Telecommunication
Development Industry Alliance

# The TD-LTE Industrial Development and Evolution

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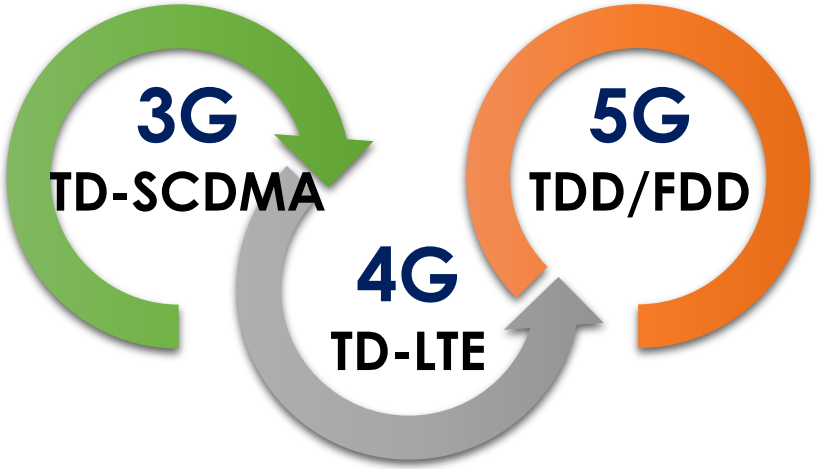
# In a Nutshell

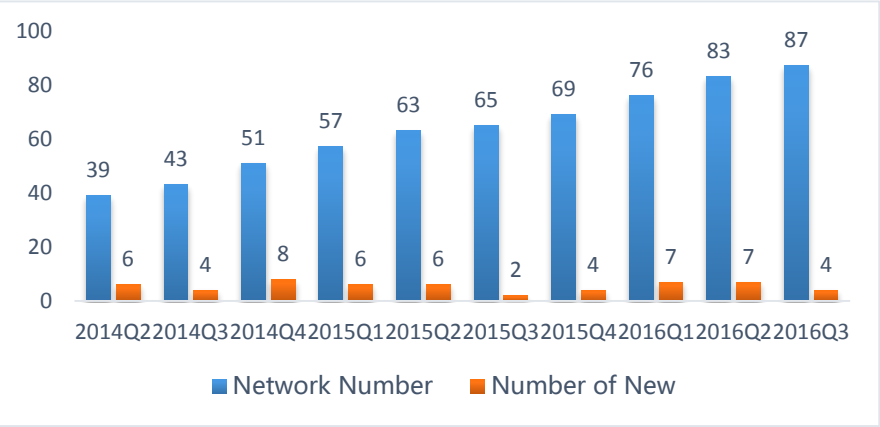
The history of TDIA mimics the development progress of Chinese mobile communication technologies.


From the TD Industry Alliance in 2008 to the Telecommunication Development Industry Alliance in 2013, the renaming of the TDIA not only represented the upscaling of our missions but also demonstrates a new era of mobile communication technologies.

# Global TD-LTE Commercial Networks Are Growing Continually

## The number of global TD-LTE commercial networks reaches 87

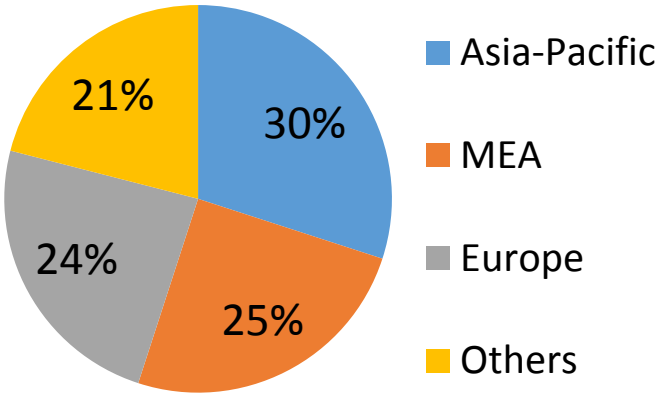



## The Number

- As of September 2016, the number of global TD-LTE commercial networks has reached **87**.
- By 2016 Q3, there are **49** countries have deployed TD-LTE networks.
- Over **102** networks are under construction globally.

## The Distribution

- The number of TD-LTE commercial networks in Asia-Pacific is ranked to the first, accounting for **30%.**
- The second one is the MEA region accounting for **25%.**
- Europe is the third one accounting for **24%.**



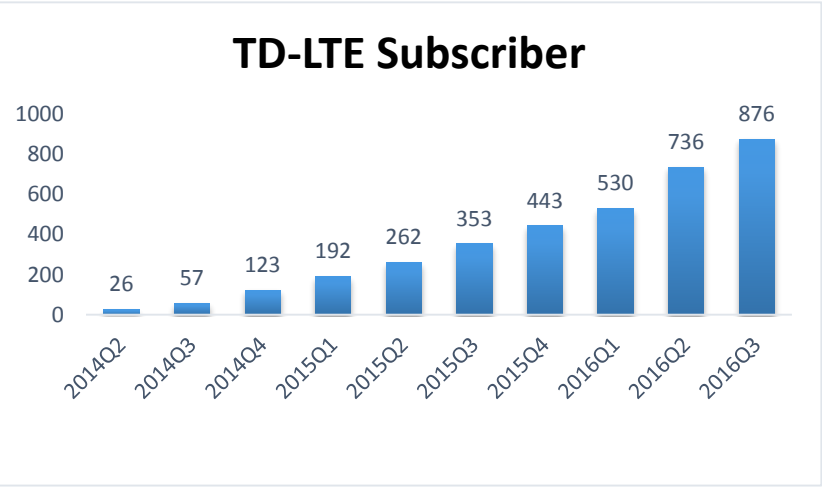
# Global TD-LTE BS Shipment & User Number are Increasing

## Deployment Scale of the Base Stations

- As of September 2016, the TD-LTE base station shipment is **1.82 million** globally
- As of September 2016, the TD-LTE base station shipment is **1.48 million** in China , accounting for **81.3%** of the global market

## Global TD-LTE base station shipments (Unit: ten thousand)


## Global TD-LTE Subscriber Growth (Unit: million)



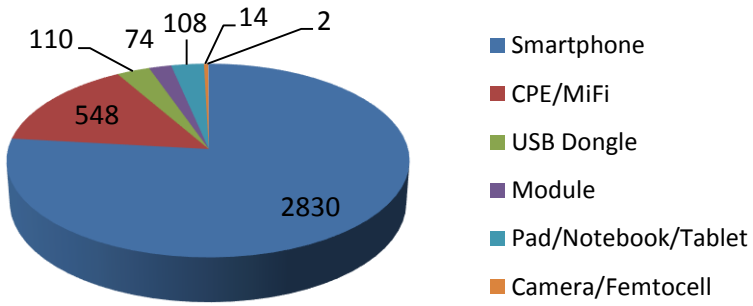

## The Distribution of TD-LTE Users

- As of September 2016, there are over **876 million** TD-LTE users, accounting for **54.1%** of total 4G users globally
- TD-LTE subscriber number grows fastest in **Asia**, of which TD-LTE user number in China accounts for **80.3%**, while Japan for 3.34%.

# The Global TD-LTE Terminal Industry Is Prosperous

- As of June 2016, the sales volume of TD-LTE smartphone has reached **147 million**, accounting for **46.4%** of total 4G.
- As of June 2016, the global TD-LTE terminals have released 3686 models, of which **2830** smart phones accounting for **77%** of all TD-TE terminal models.

**The Distribution of Global TD-LTE Terminal Models**




Data Source ：GSA，TDIA

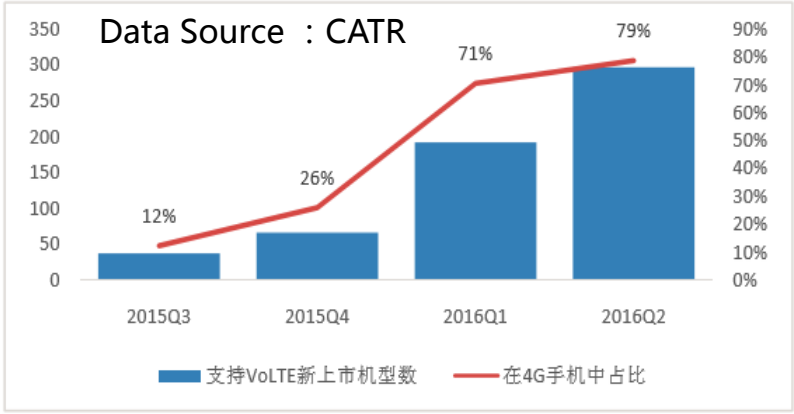
**The models of five-mode & all-mode mobile phones are increasing fast**

Within 3686 TD-LTE smartphone models:

**838 models** support TD-LTE / LTE FDD / TD-SCDMA / WCDMA / GSM

**364 models** support TD-LTE / LTE FDD / TD-SCDMA / WCDMA / cdma 2000 / CDMA 1X / GSM

**The sharp development of VoLTE phones**




**Proportion of VoLTE phone in TD-LTE mobile phone in China**

# TDIA Promotes TD-LTE Industry-Specific Applications

- The market potential of TD-LTE industry-specific application is huge.
- TDIA has promoted the industry-specific application of TD-LTE since **2013**.

## Spectrum Coordination

**1447~1467MHz &**
**1785~1805MHz** has been allocated for industry-specific network deployment.

## Technical Specification

- **B-TrunC** Standard
- Industry specifications in the field of **smart medical, power industry, rail transportation,etc**

## Demonstration Applications

- S1 TD-LTE **Railway** Project in Wenzhou
- TD-LTE **Power Industry** Lab in Nanjing
- etc

# TD-LTE Industry-Specific Networks are Implemented

205+ TD-LTE industry-specific network applications in 102+ countries

- Industry Sectors: Public Safety, Airport, Harbors, Rail Transportation, Governmental Enterprises, Emergency Rescue, Energy, Medical, Agriculture, Water Resources……

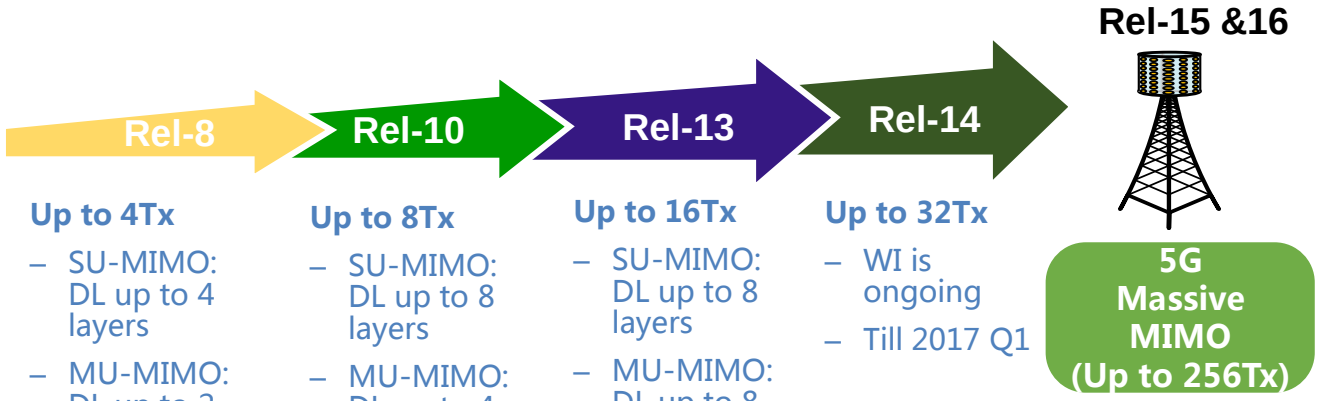




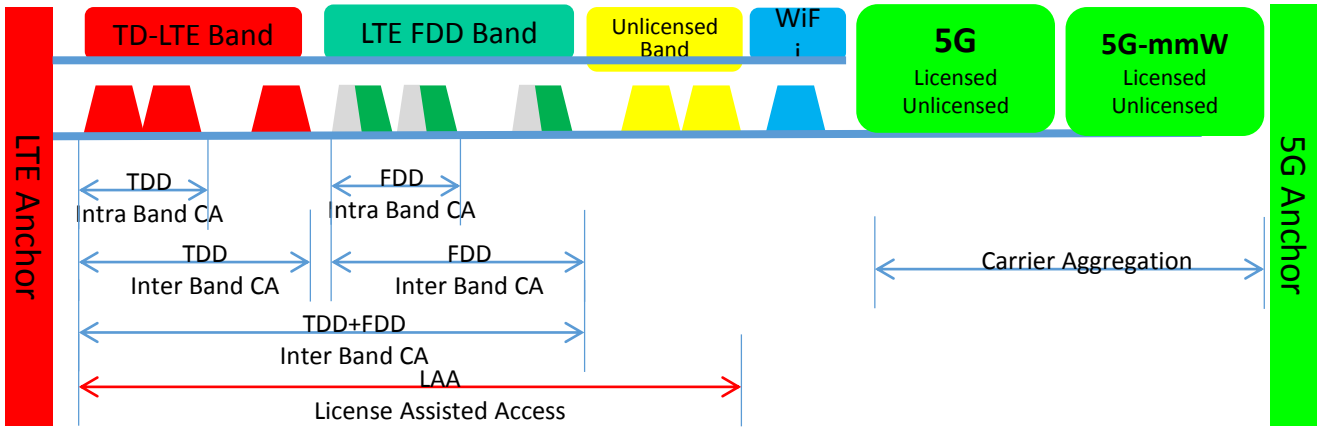

# TD-LTE Evolves from 4G to 5G: MBB Enhancement

**VoLTE** | **256QAM** | **CoMP** | **TDD+FDD Convergence** | ...

**TD-LTE : more suitable for MIMO**




**TD-LTE : more flexible for CA & LAA**



# TD-LTE Evolves from 4G to 5G: IoT Application

| | eMTC Terminals ( R13 1.4MHz ) | NB-IoT Terminals ( R13 200kHz ) |
|---|---|---|
| Downstream peak rate | 1Mbps | ~200kbps |
| Upstream peak rate | 1Mbps | 40或200kbps |
| Antennas | 1 | 1 |
| Duplex | Half-Duplex | Half-Duplex |
| Bandwidth | 1.4MHz | 200kHz |
| Transmission Power | 20/23dBm | 23dBm |
| Terminal Complexity | 20% | <15% |
| Coverage | +15dB | +20dB |

**ITU 5G mMTC Capacity Requirement**

| | |
|---|---|
| Area Traffic Capacity | 10Tbps/km$^2$ |
| Connection Density | $10^6$/km$^2$ |

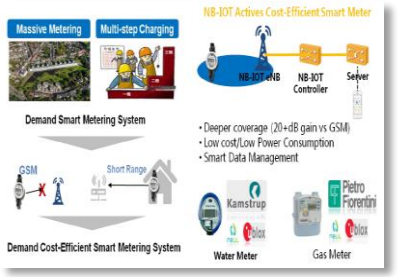
## eMTC Applications

Wearable Devices

Vehicles Management

Electronic AD

## NB-IOT Various Scenarios




Intelligent Meter


Security and Emergency Monitoring System

Intelligent Parking  Intelligent Agriculture •••

# TD-LTE Evolves from 4G to 5G: V2X & Industrial Internet

LTE V2X → Auto Driving

Low Latency Reliable

Industrial Internet → Industrial Control

**ITU 5G uRLLC Capacity Requirement**

| | |
|---|---|
| Latency | 1ms |
| Mobility | 500km/h |

Public Users → Public Users + Industry

Energy Industry

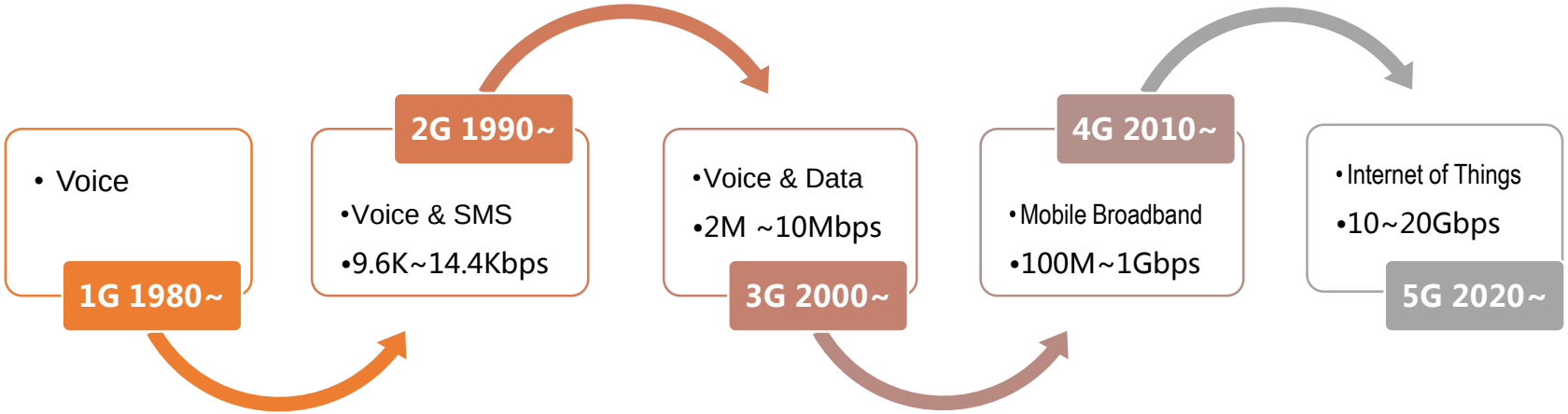
Aviation

...

Emergency Rescue

Industrial Robot

# 5G Era: Thrive Various Innovative Applications





*5G provide opportunities for the traditional and emerging industries in terms of technical innovation, innovative applications, and new business models.*

# The Increasing Work for 5G Worldwide

## EU

- 5G PPP and METIS etc. project launched
- R&D cost over €1.4 billion
- NGMN Transiting to 5G
- 5G IPR FORUM established for 5G patent assessment and patent pool building

## Japan

- 5G Mobile Promotion Forum (5GMF) founded
- 5G service offered before 2020 Tokyo Olympic Games


## Korea

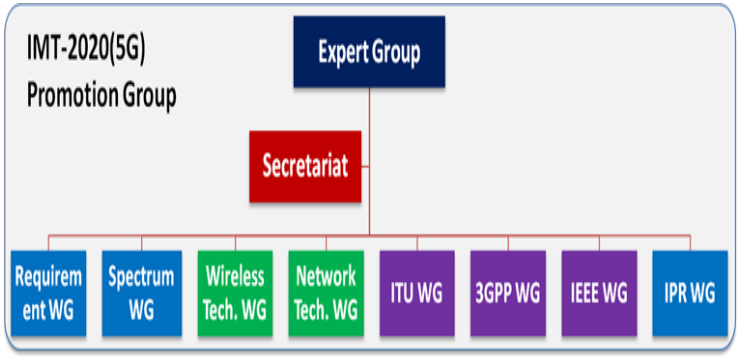
- 5G national strategy released, planning to invest $1.5 billion for R&D
- 5G Forum founded, major projects launched
- 5G service offered for Pyeongchang Winter Olympic Games in 2018

## USA

- 5G research stared by 4G Americas
- Verizon established 5G technology forums, 5G technology standard published in June 2016

# 5G R&D @China

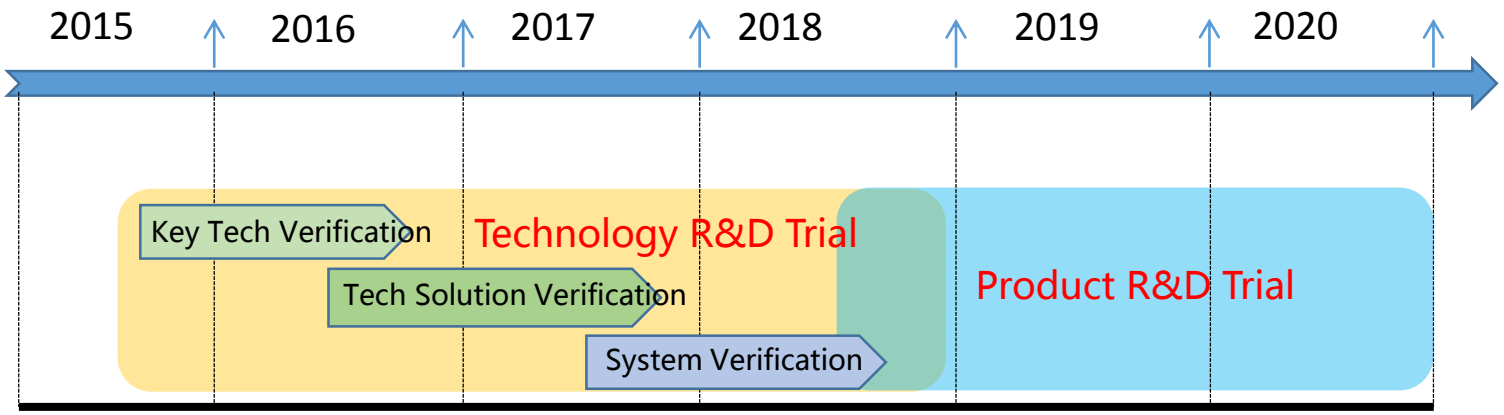
- IMT-2020(5G) Promotion Group supported by Chinese government set up in February, 2013
- White Papers on “5G Vision and Requirements", "5G Concept", "5G Wireless Technology Architecture", “5G Network Technology Architecture" were released by IMT-2020 during 2014 – 2016
- National Science & Technology Project launched for 5G research
- Chinese enterprises actively involved in 5G technology research and patent portfolio, such as China Mobile, Huawei, ZTE, Datang, etc.




eMBB

uRLLC

mMTC




**5G Trial in China**

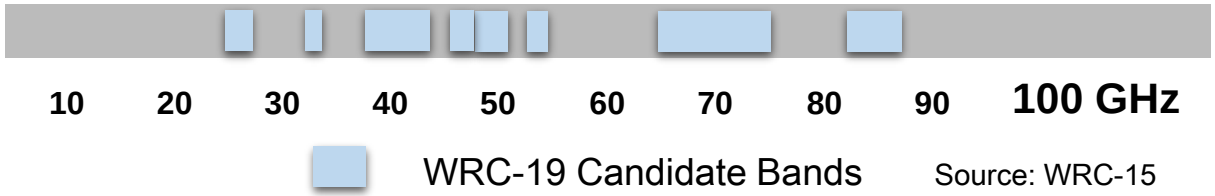
# Spectrum is a Critical Aspect in the 5G Ecosystem

- 5G ecosystem needs full spectrum eco-system to accelerate industry maturity.
- International harmonized spectrum is necessary for 5G to achieve economy of scale.

## Spectrum below 6G

- Spectrum below 6G is crucial for the first stage of the 5G deployment.
- Initial 5G networks may use existing mobile bands: flexibility for operators to select technologies in existing spectrum bands.

## Spectrum above 6G




- Various bands in the range of 24.25 to 86GHz is being studied, but 6 to 24GHz is still not addressed currently.
- Priority should be given to the band with the best propagation characteristics and potential for global harmonization.

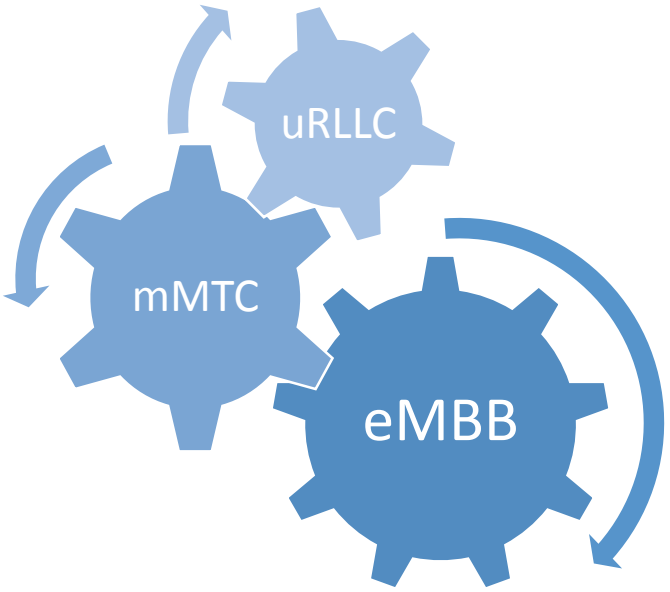
# Spectrum Challenges & New Opportunities at 5G Era

## for eMBB scenario

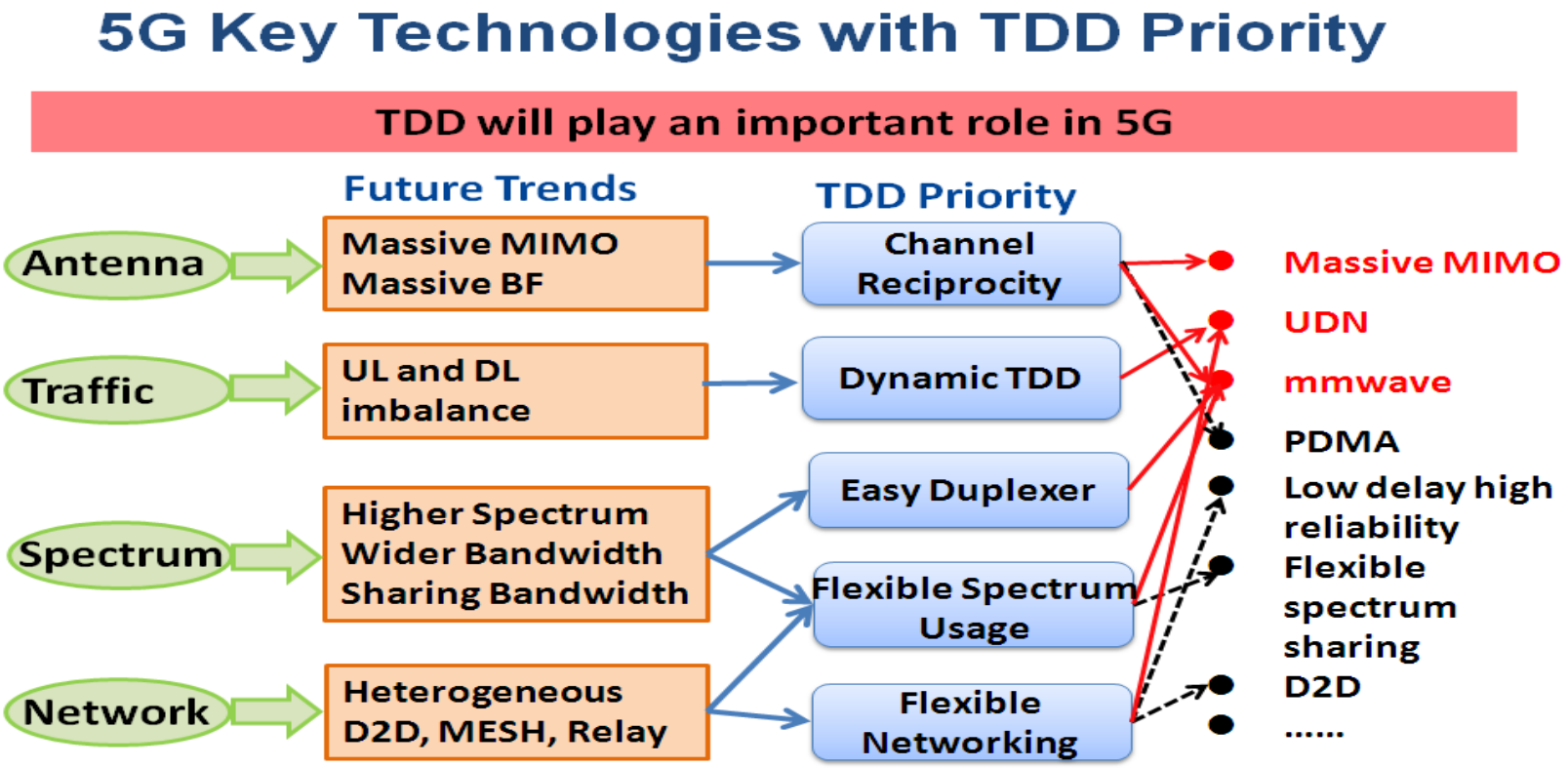
- **Spectrum below 1G**
- **700MHz** band could be the tool for large scale deployment.
- The reframing of **900MHz** band could be further studied.
- **Wide range of frequency requirement**
- eMBB scenario needs a wide range spectrum for coverage, throughput, capacity, etc.

## for IoT scenario

- **Overall planning**
- **Balance** the development of every industry to avoid vicious competition.
- **Special usage for special application**
- Different applications should be supported by spectrum bands with **different characteristics**.
- **Scheme more TDD spectrum**
- Use **asymmetric TDD spectrum** to improve spectrum efficiency



# TDD Technology & Spectrum Advantages for 5G




- The TD-LTE development and evolution will be an important part of 5G.
- TDD technology has more advantages for Massive MIMO, UDN & mmWave, etc.
- TDD spectrum has unique advantages to improve the spectrum efficiency :
  - flexible application
  - sufficient frequency


Thank you!