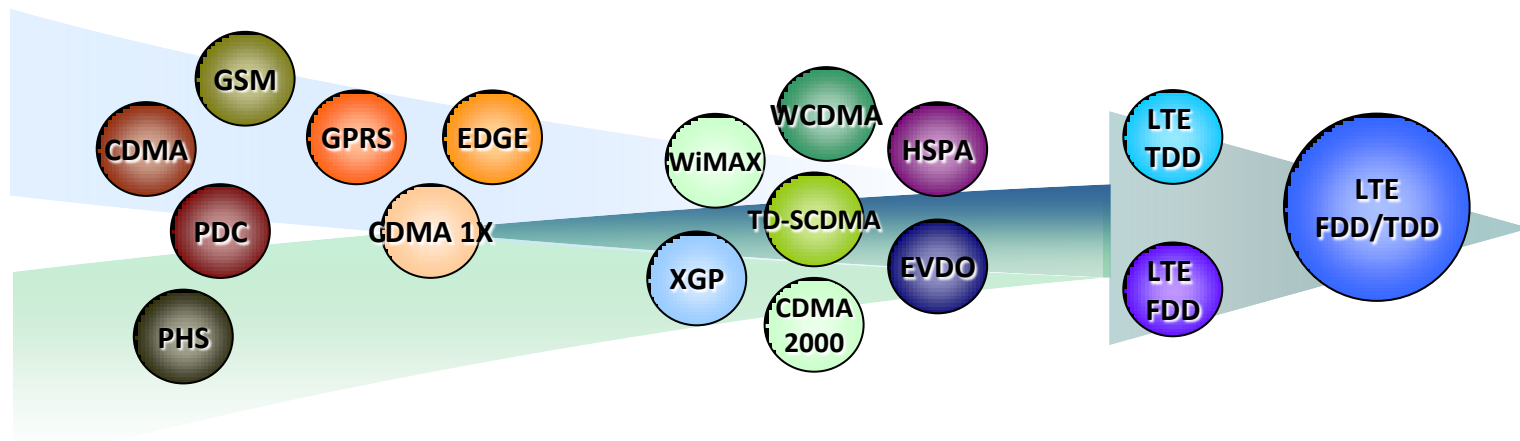


Implementing LTE FDD/TDD Convergence Network in the age of Mobile Internet

June, 2013



LTE Has Brought Us to the Best Times Ever



With the introduction of TD-LTE and its convergence development with LTE FDD, LTE has realized utilizing both FDD and TDD spectrum with **one unified solution** which is **the first time** in mobile technology history

- **Global Scale:** Less fragmentation of market for operators to use the same mobile technology which creates a global market scale and benefits the whole industry
- **Global Roaming:** The convenience for customers to enjoy high speed mobile data roaming service across different networks no matter FDD or TDD spectrum is applied

More on TD-LTE: Better Suit Mobile Internet

Traffic in Mobile Broadband Era
is Asymmetric in Nature

TD-LTE can Offer Flexible UL/DL
Ratio

Ratio of UL:DL traffic is about
1:4-6

Match

UL:DL speed in TD-LTE system
(UL:DL configuration = 1:3)
1:5.94

Typical UL:DL ratio in Mobile Broadband Era

Services	Web browsing	1:9-10
	Video	1:4.5-12
	Interactive service	1:2.6
Markets	China Mobile	1:4-6
	Hong Kong	1:4
	Singapore	1:4.3
	Spain	1:4.2
	Romania	1:5.4

- Typical UL:DL ratio offered by LTE.
- TD-LTE still has big technological potentials

System	Ant.	Cell throughput (UL/DL, Mbps)	UL:DL throughput
TD-LTE 2:2	8-path	13.8 / 25 (Test results)	1 : 1.81
TD-LTE 1:3	8-path	6.9 / 41 (Test results)	1 : 5.94
LTE FDD	2-path	30.98 / 37.55 (Test results)	1:1.21

TDD 20MHz, FDD 20*2MHz

Industry Maturity: Meet Demands of Large-scale Commercial Deployment

Converged and Robust Industry Ecosystem



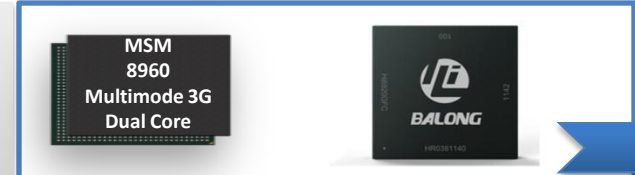


- **Converged** Infrastructure, terminal, chipset and equipment products
- **Comparative** industrialization level between TD-LTE and LTE-FDD

TD-LTE Chipset and Terminal

The terminal and chipset maturity has met the needs of large-scale commercial deployment

<p>TD-SCDMA chipset vendor</p> <p>Spreadtrum Leadcore 重邮信科</p>	<p>FDD chipset vendor</p> <p>Qualcomm Samsung Intel Broadcom</p> <p>STE Marvell MTK</p>	<p>>30 Data card</p>	 <p>ZTE innofidei Leadcore Sequans Hisilicon Qualcomm</p>
<p>Wimax chipset vendor</p> <p>Sequans altair Wavesat</p>	<p>New chipset vendor</p> <p>Innofidei Hisilicon ZTE</p>	<p>>60 MiFi /CPE</p>	 <p>ZTE innofidei Sequans Altair NSN MTK Seiko</p>
		<p>18 Smart phone</p>	 <p>Samsung Galaxy Note2 ZTE U9815 Sony Xperia SP M35t STREAM 201HW Huawei PAZR™ M201M Moto PANTONE @ 6 200SH Sharp Grand Era ZTE</p>
		<p>2 Tablet</p>	

The availability of **5 mode chipset** expedites the development of **converged LTE TDD/FDD devices**.

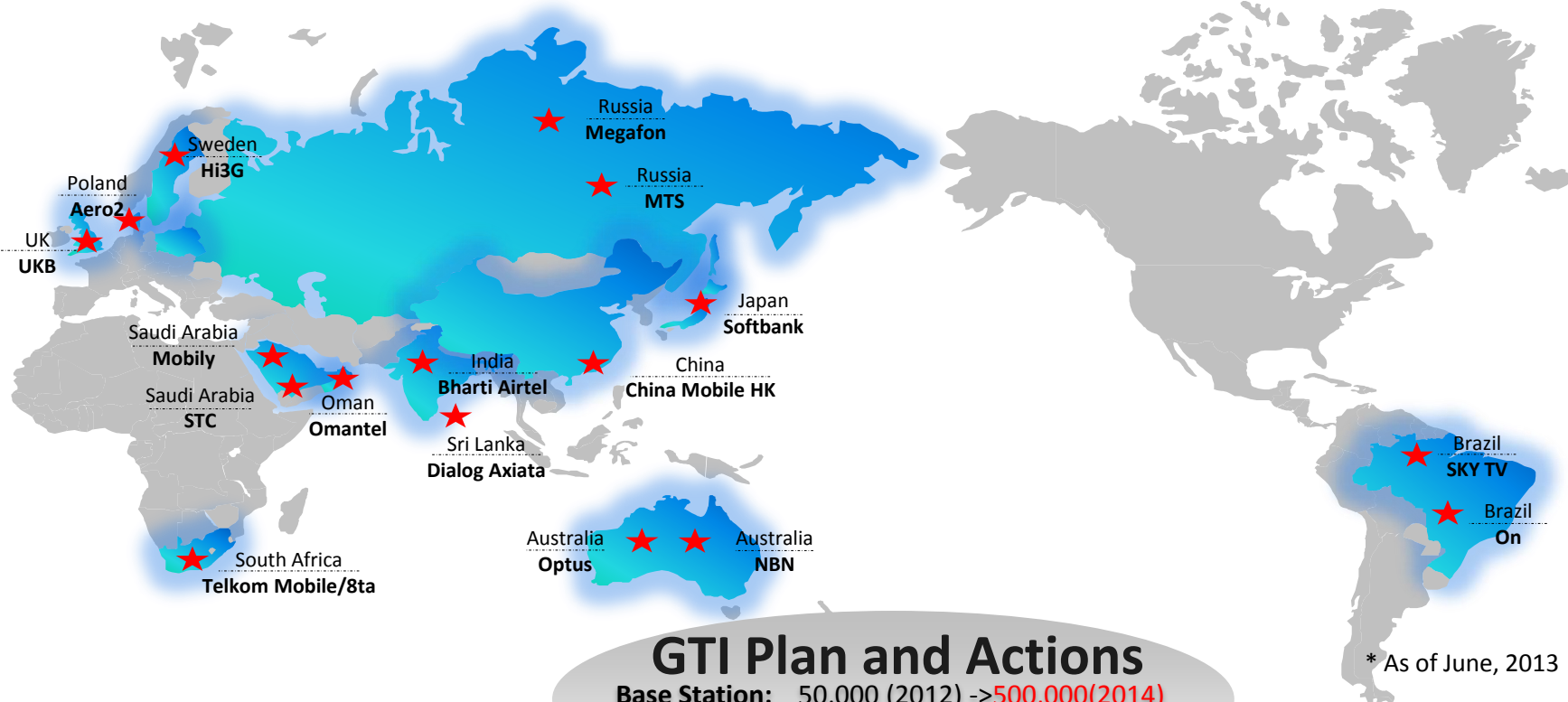
<p>2012.2</p> <p>LTE TDD/FDD uni-mode chipset</p>	 <p>Qualcomm MSM8960 MSM 8960 Multimode 3G Dual Core</p> <p>Hisilicon Balong710</p> <p>TD-LTE /LTE FDD/WCDMA/ CDMA/GSM/EDGE/GPRS</p> <p>TD-LTE /LTE FDD/ TD-S/GSM/EDGE/GPRS</p>	<p>2012.10</p> <p>Multi- Mode Multi- Band MiFi</p>	 <p>Gemtek Quanta</p> <p>5 modes: TD-LTE /LTE FDD/TD-S/WCDMA/GSM 11 bands: Band 38/39/40/41/3/7/34/1/2/5/8</p>	<p>2013.2</p> <p>MMMB smart phone</p>  <p>HUAWEI ZTE中兴 SAMSUNG HTC</p>
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Market: Global Deployment as the Mainstream Mobile Broadband Technology

17 TD-LTE commercial networks have been launched as of June, 2013

38 LTE TDD commercial networks in progress or planned

- TDD operators including WiMAX, PHS, iBurst have chosen TD-LTE as the evolution technology
- LTE FDD operators deploy TD-LTE to enhance their mobile broadband capability.



TD-LTE in China

China is accelerating TD-LTE deployment and promoting a successful business model

Spectrum

China announced to assign **2500-2690MHz** to TDD at ITU Telecom World in Oct, 2012

Allocation

China will finish 4G spectrum allocations **in one year**

Deployment

2013

- 100 cities
- 300 million pop.
- 200,000 BS

2012

- 13 cities
- 20,000 BS
- TD-LTE/LTE FDD Converged Network in HK

2011

- 7 cities
- 1100+ BS

Application

Friendly User Test in Multiple cities



China Wireless City Plan: Fully utilize TD-LTE to launch innovative applications



By the end of March 2013, there has been **22,082** newly built TD-LTE Base Stations in **13** cities in China

Key Performance: Peak Data Rate Reaches Theoretical Value

Peak Throughput

TD-LTE results (with 20MHz of Band 38)

90%-99% of theoretical value, w/ CAT3 dongles

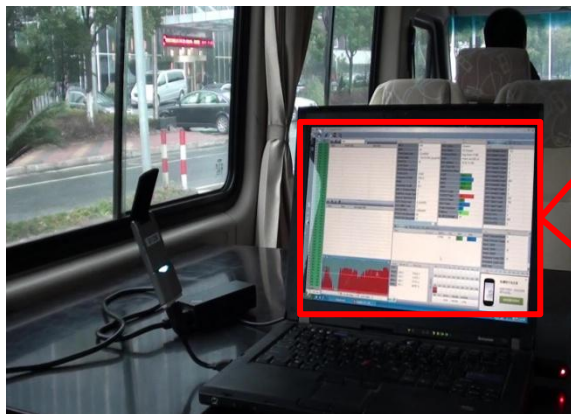
- 55-60Mbps (DL:UL = 2:2, 9 vendors)
- 76-81Mbps (DL:UL = 3:1, 6 vendors)

LTE FDD Results from FDD operators

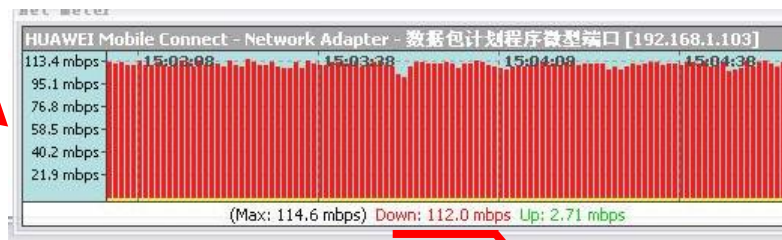
- 97-102Mbps (20/15 MHz*2, 95%-100% of theoretical value)
- 61Mbps (10MHz*2, 81% of theoretical value) w/ CAT3 dongles

112Mbps ever achieved using CAT4 terminal in TD-LTE system with 3:1 configuration. Using CAT4 terminal, LTE FDD (10MHz*2) theoretical value will reach 75Mbps.

Snapshot of TD-LTE peak throughput test



DL: 81.09Mbps (CAT3, 3:1)



DL: 112Mbps (CAT4, 3:1)

An Example of Pre-Commercial Activities: Hangzhou Network

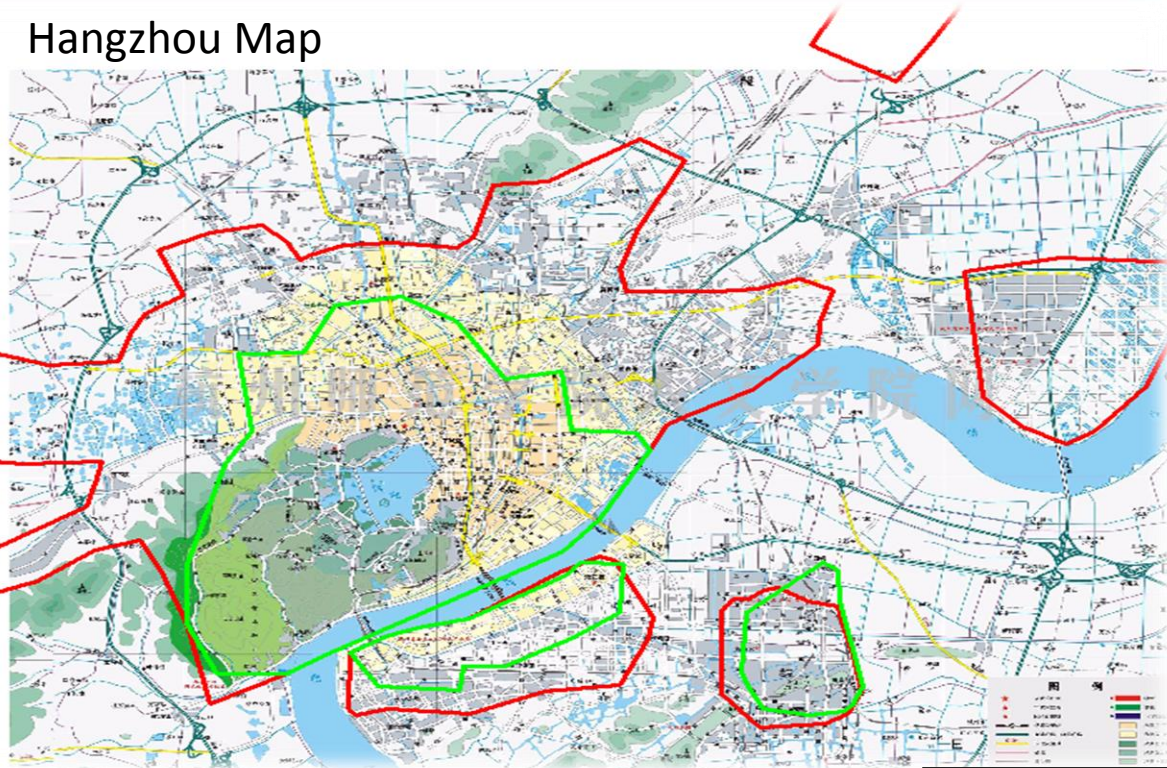
2012 Q2

- 500 macro in band 39
- 200 macro in band 38
- 100 indoor coverage
- Green line in the right map

2012 Q3

- 1000 macro in band 39
- 500 macro in band 38
- 500 indoor coverage
- Red line in the right map

Hangzhou Map



Band 39 TD-SCDMA live network can be upgraded smoothly to TD-LTE sharing the same HW

- Only upgrade RRU's software. BBU shelf is shared; upgrade takes less than three hours.
- 5000 TD-SCDMA sites in Hangzhou; 20,000 in Zhejiang province.

First commercial bus line covered by LTE-Fi in Hangzhou

- B1 bus line with 20 stops extends 28Km and is covered by 74 BS; LTE-Fi installed on 55 B1 buses & 20 stations
- Providing Wi-Fi access to users.

So far, almost 20,000 friendly users in Hangzhou enjoy the TD-LTE using MiFi, CPE and Smartphone



Example of Convergence

Converged TD-LTE/LTE FDD Network in CMHK



FDD/TDD Mobility Test

• Idle Mode

- Reselection: enabled in the network
 - Succ. Rate: 100%, latency: ~31 ms; close to that of intra-freq. reselection

• Connected Mode

- Redirection:
 - Latency: 500 ~ 900 ms
- Handover (with test terminals):
 - Succ. Rate: 100%, latency: **16~18ms** in control plane and **55~56ms** in user plane; close to those of intra-freq. handover

Network Perspective

- Co-site, co-antenna, common EPC, only RRU separated
- Seamless mobility
- TD-LTE/LTE FDD act as a unified 4G network
- Enhanced network coverage and capacity

User Perspective

- LTE Smartphone available
- Seamless user experience: Reselection has been supported by commercial UE; handover will be supported by the end of 2013
- Dual LTE network protection

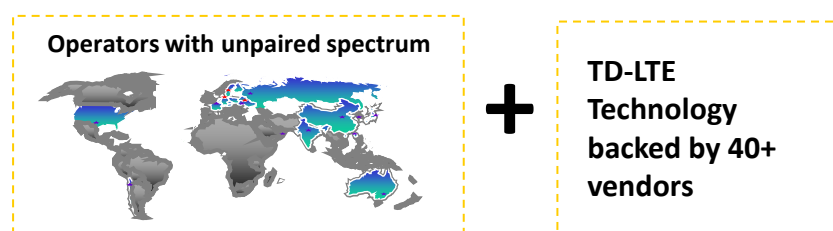
Global TD-LTE Initiative (GTI)

In order to speed up the commercialization of TD-LTE and promote the convergent development of LTE TDD and FDD,
Global TD-LTE Initiative (GTI), an open industry cooperation platform is founded.

Operators Kick-off GTI together on Feb 2011



Backed by the wide industry

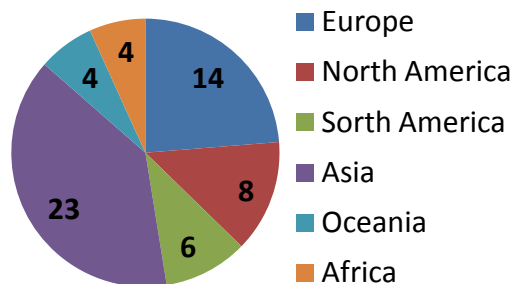


GTI Objectives:

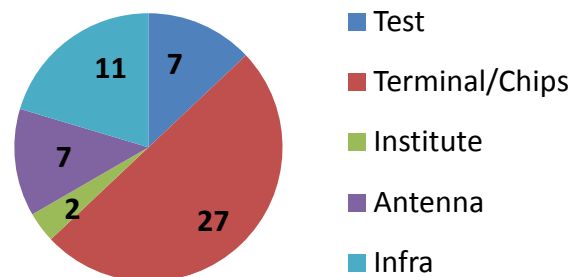
- 1) Sharing TD-LTE development strategies and best practices among operators and vendors and facilitating multilateral cooperation;
- 2) Identifying common requirements among operators and leading the industry to develop solutions to meet these requirements;
- 3) Accelerating the development of TD-LTE technology by addressing the challenges in the areas of network, terminal and business & services;
- 4) Promoting the deployment of TD-LTE in global markets and establishing a broad support for TDD

GTI Membership & Technical Works

59 operators have joined GTI

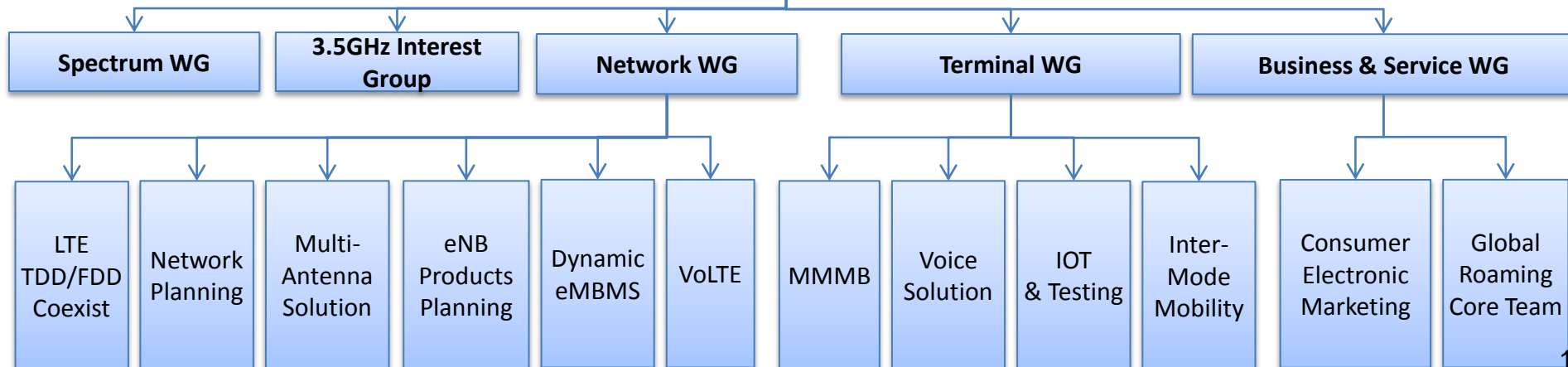


54 vendors have joined GTI Partner Forum

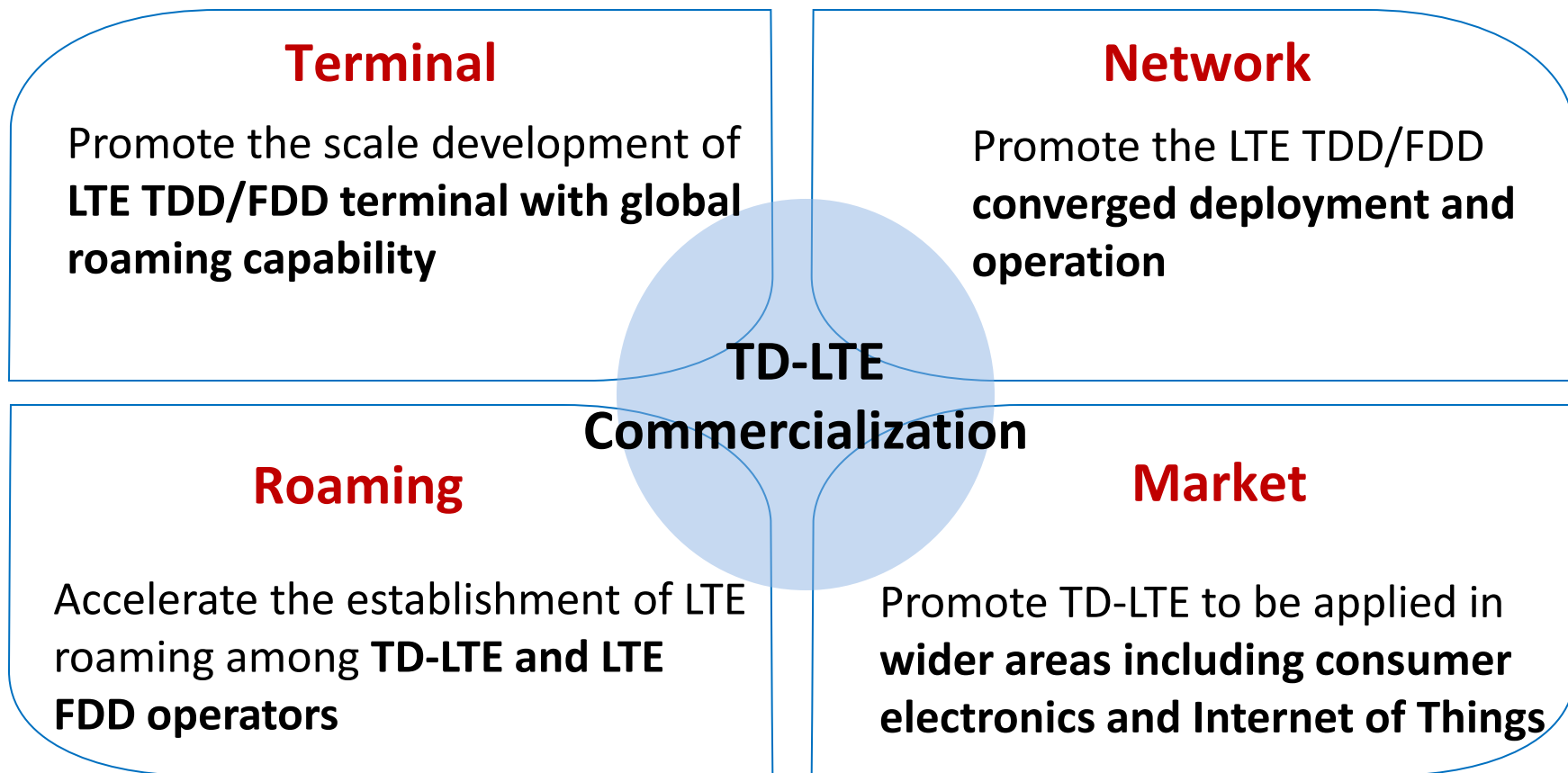


GTI set up **4 Working Groups** and **1 Interest Group**, including **11 Task Forces** and **1 Core team** for Global Roaming to solve essential technical and business issues.

GTI Technical & Product Works



GTI Works with and Global Industry Partners to Facilitate the Scale Commercialization of TD-LTE



Basic Requirement

TD-LTE: B38/39/40/41*

LTE FDD: B3/7

TD-SCDMA/TD-HSPA: B34/39

WCDMA/HSPA: B1/2/5

GSM/GPRS/EDGE: B2/3/8



Recommended Requirement

TD-LTE: B41

LTE FDD: B1/17

LTE FDD: B20/4

GSM/GPRS/EDGE: B5

***need to support since 2014**

- **Type 1 Terminals:** need to support basic requirement, with LTE roaming capability to Europe by Band 3/7
- **Type 2 Terminals:** need to support basic and recommended requirement, with LTE global roaming capability by Band 3/7/1/17/(20/4)

TD-LTE Merits: its development has helped LTE realize the convergence of TDD and FDD spectrum for the first time in history, which will benefit the whole industry.

China Mobile TD-LTE Strategy: Key network component for mobile broadband service; the deployment plan is to build TD-LTE networks in more than 100 cities and purchase more than 1 million terminals in 2013.

Global TD-LTE Initiative: Global cooperation to facilitate the commercialization of TD-LTE; Multi-Mode Multi-Band device and global LTE roaming are two key areas of promotion.

***Global Technology,
Global Deployment!***

www.lte-tdd.org

Thank You



Mobile Changes Life

