summit (Including GTI Awards)** | | Time: TBD<br>(MWCS18)<br>Venue: Shanghai, China<br>**GTI Summit** | | Time: TBD<br>(MWC America)<br>Venue: San Francisco, USA<br>**GTI Summit** | |
| **Workshop (4)** | Time: 22nd -23rd Feb.<br>(MWC)<br>Venue: Barcelona, Spain<br>**The 21st GTI Workshop** | | Time: TBD.<br>(MWCS18)<br>Venue: Shanghai, China<br>**The 22nd GTI Workshop** | | Time: TBD<br>(ITU Telecom World)<br>Venue: South Africa<br>**TD-LTE Technology and Spectrum Workshop**<br>Time: TBD<br>Venue: TBD<br>➢ **The 23rd GTI Workshop** | |
| **Exhibition (4)** | 26th Feb. -1st Mar<br>(MWC)<br>**Barcelona, Spain** | | TBD<br>(MWCS18)<br>**Shanghai, China** | TBD<br>(ITU Telecom World)<br>**South Africa** | TBD<br>(PT EXPO China)<br>**Beijing, China** | |
| **Others (2)** | Time: TBD<br>(MWC)<br>Venue: Barcelona, Spain<br>**GTI Night** | | Time: TBD.<br>(MWCS)<br>Venue: Shanghai, China<br>**5G Spectrum Forum** | | | |

# How to Join Us

CLICK HERE

***http://gtigroup.org/joinUs.html***

## 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 GTI_Secretariat_list@lte-tdd.org
2. Secretariat reviews the application form and send the **declaration form** to applicant.
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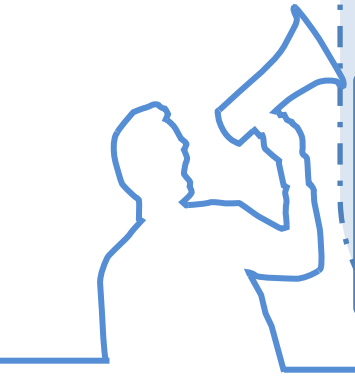


# ANNEX

# GTI Work Summary 2017

## - Program 5G eMBB

# Outline

## 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

# Overview of Program 5G eMBB


- **Spectrum**
  - sub 6GHz
  - > 6GHz
- **Deployment**
  - SA/NSA
  - deployment Scenarios and Use Cases
- **Network Architecture**
  - Network Slicing
- **Radio Access Network**
  - 3.5GHz Massive MIMO
    - Smooth evolution/ Test Solutions…
  - CU/DU deployment
  - Prototype and Field Trial
- **Device**
  - RF components
  - PA Module
  - 5G Device Form Factor

# White papers and Reports

White Papers and Technical 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

# 5G Deployment Whitepaper

- *From business motivation, spectrum availability to deployment scenarios*
- *Layout high level expectation on 5G deployment options to encourage further discussion on technical requirements within GTI for ecosystem consolidation*

## *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*


*Contributors: Sprint, Ericsson, CMCC, MediaTek*

# 5G RAN Whitepaper

- ***Define the Key performance requirements & Focus on the Key technologies and System Solutions for 5G RAN***

***1. Key performance requirements***

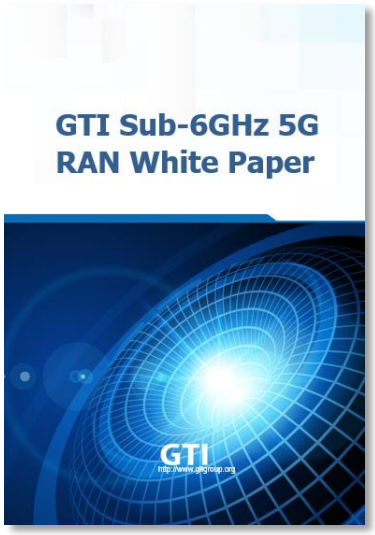
- *Key performance requirements indexes need to be identified in 5G early trial.*
- *For instance, Capacity, Coverage, Mobility, Latency, etc.*

***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*

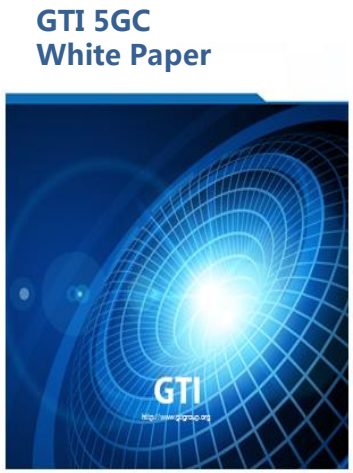
# 5G CN White Paper

- *Define the Key System Requirements and Network Architecture & Key Functions for 5GC*

## *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*

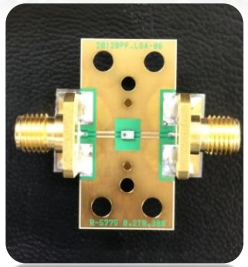
# 5G Prototypes

## 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 |

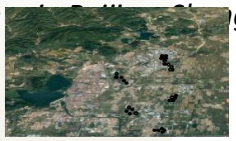
test UE/CPE/instruments

| | |
|---|---|
| **antennas** | 4T8R/2T4R* |
| **Power** | 23 dBm@1Tx /26dBm@2Tx |

* in different scenarios

### *Field Test*

- *key performance of 5G:*
  - *4G/5G coverage, latency, data rate, capacity…*
- *Beijing, Shanghai, Guangzhou, Suzhou, Ningbo*



**Beijing , 5 sites/vendor**

**Shanghai, 7 sites**

**Guangzhou, 7 sites**

**Suzhou**


**Ningbo**

***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

# Commercial Industry Promotion

**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

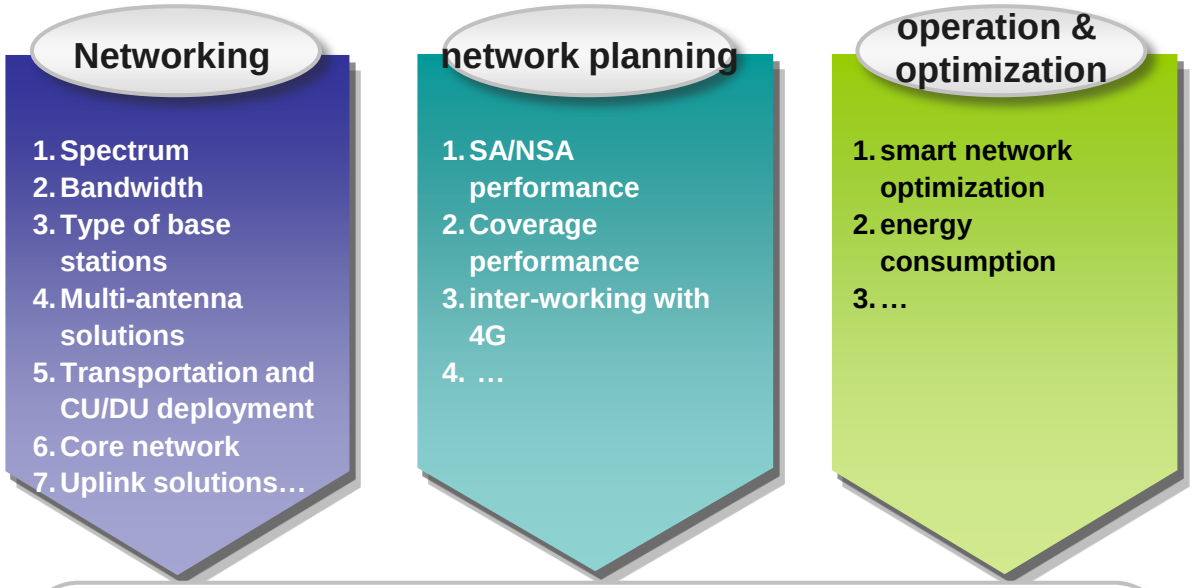
- Build up 5G chipset verification system
- accelerate joint research on 5G terminals

## >6GHz RF Components

- Joint R&D on 5G high band RF component

# 5G Field trial and networking strategy

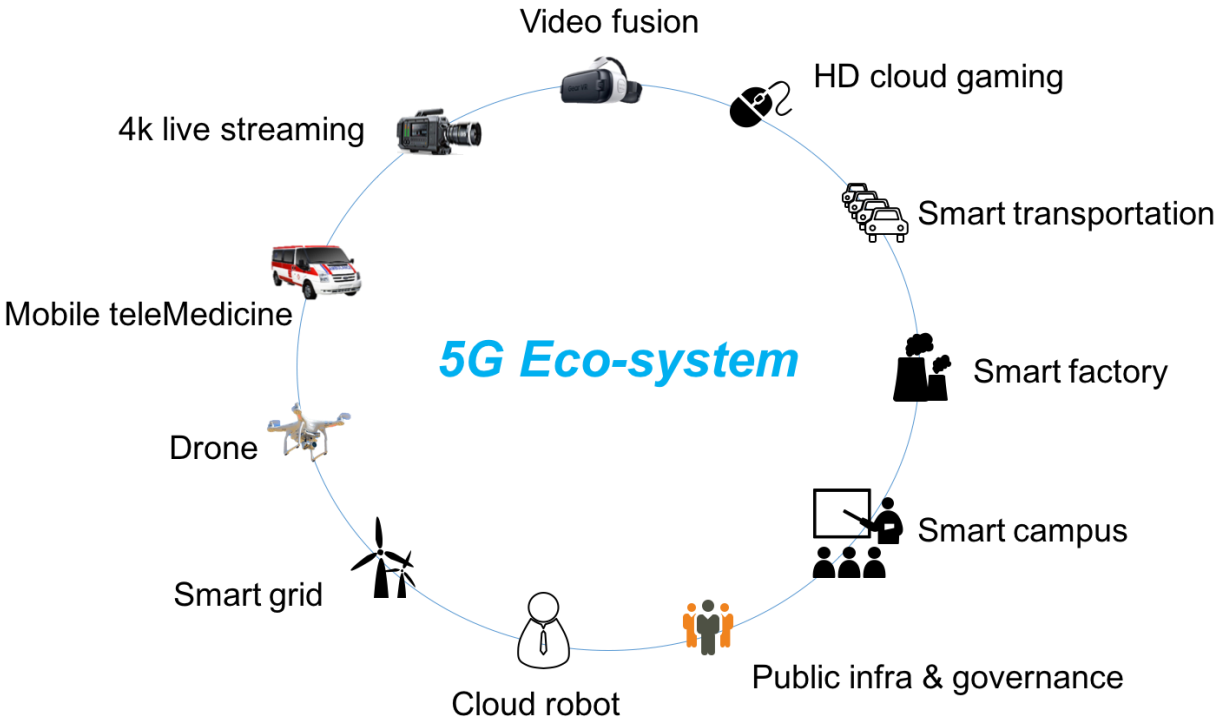
**5G field trial is conducted to validate the key solutions for networking and operation.**




- **E2E solutions such as Voice, interoperability, Slicing, MEC…**
- **Key performance of 5G coverage, data rate, latency…**

# Cultivate the 5G new Services and Applications

**5G eMBB Program aims at promoting the integration of 5G and vertical industries, proposing solutions meeting new applications/business models requirements.**



GTI

# Thank you