Radio Spectrum Management in China

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Content

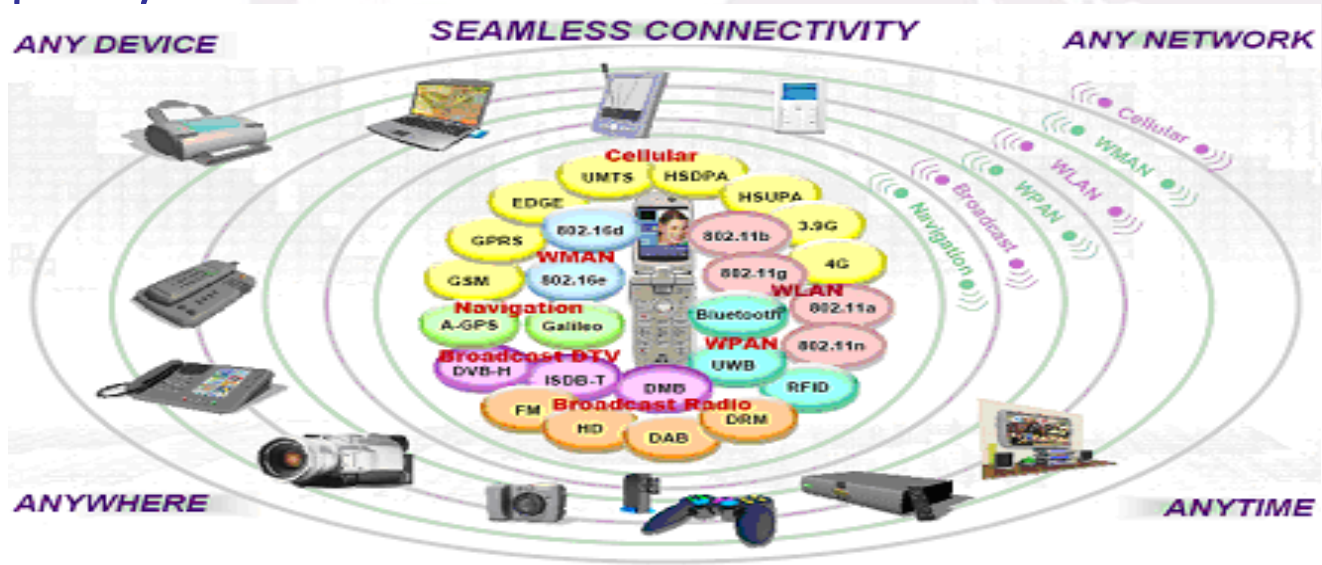
Ⅰ. Role of Radio Technology in the Ubiquitous Information Society -1

Today, radio technology plays an important role in the ubiquitous information society:

-to support ubiquitous information network coverage (Anywhere, Anytime, Anyperson etc.)

-to enhance the productivity in various industries (Broadcasting,Railway, Aviation,Transportation, Meteorology,Agriculture,etc.)

-to improve the work efficiency and people’ s life quality



Radio Applications

- Telecommunications

-Public Mobile Communications：2G, 3G, 4G(LTE),5G(IMT-2020)…
-Wireless Access：BWA, WiFi(802.11b,a,X) etc.
-Satellite Communications (FSS, BSS, MSS)

- Broadcasting (Audio, Video, Data, Multimedia)

Terrestrial, Satellite etc.

- Radionavigation, Radiolocation etc.

-GPS, GRONASS, COMPASS, GALILEO etc.

- Other Applications

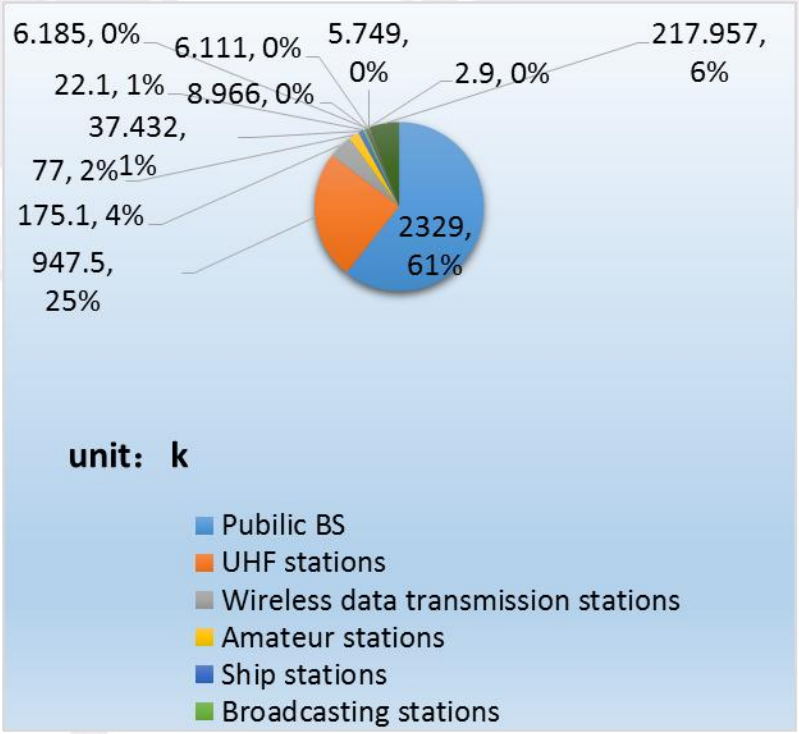
Wireless sensor (such as RFID) and various ISM applications
Internet of Things, Internet of Viecles, Mobile Internet…

In China:

-By July, 2017, the user number of Mobile Internet exceeded 1.2 billion, while the total number of mobile telecommunication user approched to 1.37 billion.

-The implementation of "Broadband China" stratery, "Made in China 2025" and the "Internet Plus" initiatives lead to more radio spectrum requirements.

- By the end of 2016, the total number of Radio stations has exceeded 3.93 million (excluding the military, police systems and mobile phones)

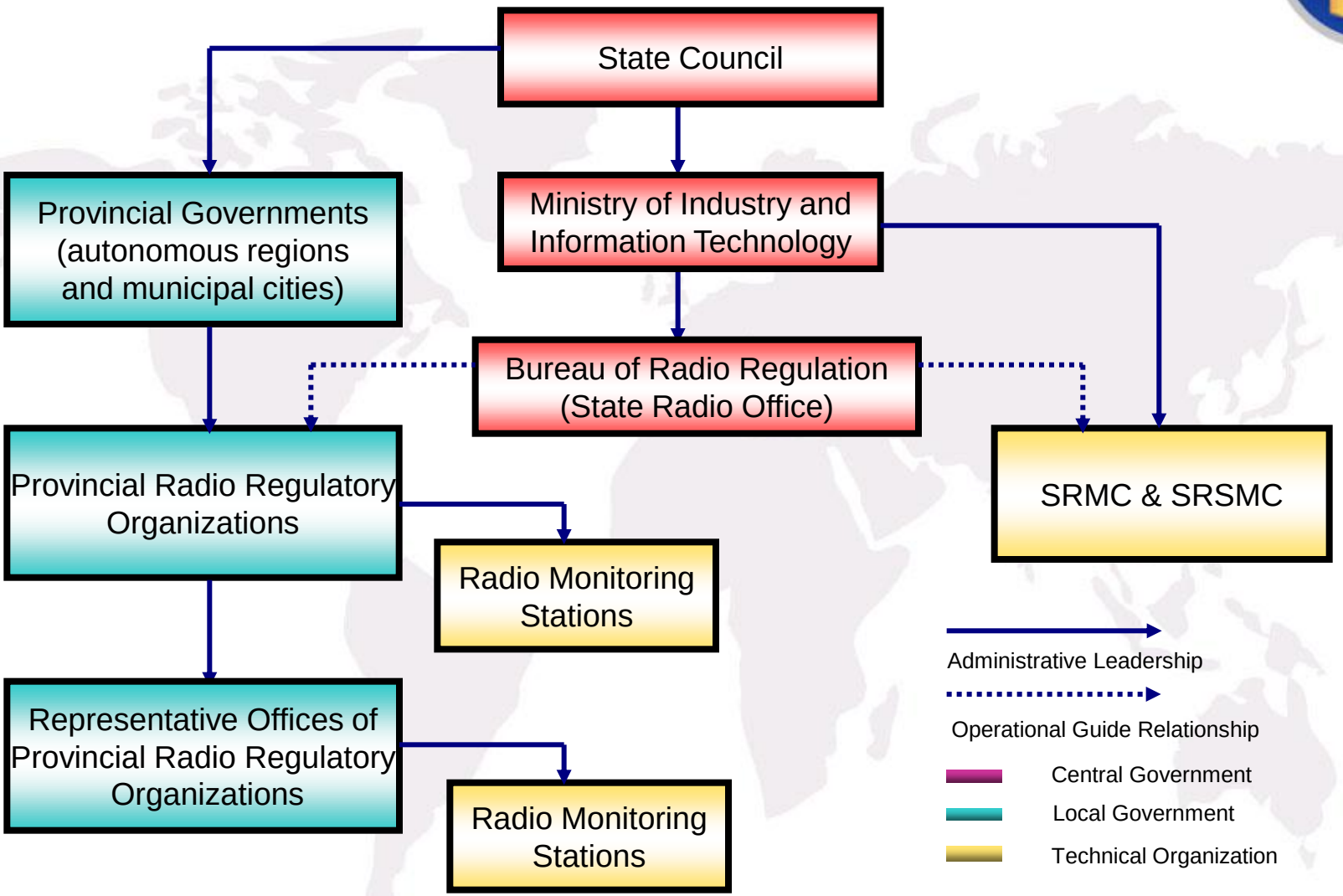


Ⅱ. Radio Management Organization in China -1

- Radio spectrum regulatory body at the national level---BRR

- provincial level

Ⅱ. Radio Management Organization in China -2

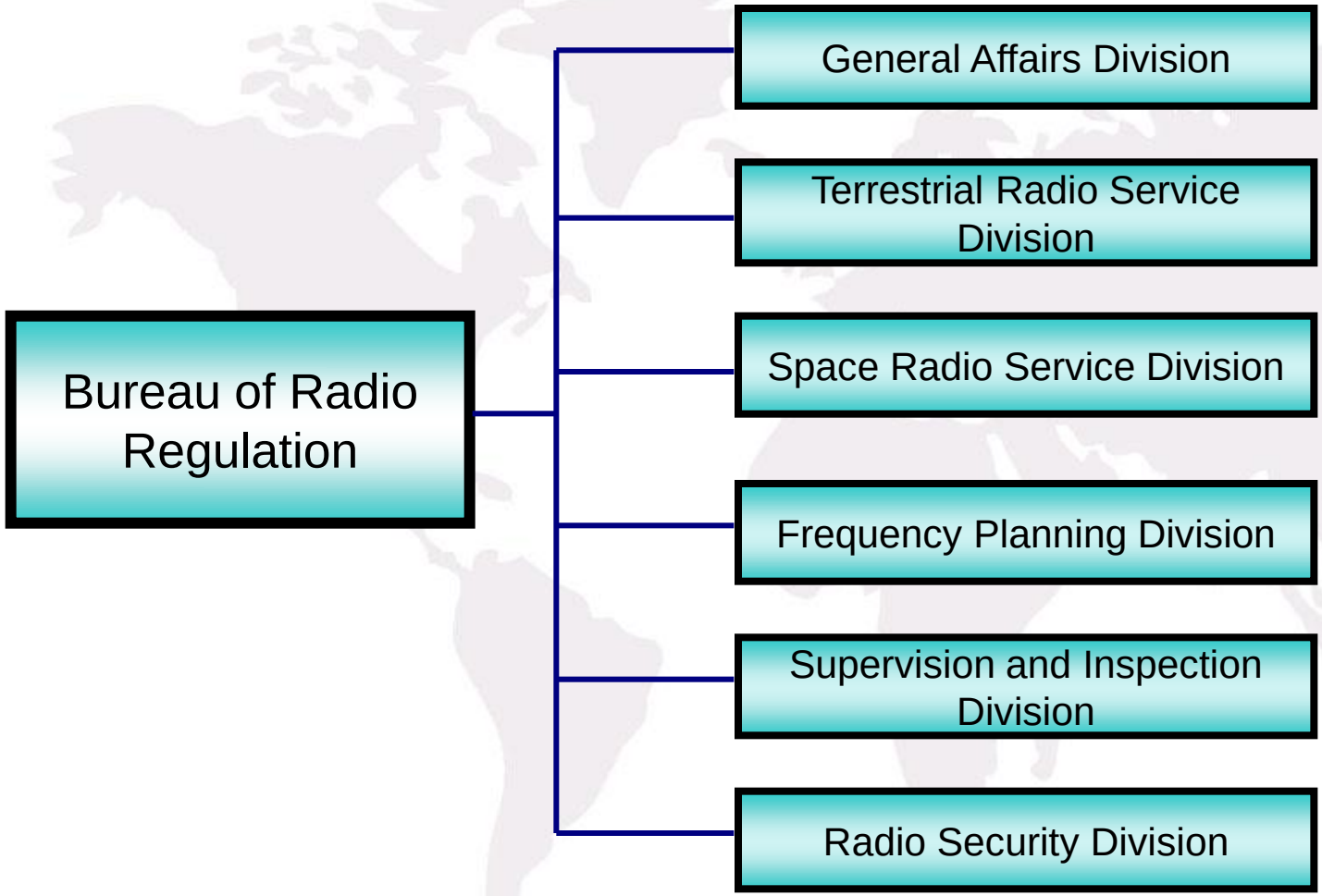


Ⅱ. Radio Management Organization in China -3

- The BRR (the State Radio Office)
  - one of the departments of MIIT with the responsibility to regulate the radio spectrum on behalf of China

- The State Radio Monitoring Center (SRMC) and the State Radio Spectrum Management Center (SRSMC)
  - affiliated to MIIT, providing the technical support for BRR

Ⅱ. Radio Management Organization in China -5



Ⅱ. Radio Management Organization in China -6

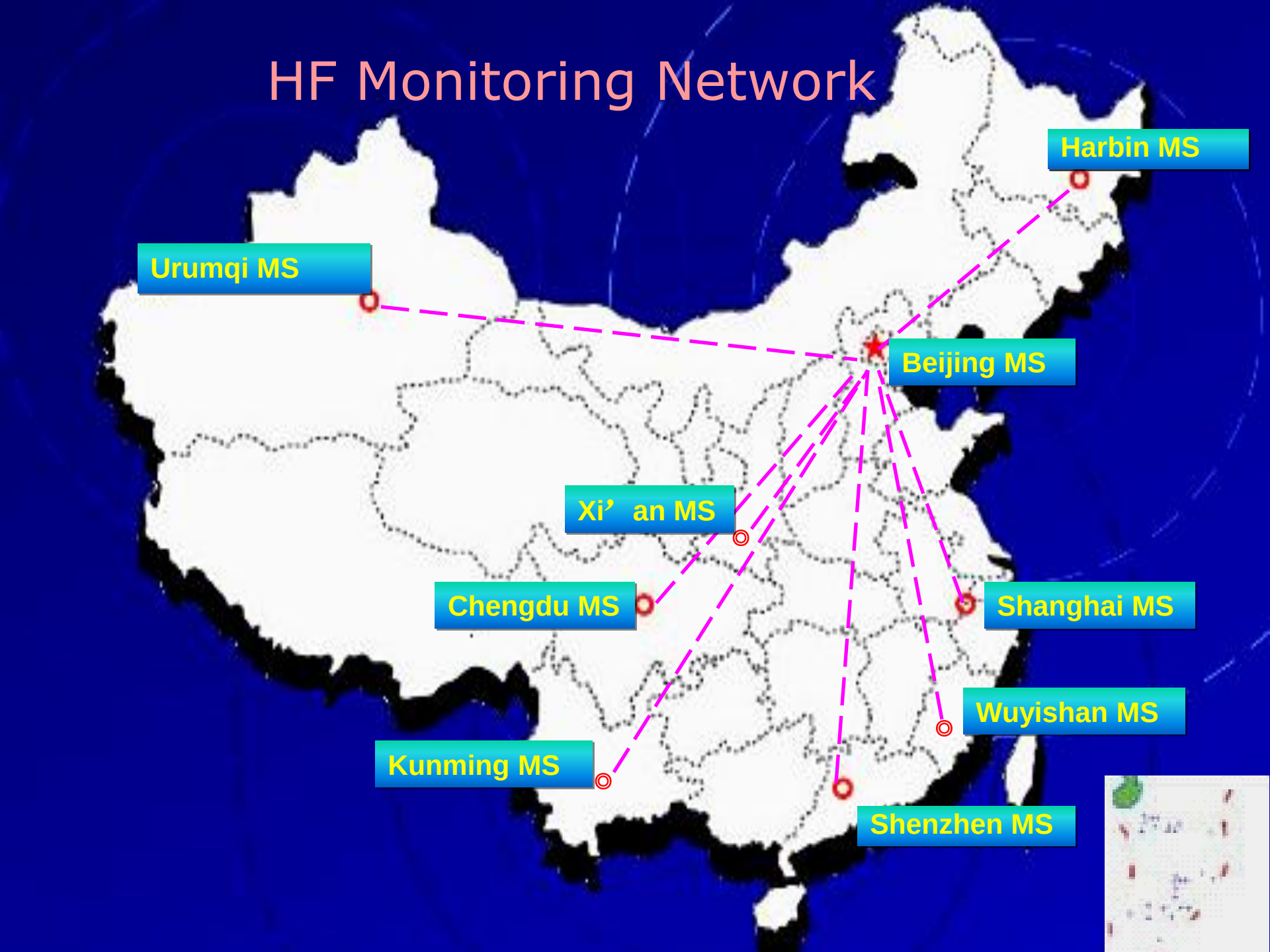
Radio Monitoring Networks

- HF Monitoring Network
- Satellite Monitoring Network
- V/UHF Monitoring Network

Ⅱ. Radio Management Organization in China -8

- HF monitoring network is composed of nine HF monitoring stations.
  - The monitoring scale can cover almost the AP area.
  - Beijing Monitoring Station is a member of ITU International Radio Monitoring Network.
  - locating the HF interference and carrying out the task from ITU.
  - Protecting user’ s legal rights and realizing the effective utilization of radio spectrum.

HF Monitoring Network



Ⅱ. Radio Management Organization in China -9

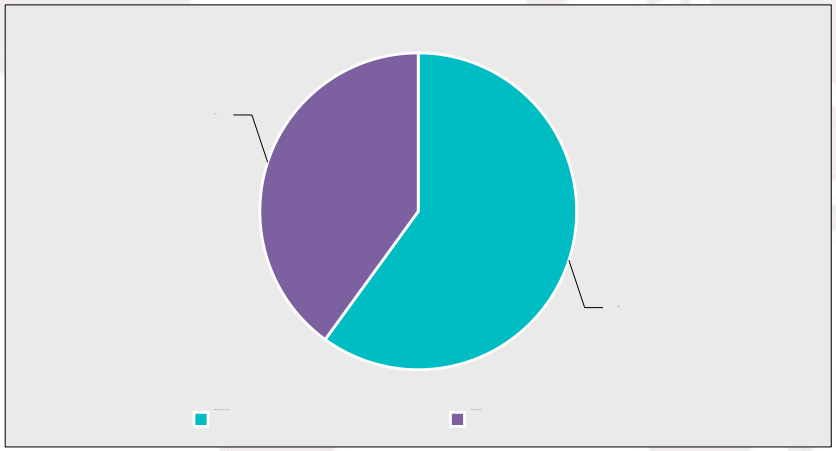
- Satellite monitoring network includes Beijing Monitoring Station, Shenzhen Monitoring Station.
  - monitoring the transponder occupation
  - locating the interference sources on the earth
  - measuring and recording of the satellite transmitting signals

Ⅱ. Radio Management Organization in China -11

- The V/UHF monitoring network is composed of provincial monitoring stations.
- Almost all the provinces have county-level monitoring stations.
- Each year, nearly 2000 V/UHF interference complains have been dealt with.

Ⅱ. Radio Management Organization in China -12

- By the end of 2016, the number of staffs in radio management organizations of China was almost 7000.



IMT development

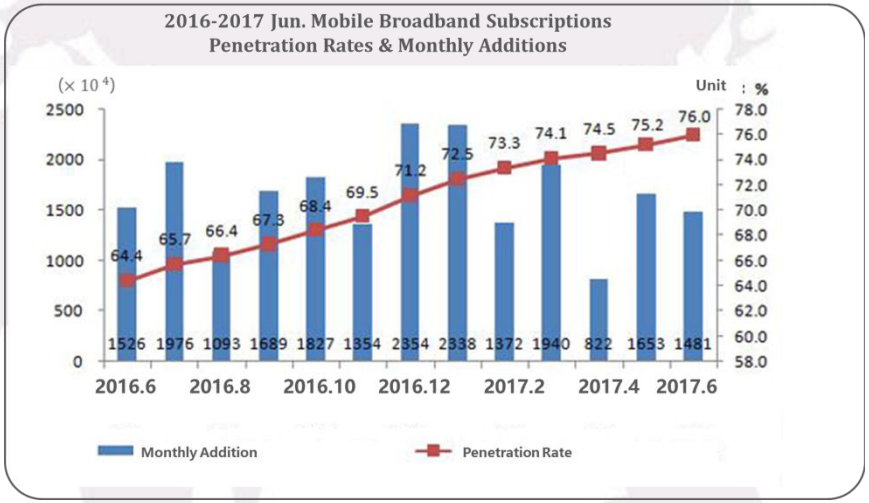
Mobile Subscriptions Sustained Growth & Explosive Increase in 4G subscriptions

By Jun. 2017:

-Total number of mobile subscribers: **1.36 billion**

-Accelerated transition from 2G&3G to 4G. total 4G subscribers: **888 million**, 4G penetration rate: **65.1 %**

-Total mobile broadband (3G&4G) subscriptions: about **1.04 billion.**



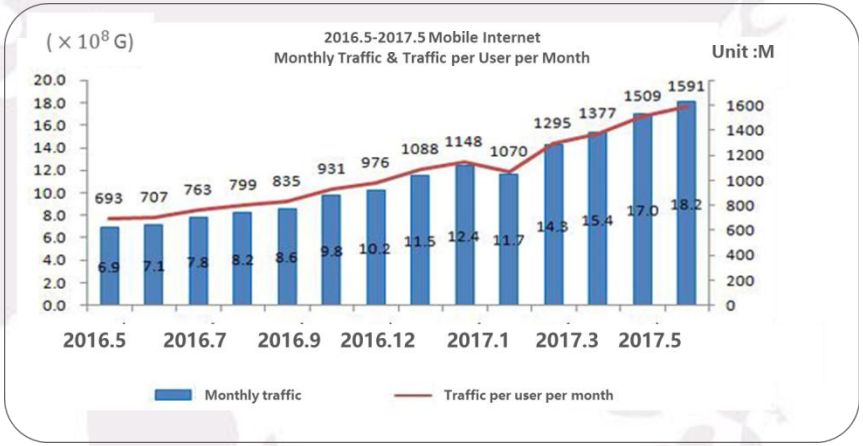
IMT development

By Jun. 2017:

–From Jan. to Jun., total mobile internet access traffic : **8.89 billion GB** , up by **over 136.8 %** comparing to Jun. 2016.

–Average mobile internet traffic per in June: **1377 MB**

–As the main driver, nearly **92.6%** traffic from phones (the remaining from mobile tablets, USB modem, Mi-Fi router, etc.)



Current frequency planning for public mobile communications(IMT) in China

MODE	Frequency Band（MHz）	Planned（MHz）
FDD	825-835/870-880	20
FDD	889-915/934-960	52
FDD	1710-1785/1805-1880	150
FDD	1920-1980/2110-2170	120
TDD	1880-1920	40
TDD	2010-2025	15
TDD	2300-2400	100
TDD	2500-2690	190
Total	***TDD345 FDD342***	***687***

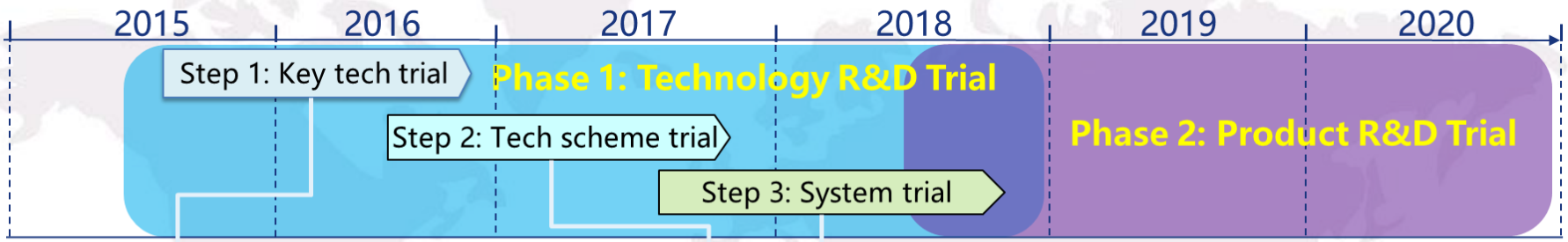
Frequency allotment

Operator	allotment		System
	uplink	downlink	
China Telecom	825-835	870-880	CDMA/LTE
	1765-1780	1860-1875	LTE FDD
	1920-1940	2110-2130	CDMA2000/LTE FDD
	2635-2655		TD-LTE
China Mobile	889-909	934-954	GSM900
	1710-1735	1805-1830	GSM1800
	1880-1915		TD-SCDMA/TD-LTE
	2010-2025		TD-SCDMA
	2320-2370		TD-SCDMA/TD-LTE
	2575-2635		TD-LTE

Frequency allotment

Operator	allotment		System
	uplink	downlink	
China Unicom	909-915	954-960	GSM900/WCDMA/LTE FDD
	1735-1750	1830-1845	GSM1800/LTE FDD
	1750-1765	1845-1860	LTE FDD
	1940-1965	2130-2155	WCDMA/LTE FDD
	2320-2370		TD-LTE
	2555-2575		TD-LTE

China 5G R&D Trial Roadmap

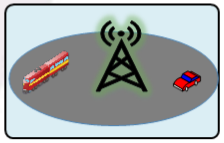


- Verify the performance of 5G key technologies
- Promote the R&D of 5G technologies
- Promote standard consensus building on 5G key technologies

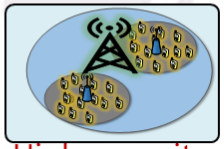
- Single BS performance test to verify the performance of 5G technology schemes

- Multi-BS performance of networking technology
- 5G typical service demo

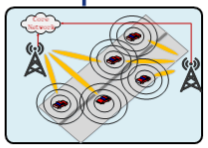
Test Scenarios for Steps 2 & 3



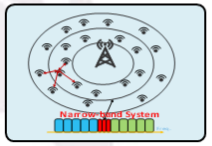
Seamless wide -area coverage



High-capacity hot-spot



Low-latency high-reliability



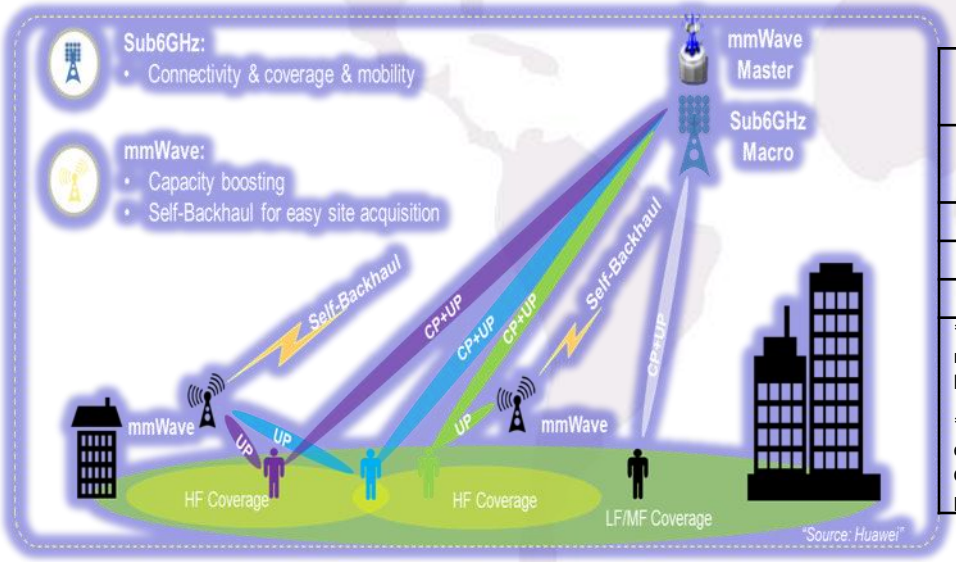
Low-power massive-connection

Suitable spectrum for 5G vision

mMTC	uRLLC	eMBB
Wide and deep coverage	Reliable link	High-speed transmission Everywhere user experience
Low band	Medium and Low band	High,Medium and Low band

5G eMBB spectrum requirements

- To enable business success of 5G eMBB deployment
  - Harmonized frequency bands and larger continuous bandwidth are necessary
  - Infrastructure and Terminal need to support aggregation of frequency bands below and above 6GHz



Spectrum needs estimate result of IMT-2020 for both below 6 GHz and above 6 GHz

Spectrum needs (GHz)	Macro	Micro	Indoor hotspot
Below 6 GHz	0.808-1.078*	–	–
24.25-86 GHz	–	14.8-19.7	
24.25-43.5 GHz**	–	5.8-7.7	9-12
45.5-86 GHz**	–	–	

* Considering the coexistence between multiple network operators (e.g. the guard band(s) may be required in the case of multiple network operators scenarios), the total spectrum needs are expected to be increased.

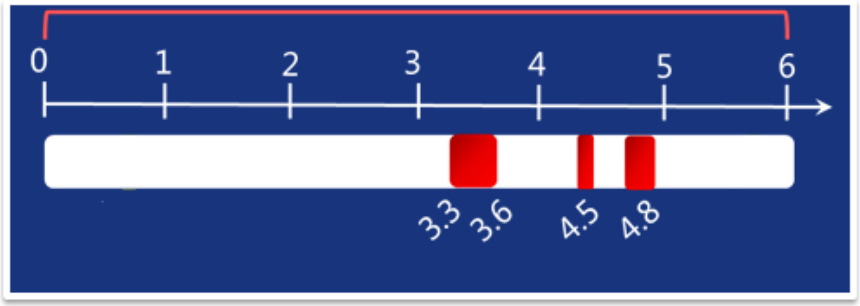
** The division in this table regarding frequency ranges and deployment scenarios is just an indicative example how spectrum needs could be distributed for different spectrum sub-ranges within 24.25-86 GHz and different deployment scenarios. This table should not be understood nor used to exclude any possible IMT-2020 deployment options in these sub-ranges.

High, Medium and Low band for 5G systems

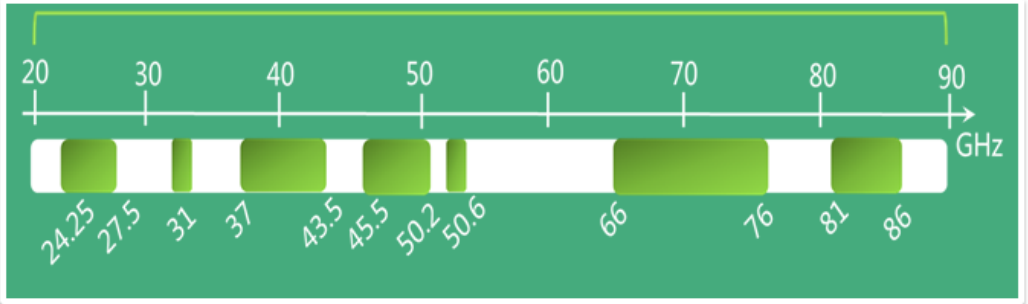
- 5G system need to support aggregation of frequency bands: low and medium band for 5G coverage and capacity, high frequency band for 5G capacity and backhaul.
- C band will be the key 5G band
- Frequency band below 1GHz is applicable for MTC
- V2X will be a key application of 5G URLLC
- Cooperation in ITU is important to ensure global/ regional harmonization of 5G spectrum

5G Spectrum Development in China

Low and medium band



High band



☐ Low band (below 3 GHz) & Medium band (3-6GHz)

- 3.4-3.6GHz: IMT vs. FSS compatibility trial is due to be finished by 2017
- 3.3-3.4, 4.4-4.5, 4.8-4.99GHz: domestic coordination in progress of IMT identification in Chinese Regulations on the Radio Frequency Allocation (new version)
- 5 905 - 5 925 MHz : apply for LTE V2X trial

☐ High band (above 6 GHz)

- Promoting global harmonization under WRC-19 AI.1.13
- High priority for 20~40GHz for outdoor deployment
- Current concentration on compatibility studies in 26GHz and 40GHz

MIIT notification on frequency usage of 3300-3600MHz and 4800-5000MHz for 5G communication system (IMT-2020)

1. 3300-3600MHz and 4800-5000MHz are allocated as IMT-2020 operation bands
2. For 3300~3400MHz, IMT-2020 system should, in principle, be limited for indoor use only. Without any interference to in-used station of radiolocation service, it can be used for outdoor.
3. For 3400-3600MHz, IMT-2020 should not generate interference to earth stations of FSS with valid license on this band. Meanwhile, IMT-2020 should provide protection to satellite telemetry system in this band and in adjacent band. Details protection method should be negotiated btw MNOs and Satellite operator.
4. For 4990~5000MHz, IMT-2020 shall not generate interference to radio astronomy stations listed in footnote of CHN 12 in “People’s Republic of China regulations on the radio frequency allocation”.
5. The above bands are used as IMT-2020 operating frequency bands and are managed by the national radio regulation authority. Specific regulations of frequency allocation, RF technical indices and radio station management will be developed and released in future.

MIIT public consultations on mmWave Frequency Band Allocation for 5G system

MIIT is soliciting public comments on identifying 24.75-27.5GHz, 37-42.5GHz and other mmWave bands for 5G IMT system. Feedback may include but are not limited to following items.

1.Companies/organizations which are using or plan to use these bands, could list out the current usage/intended usage of these bands, deployment plan & key time point and provide opinions upon how to use these band for 5G.

2.Illustrate technical problems (including RF components, chipset, instruments & etc.) to deploy 5G system in these bands, as well as feasible solutions and schedule.

3.Coexistence & sharing study reports could be attached in which detailed system parameters, obit/position of stations, study method and results should be included.

4.Suggestions on how to coordinate 5G system with other systems operating in the same or adjacent bands, as well as possible technical/administrative methods to achieve the coexistence of 5G and other systems.

5.Other issues need to be addressed.

Legislative Framework of Spectrum Management (International and Domestic)

- ✓ ITU Radio Regulations
- ✓ Radio Regulations of the People's Republic of China
- ✓ Regulations on the Radio Frequency Allocation of the People's Republic of China
- ✓ Frequency planning policies

Ⅳ. Spectrum Management Framework and Challenges -2

"Radio frequencies are limited natural resources and that they must be used rationally, efficiently and economically…"

-No. 196 of the Constitution of the International Telecommunication Union

Increasing requirements of spectrum resources

- *General increasing requirement of spectrum in ubiquitous era(with the mobile broadband wireless access any time anywhere)*
- *Increasing of broadband and multi-media services*
- *Preference of "golden" bands (lower part such as VHF, UHF etc.) which leads to unbalanced supply & demand situation*
- *Emerging new broadband technologies and applications…*

Ⅳ. Spectrum Management Framework and Challenges -3

- Radio Regulations defines 42 radio services
  -RR, Article 1 "Terms and definitions", Section3 "Radio Services"

  However, with the emerge of new radio applications and devices（satellite communication in motion, unmanned aerial vehicle,HAPS,Project Loon of Google, .etc）,it becomes more and more difficult to define which services they belong to .
- Besides applications in the field of telecommunications, industrial, scientific and medical (ISM) applications (of radio frequency energy) are widely used
- Accompany with the implementation of "Internet of Things","Internet Plus", "Sensor Network" , wireless technologies like RFID, short-range wireless communications etc. are now intensively used, which are aggravating the shortage and scarcity of radio spectrum resource.

Please be awared that the scarcity of radio spectrum resource!

The administrations are facing strong pressure to free up more spectrum for broadband wireless networks.

Ⅴ. Spectrum Management Strategies -1

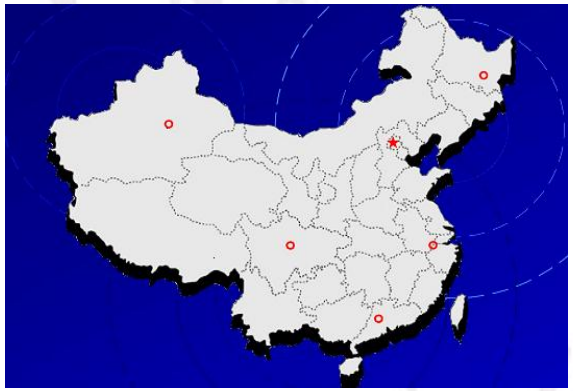
1. To meet the increasing demands of spectrum of various radio applications, the administration should take appropriate measures:

- **(1) Spectrum Sharing: more flexible spectrum allocation to new radio services**

  - ✓ Seperation of geographic locations and frequencies,differential of the polarization to improve compatibility of different services.
  - ✓ To facilitate the efficient and economic operation of all radiocommunication services;

Examples:
-Frequencies for Maritime Services can be used in inland areas

-2.3GHz band issues
Sharing frequencies between IMT and radiolocation, IMT and radio astronomy



(2) Facilitating Spectrum Refarming: relocating the incumbent radio services, introducing new radio technologies, improving radio frequency usage efficiency

Case1: frequency planning for IMT

S band: Remove microwave, radiolocation, radar, seeking frequency resource for IMT and LTE

Case2: analogue to digital

VHF band

UHF band

Case 3: 2G/3G to LTE

800MHz

2100MHz

(3) Deepening Spectrum usage Exploration: encouraging application of new radio technologies which could coexist with the existing systems, thus improve efficiency of frequency usage

(*especially low power, short range, broadband access technologies*)

-UWB
-CR
-LSA
-DFS
-SDR
-White Space

(4) To explore the frequency usage in the higher frequency band

-IMT (above 6GHz)

-Microware link (71-76/81-86 GHz)

- (5) Popularization of Spectrum Awareness to the Publics

To improve:

- awareness of special value of radio spectrum resource
- awareness of importance of radio environment protection
- awareness of serious consequence of radio interference

Ⅴ. Spectrum Management Strategies -4

- 2 .Encouraging application of radio technologies which improves the productivity in various industries.

-Promoting application of radio technologies in various social sectors;

-Improving the intellingence and automation in various industry systems;

-Facilitating the convergence of industrialization and information technologies.

Example: NB-IoT,RFID,Zigbee,Bluetooth,etc in applications of IOT,Industrial Internet,Internet of Vehicles ...

Thanks!

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