

Introduction of GTI

4G Evolution and 5G Innovation

2018

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

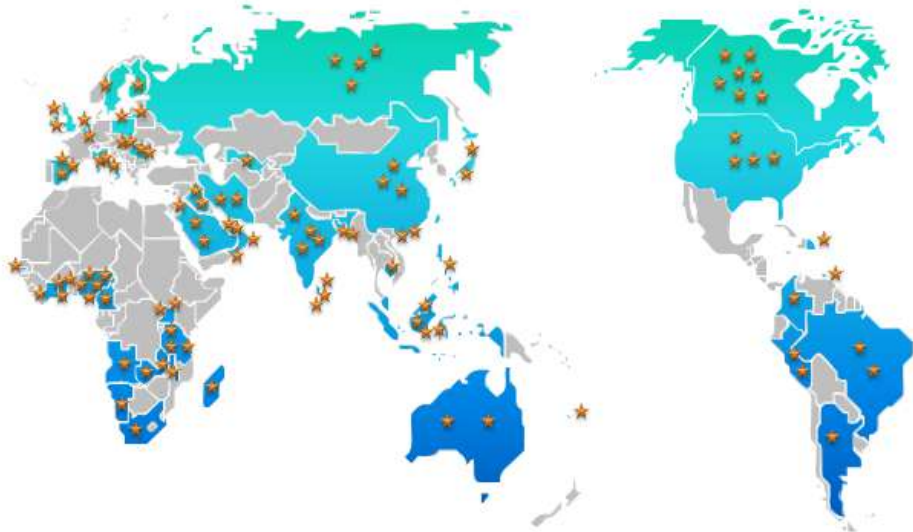
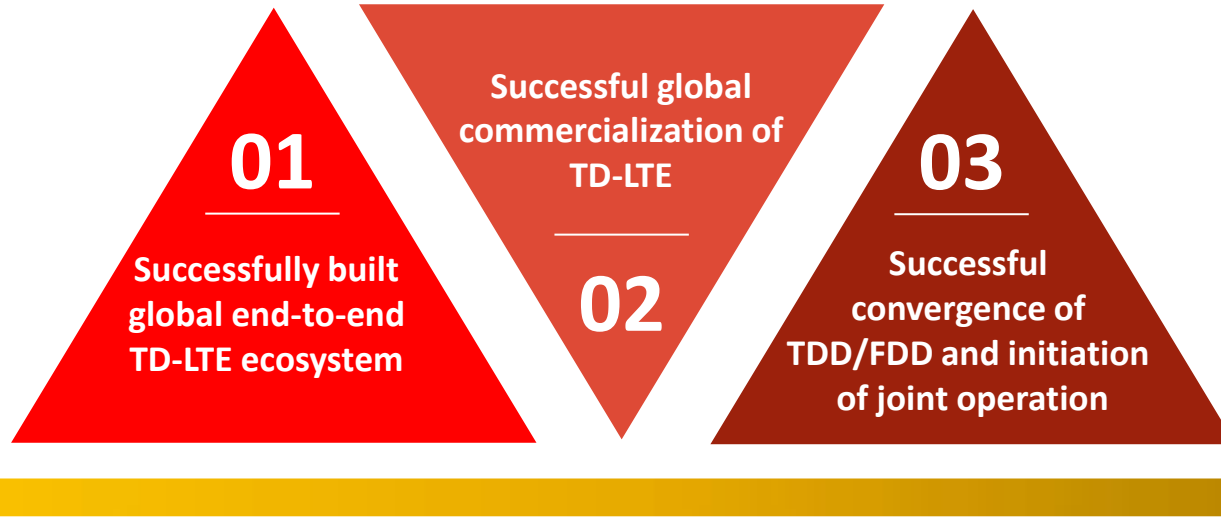
- ◆ 4G Development
- ◆ 5G R&D and Commercial Preparation
- ◆ Cross-industry Opportunity

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

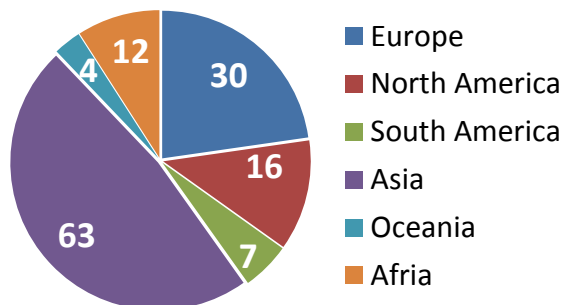
- Promote advantage of TDD and the deeper convergence of TDD/FDD
- Promote 5G unified standard and end-to-end ecosystem
- Explore 5G cross-industry market and opportunities



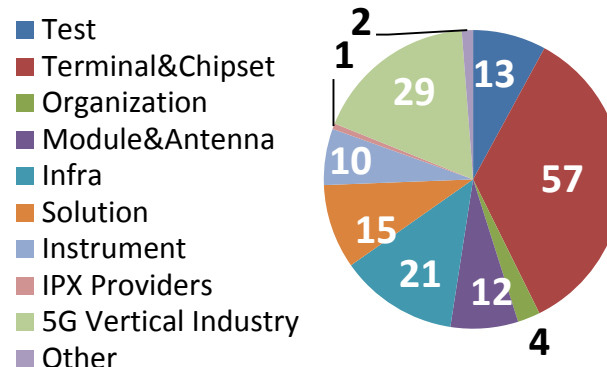
- ◆ **105** TD-LTE commercial networks in **55** countries, and **91** TD-LTE commercial networks in progress
- ◆ **36** converged TDD/FDD networks
- ◆ **2.709 million** TD-LTE base stations
- ◆ **1.15 billion** TD-LTE subscribers
- ◆ **6457 TD-LTE** terminals, **62.6%** supporting TDD/FDD

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

132 operators have joined GTI



166 vendors have joined GTI Partner Forum



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 | |

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*

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

GTI Summit



Exhibition



GTI Awards



Investor Conference



On-line Promotion

Website / Industry Briefing / Video / Brochure

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 Uplink Enhancement Smooth Evolution	Innovative Business & Service eMBMS ...
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 New Device Architecture	Test Equipment ...
IoT	Promoting development of cellular IOT technology and its commercialization	Pilot and Trial Wireless Solution Network Architecture Chipset and Module	Device Certification Open Platform Market & Business ...
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 Prototype demo 5G integration	Pre-5G demo ...

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

5 Modes 12 bands GTI Hotspot

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

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

3.5GHz

Build 3.5GHz industry ecosystem

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



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

<http://gtigro-up.org/joinUs.html>



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

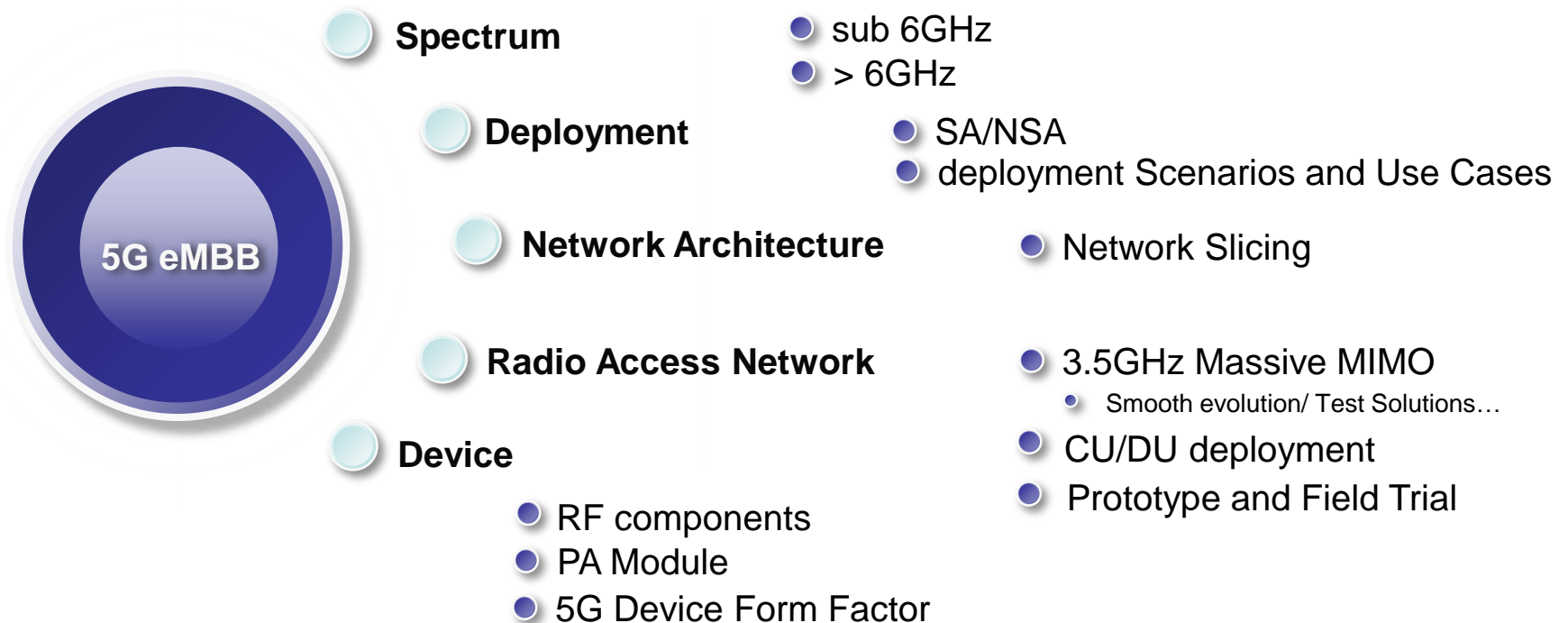


Commercial Industry Promotion



Integration of 5G and vertical Industries

Overview of Program 5G eMBB



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

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

GTI
Sub-6GHz 5G Deployment
White Paper



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

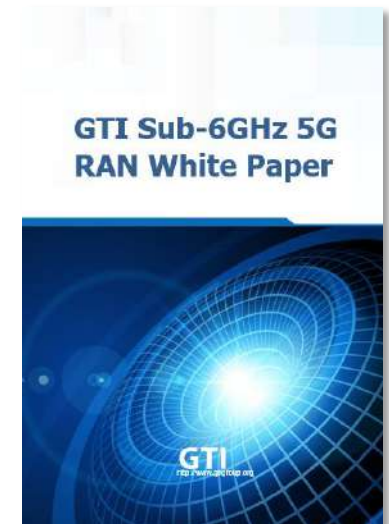
- Key performance requirements indexes need to be identified in 5G early trial.
- For instance, Capacity, Coverage, Mobility, Latency, etc.

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

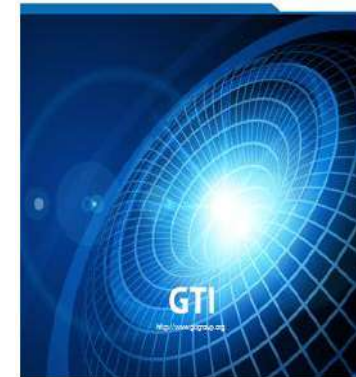
- Define the *Key System Requirements and Network Architecture & Key Functions* for 5GC

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

GTI 5GC
White Paper



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

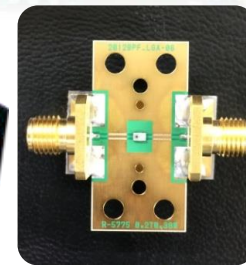
5G System Prototype



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 , 5 sites/vendor



Shanghai, 7 sites



Guangzhou, 7 sites



Suzhou



Ningbo

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

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

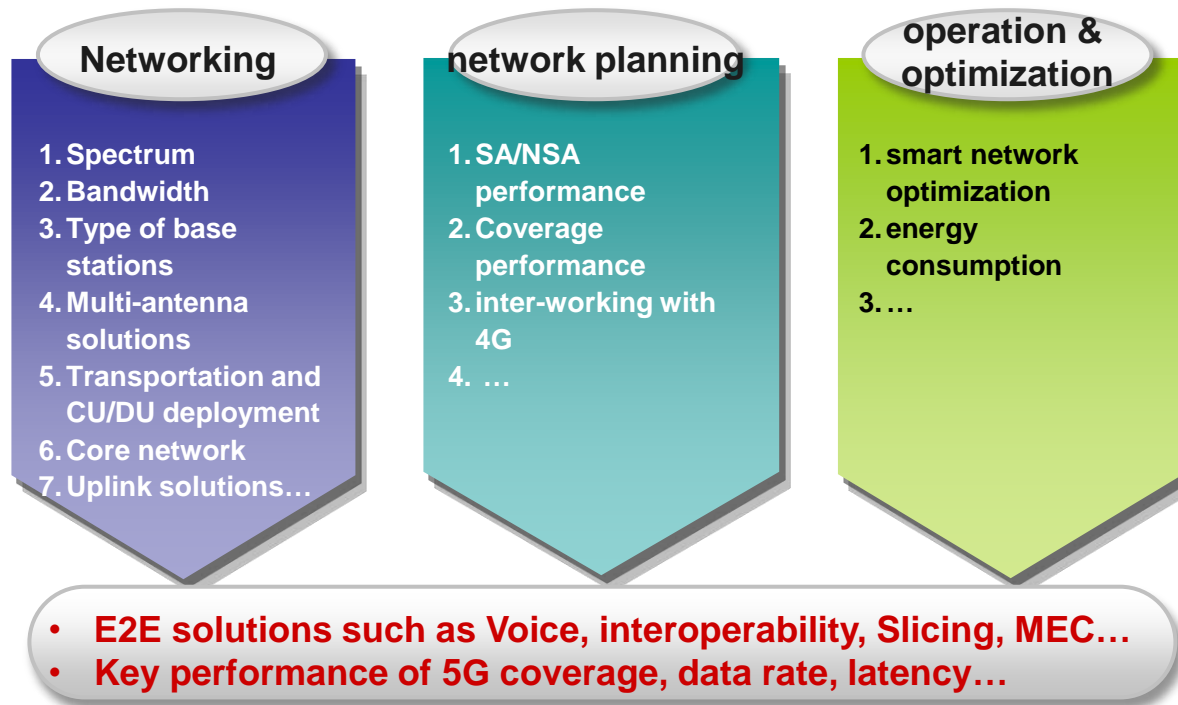
- Build up 5G chipset verification system
- accelerate joint research on 5G terminals

>6GHz RF Components

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

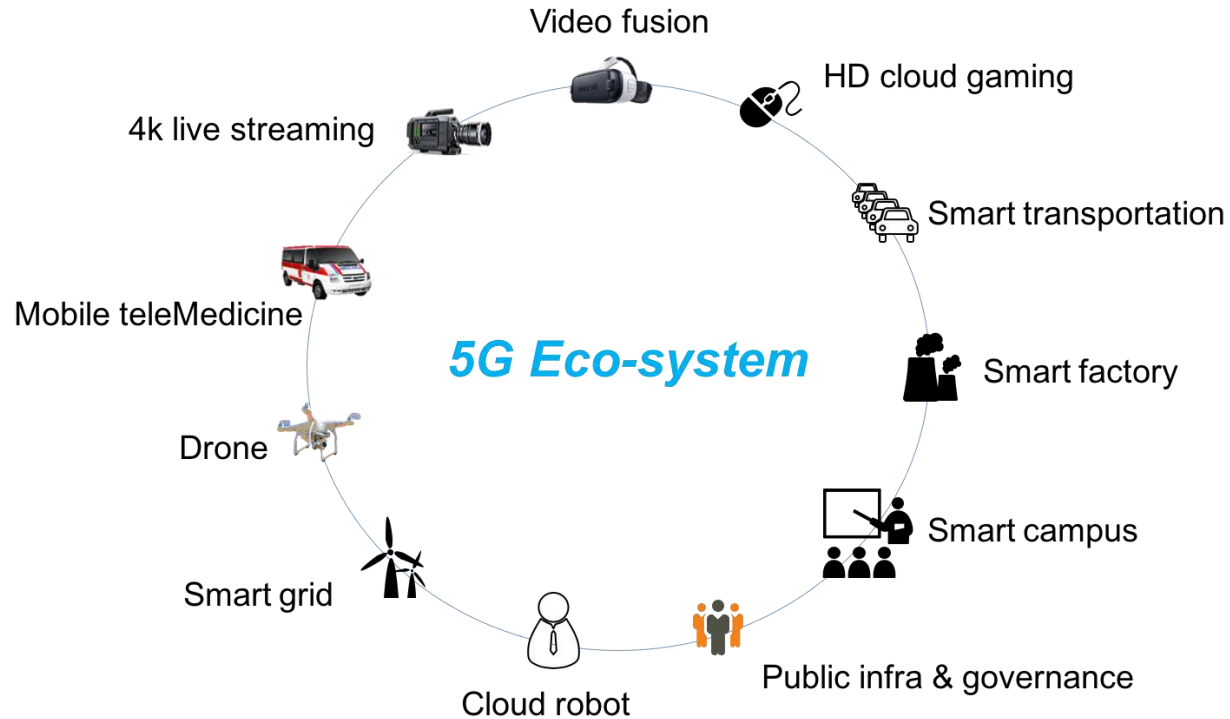
5G Field trial and networking strategy

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



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.



Thank you