

# **Abstract**

## **Motivation**

It is obvious that the developed countries see 5G development as a target development. The planning of the release of the 5G spectrum and the schedule of further infrastructure are going to affect the promotion of application in various industries. Therefore, the aim of this research is to propose a practical method of release licenses and further supervision policies by investigating the development of international 5G technology standards, the promotion of 5G policy frameworks in major countries, 5G deployment and application development, etc.

## **Methods and Processes**

The research team uses document analysis, benchmarking, focus group and comparative research, to analyze the theoretical models, international cases of eligibility point and second price among the United Kingdom, Germany, Italy, France, Austria, the United States, Japan, South Korea, Mainland China, Hong Kong, Singapore and Australia, etc. It also held conferences to collect opinions from experts among industries, government and professors, then integrating research results and providing suggestions for policies and regulations on 5G development in Taiwan.

## **Crucial Discovery**

### **1. Analysis of 5G Policies in Major Countries**

The 5G promotion policies in each country can be aggregated into four major strategies, including open 5G testbeds, promote early deployment of

major cities and transportation hubs, promote infrastructure and network construction and release more spectrums.

## 2. Analysis of 5G Spectrum and Licensing

Countries that release MF through auctions often plan to use smaller bandwidths as block units, while HF releases plan to use larger bandwidths. Countries that assign spectrum plan bandwidths above 100MHz in terms of MF and HF.

In most countries, the spectrum cap is 100MHz in the MF auction. In the millimeter wave auction, the spectrum cap is 400MHz in countries releasing the smaller bandwidth, while countries releasing more spectrum set 1,000MHz or 800MHz as spectrum caps. Expiry dates varies from 5 to 20 years in each country.

Each country considers promoting the use of spectrum efficiency, enhancing the flexibility of use, accelerating the launch time of 5G services, improving coverage, narrowing the digital divide, and promoting innovative applications. They set different types of obligations such as coverage obligations, deployment obligations, usage obligations and other obligations.

## 3. Analysis of Eligibility Points and Second Price

The purpose of using eligibility points is to increase the amount of information for bidders, promote honest bidding, promote bidders to actively bid, and speed up the auction. eligibility points are set taking into account spectrum characteristics, release bandwidth, and geographical scope of license authorization.

The theoretical basis of second price is reaching the Pareto-Optimal by enhancing the auction system through Pareto-Improvement. Second price

can be divided into the “Second Highest Price Rule” to pay the second highest price and the “Nearest Vickrey Core Price Rule” to pay the core price.

#### 4. Analysis of the 5G Network Development, Network Sharing and Application Promotion in Major Countries

Among the relevant policies of major countries in the world to promote the construction of 5G infrastructure networks, the research summarizes into two major policy directions, improving the degree of infrastructure deployment and reducing construction costs and obstacles to deployment. Also, the major network sharing types admitted in each country are basic network sharing strategies, spectrum harmonious sharing strategies, frequency sharing strategy and other secondary spectrum utilization.

The 5G network application development strategies in major countries mainly include 5G experimental plans and experimental platforms, related technology research and development, national application development, vertical applications and other 5G related applications.

### **Main Suggestions**

#### 1. Recommendations of 5G Licensing under the Auction System (National Communications Commission)

In the future licensing plan, if there is no obvious difference in the frequency band, a mechanism of eligibility point may be adopted. If the frequency characteristics are different, the bandwidth of a specific frequency band is less, or the frequency band with more intense competition, the design of different eligibility points in different frequency bands can be adopted. The design of eligibility points must also be

negotiated with stakeholders. The use of eligibility points in the first round can promote close bidders to bid aggressively and honestly from the beginning, speeding up auctions.

The design of the second price is due to the phenomenon that the bidder may not be able to obtain enough information to bid in a round of auction, resulting in the price being too high or too low. If Taiwan adopts second price, National Communications Commission may apply Nearest Vickrey Core Price.

Regarding spectrum caps, Taiwan should first conduct a competition evaluation of the amount of spectrum held by telco, confirming that excessive concentration of spectrum will affect fair competition in the market, then setting hold restrictions at last.

## 2. Recommendations of 5G Licensing under the Evaluation System and the Public Auction(National Communications Commission, Ministry of Transportation and Communication)

The evaluation system can be policy-oriented for spectrum licensing. However, if the evaluation system applies to highly competitive frequency bands, it is difficult to design, equilibrate and maintain fairness. In the high frequency bands, where the bandwidth is relatively sufficient and the related equipment and application scenarios are not yet clear, Taiwan should apply the evaluation system to licensing.

## 3. Recommendations of Promoting 5G Infrastructure Deployment (Cross-ministerial Cooperation, Central and Local Government)

5G infrastructure and network deployment involve many agencies. When coordinating, Taiwan may rather refer to international practices and set up cross-ministerial groups and industry-government-academic

cooperation platforms to understand the difficulties and needs of 5G deployment and make adjustments.

In addition, Taiwan should continue the policy of setting up base stations for public buildings, open more public facilities(such as power poles, street light poles, etc.) to telco and develop related supporting measures. In terms of adjusting laws and regulations, if Taiwan can strengthen the right of way on 5G, and promote 5G from the perspective of the overall development of the country, the development of Taiwan's 5G network deployment will speed up.

#### 4. Recommendations of 5G Network Frequency Sharing(National Communications Commission, Ministry of Transportation and Communication)

Taiwan should complete the amendment of the sub-law of the Telecommunications Management Act on network sharing as soon as possible, to clarify the application of regulations. In order to understand the type of network sharing suitable for Taiwan's market, in the medium and long term, the competent authority can also conduct research on Taiwan's telecommunications market, explore a suitable network sharing model.

Under the framework of Taiwan's Telecommunications Management Act, operators can share frequency through cooperation, which is conducive to promoting the efficiency of the application of spectrum resources. However, it must be noted that frequency sharing may cause excessive concentration of resources on the certain operators. When the closer cooperation between the players exists, concerted actions may appear.

While the development of innovative application services requires flexibility and timeliness, Taiwan should encourage MVNOs to register

telecommunications enterprise under Telecommunications Management Act.

Besides, Taiwan should refer to international experience to comprehensively consider the extent and scope of the impact of frequency sharing and secondary use on market competition as the basis for permitting operators to use frequency.

#### 5. Recommendations of 5G Network Application Development Strategy (Cross-ministerial Cooperation, Public-private Sector Cooperation)

Taiwan should develop 5G services and applications through industry-government-academia cooperation, and to describe the conditions of the 5G ecosystem. While 5G innovative applications must also be adapted to local conditions, Taiwan should encourage local governments to cooperate with enterprises to create local 5G ecosystems, and planing for 5G testbeds and sandboxes, helping startup teams and SMEs develop 5G applications.