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## MAXIMIZING AUCTION RESULTS IN THE FORM OF FREQUENCY SPECTRUM

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### ABSTRACT:

Auction Theory developed by Paul Milgrom and Robert Wilson is an innovation in the world of auctions, especially for intangible auction objects such as the frequency spectrum. Auction Theory plays an important role in providing the main idea regarding how frequency spectrum auctions are executed so that it can help generate optimal state revenues and allocate these limited natural resources into the hands of the right third-party companies. This analytical study aims to find out how the auction theory developed by the two figures works in auction practice, which mainly highlights how the theory solves several frequency spectrum auction problems so that it can be used as a basis for reference in setting frequency spectrum auction policies in Indonesia.

**Keywords:** Auction, frequency spectrum, auction theory, optimization, auction mechanism design, bidding competition policy.

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### INTRODUCTION

Auctions have been used in almost all aspects of the economy. One element of the auction that is important is that the government or stakeholders can include a number of policy settings to discipline the

public sector in making decisions, as has been implemented in Indonesia, the mandate related to the implementation of frequency spectrum auctions is stated in Government Regulation Number 46 of 2021 concerning Post, Telecommunication, and

Broadcasting Article 50 Paragraph 4 that cooperation in the use of radio frequency spectrum is one of them implemented with the aim of meeting the needs of the national interest. The use of such radio frequency spectrum is manifested by related companies that have carried out a series of selection processes. One of them is as mentioned in the Regulation of the Minister of Communication and Information Number 2 of 2006 Article 3 Paragraph 2 that: "The determination of radio frequency spectrum in the 2.1 GHz radio frequency band to the selection participants of the IMT-2000 mobile mobile network operator was carried out through an auction mechanism."

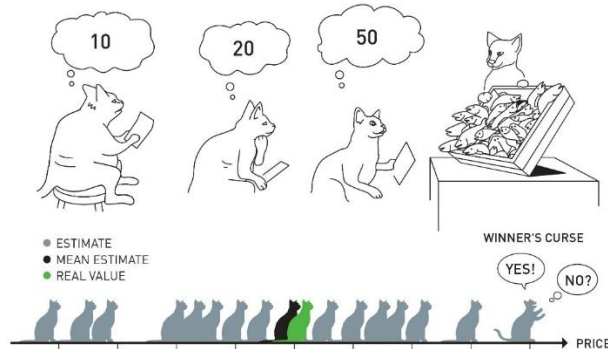
However, auctions may not proceed in accordance with the objectives and desired end results in a policy setting. Basing on this, Paul Milgrom and Robert Wilson made new discoveries about improved theory and a more suitable auction format. In short, there is no perfect auction design that can be applied to all problems and conditions of auction objects. In the process of thinking about how auctions should work under certain conditions, policymakers must take into account all kinds of specific contexts such as how appropriate auction rules and mechanisms will be applied in that situation, based on the following information: What determines the value of the object to be auctioned, the type of information obtained by the bidder, and what uncertainty the bidder will face.

Other problems will arise if bidders find loopholes and ways to signal other bidders to hold prices not too high. Paul Klemperer again provides a case in point in a multilicense US spectrum auction in 1996-1997. At the time, the U.S. West company was competing with McLeod's company for the object with lot number 378: licensed in Rochester, Minnesota. Most of the bid prices in those auctions ended up in the thousands of dollars. However, in contrast to West's U.S. bid, which expired at \$313,378 and \$62,378 for two licenses in Iowa, the company had previously shown no interest in anything. In that case, U.S. West exceeded McLeod's offer, which had been the high bidder for the license before. McLeod eventually got the signal given by the U.S. West company and ended up exiting the auction market. The signal comes from U.S. West's bid price ending at 378, which is the lot number on which U.S. West wants McLeod to withdraw.

Another well-known problem in the conduct of auctions is 'the winner's curse' which was first documented in the context of bidding by companies for oil leases. Analysis of the auction results for oil land leases managed to find the fact that the winners of this auction on average lost money. Some companies are more optimistic than others, and it is the most optimistic companies that are most likely to bid very high and win the auction by including new consequences, namely losing money because their bid prices are too high compared to other bidders. Once bidders in an auction realize the risk of 'the winner's curse', they become so reluctant to bid, that

bids no longer represent an estimate of their true value.

**Figure 1.** Illustration of The Winner's Curse



Source: Johan Jarnestad/The Royal Swedish Academy of Sciences

That's how auction bidding ends up being affected by many factors that might reduce the sellers' final profits, which could eventually also lead to losses for auction winners, create inefficiencies in the allocation of funds, or even harm public goods. If the auction is still using the old method, namely by selling goods to the highest bidder the amount of the price they bargained, for example, electricity generation or distribution is auctioned off to the bidder who bids at the highest price, electricity bills for each household and office will rise.

Based on the background description of the problem above, the author conducts analysis and synthesis to find out how the auction should be carried out, especially for frequency spectrum auctions which are limited natural resources of countries whose allocation needs to be paid more attention to by the government, in order to achieve optimal targets for the interests of the wider community. This analysis focuses on auction theory and solving various problems related to frequency spectrum auctions initiated by Paul Milgrom and

Robert Wilson in the book "Putting Auctions Theory to Work".

## RESEARCH METHODS

**Type of Data** The method used is the literature study method. The literature study in this study is in the form of a book synthesis that displays information related to background and theoretical studies as support in the discussion.

**Data Source** The data needed in the preparation of this final project research include:

1. The book "Putting Auction Theory to Work" by Paul Milgrom and Robert Wilson. The selection of this book is based on the purpose of research that discusses the auction theory proposed by the two figures which will then also be synthesized by researchers;
2. Various laws and regulations, books, or literature related to the implementation of auctions, especially frequency spectrum auctions in Indonesia. The selection of sources is based on the purpose of research that discusses how frequency spectrum auctions are carried out in Indonesia;
3. Information related to possible obstacles will occur in the application of Paul Milgrom and Robert Wilson's auction theory in Indonesia obtained from researchers' hypotheses based on facts, both in laws and regulations, previous events, and real circumstances.

## RESULTS AND DISCUSSION

### A. Auction Theory by Paul Milgrom and Robert Wilson in Their Role in Solving Some Problems Related to Frequency Spectrum Auctions

Paul Milgrom and Robert Wilson are economists from the United States who received the Nobel Prize in Economics in 2020 for introducing auction theory and developing new auction procedures. These two figures created a new auction format that aims to facilitate the sale of items that do not have a physical form, such as the frequency spectrum. The question of auction theory initiated by the two figures then arises, the answers of which can be summarized in the following two questions:

1. How bidders behave in the case of auction formats under different auction conditions?
2. How the auctioneer can choose the format of the auction and apply the rules that best suit its purpose?

To approach the first question, what needs to be understood is about what kind of auction might occur. As for the second question, what needs to be seen is that the purpose of the auctioneer can vary greatly. It could be that they want to maximize their profits, or it could be that they aim to achieve optimal public social welfare.

### **1. The Simplest Standard Auction**

Before entering the discussion related to Paul Milgrom and Robert Wilson's auction theory, researchers will start by discussing the simplest auction designs. The simple auction in question is a standard auction with the highest bid price as the winner and the bidder is also entitled to receive the auction object. Examples of non-standard auctions are all auctions that use reservation prices or

lottery games. The most simple and well-known auctions (single object) are:

#### *a. Dutch or Clock Auction*

The auction begins by announcing a very high price and is gradually lowered little by little until it becomes the right price for one of the bidders. The bidder shows the accuracy of the price according to them by raising their hands, for example. This will end the auction and the winner of the auction is the raised hand bidder who must pay the valid price when the auction ends. In this way, more than 20 million flowers are marketed in the Netherlands every day, which is why it is called Dutch Auction.

#### *b. English Auction*

Unlike the previous mechanism, the British auction starts at a price so low that many bidders will buy the auction object at that price. Then the price is gradually increased with a specified rate of increase. If the price becomes so high that it is no longer acceptable to the bidder, the bidder will withdraw from the auction. They demonstrate this by lowering their hands, for example. The auction ends when there is only one bidder left. The winner of the auction is the sole bidder, and must pay the prevailing price at the end of the auction. The root of the word "auction" probably comes from the Latin verb "augere" (increase) which suggests that English auctions may have been known in the era of the Roman Empire as well. Art auctions, also known from movies, such as auction house Sotheby's, also work

this way. This is why this method is called a British auction.

c. First Price Closed Offer

Bidders place their bids in sealed envelopes, which means that the players in the auction have no information about the bids of each bidder, and with that, the auction ends. After the opening of the bidding envelope, the bidder who submits the highest bid is the winner of the auction so that it will acquire the object and must pay the bid amount.

d. Second Price Closed Bid or Vickrey Auction

This method is quite identical to the auction of the first price closed bidding, except about the obligation to pay. The winner of the second price closed bid auction is not obliged to pay his own bid, but rather the second highest bid price after the price he bid.

**Table 1.** Different Types of Auctions

	<b>Dutch Auction</b>	<b>UK Auction</b>	<b>First Price Closed Auction</b>	<b>Second Price Closed Auction (Vickrey)</b>
Offer	Increase	Increase	Increase	Increase
Availability of Information for Bidders	Yes	Yes	No	No
Auction Winner	First Bid	Last Bid	Last Bid	Last Bid
Price Paid	Highest Price	Highest Price	Highest Price	Highest Price

Source: Processed by Researchers

Of the four auction categories mentioned above, the researcher examined them based on the following criteria:

1. Who will be the winner?
2. Who pays what amount?

In the above auctions, the object is won by the bidder with the highest bid and they are the only paying party. Losing bidders are

not required to pay anything. The obligation to pay the highest bid price is carried out in the Dutch auction and the first closed bid price auction. Meanwhile, the obligation of bidders to pay a sum of the second highest bid price submitted in one way or another is carried out in the English auction and the second price auction. Hence from this point of view, the dutch auction and the first

closed bid auction are interrelated, and similarly for the English auction and the second closed bid auction. Then, the next question is whether the dutch auction can be regarded as exactly the same as the closed first price auction, and by analogy the same for the english auction as the closed bid second price auction.

### **1. Bidder Appraisal Information**

The researcher assumes that bidders will definitely think rationally, which of course they have some evaluation of the object of the auction, which then bids based on that assessment. How valuations can be formed is well illustrated by the information gap between the UK auction and the second price auction. In the English auction, the exiting bidders will gradually announce their highest bid price. In the end, only one bidder's bid price won, whose information was unknown to the other bidders. As for the second price closed bid auction, of course no information can be obtained during the auction process.

If you compare the dutch auction with the first price sealed bid auction, during the auction process everyone has at least an estimate of the bids of the other players. When the dutch auction ends, the winning bid price will be revealed, but this information will be too late for the other bidders as the auction will end. The question is whether or not this discrepancy in information feeds into the judgments of individual players. Based on this, the researcher distinguishes assessments:

- a. Nilai Privat (*Private Values*)

Private value is when bidders, regardless of the influence of others, know how much the auction object is worth to themselves. In another sense, none of the bidders knows and is not even interested in the evaluation of other bidders on the object of the auction. This is common when the auction object is used for personal gain, such as in art auctions or bond issuance, because the use of an object is also influenced by the secondary market and thus its value is highly dependent on projected appraisals from other people. In practice, the most important factor in supporting valuations for solar power companies for landowners is the number of hours of sunshine on their land. This assessment will in no way be affected by the assessment of other farm owners hundreds of kilometers from the site in question. It should be noted that while spectrum frequency auctions are similar to this, they are not. The frequency spectrum auction does have aspects of private valuation, such as the necessary technological tools available to everyone and market demand that can be estimated in a suitable way, but the value of each frequency band is highly dependent on the frequency of the contiguous area. In addition, companies that are bidders may have different ranges of service providers and business strategies, so spectrum packages may have different utilization values for each of them.

b. Common Value (*Common Values*)

General value is an assessment that does not only depend on the object being auctioned itself, but also on the opinions of other bidders. Usually, this is a valuation case where the value of the auction object depends on the value developed in the secondary market. Valuation of oil fields, for example. It is impossible to know with certainty the capacity of an oil field and estimating that capacity must also be expensive. In this way, all the information obtained about capacities becomes invaluable, and therefore by disclosing their judgments, the parties involved in the bidding will influence each other. Based on private value assumptions, the first closed bid auction can be identified with the Dutch auction, and similarly, the researcher does not differentiate between the second closed bid auction and the English auction. This is called strategic equality, which roughly means that if the same bidder plays two types of auctions with the same value, the identity of the winner and the profit received by the auctioneer will be the same in both auctions.

**2. Multi-unit Auctions and Related Applications**

In market practice, the auction procedure becomes more common even in more complex cases where a buyer wishes to purchase a larger quantity of a product or several related products at the same time.

a. Shareable Items

If one or more sellers want to sell large quantities of homogeneous products to several buyers at the same time, then this is called a stock auction. The earliest application of this is the market for public claims or debt, but the energy market (Wilson 2002), or, say, the market for fishing rights (Bichler et al. 2019) can also be mentioned and linked to this. In Wilson's (1979) article, he examines a model in which customers can also provide their ratings for certain parts of a divisible object. He examined two types of auctions. In one case, being in a condition *common price*, whereas on the other hand customers are allowed to pay different prices for the same amount of product according to their offer. This suggests that, compared to a single object market, market participants have more incentive to bid lower than their actual valuations and are even more able to suppress the equilibrium price through coordination.

b. Indivisible and Interrelated Objects

One of Milgrom and Wilson's other most important findings was the 1994 FCC spectrum allocation auction (Bichler – Goeree 2017), which was based on a simultaneous multi-round auction (SMRA, or simultaneous ascending auction, SAA). An improved version is a combinatorial clock auction (CCA), in which buyers can also bid on

packaged auction objects. In the next sub-chapter, the researcher will explain about the incentive auction that was first used in the 2017 FCC auction, in which radio frequencies and TV operators were first purchased centrally and then, after reallocating the remaining frequencies, the freed bands were sold to cellular operators.

The next challenge in a multi-unit auction is illustrated in the following case. Suppose the spectrum is auctioned simultaneously in Northern and Southern California. There may be a company that is only interested in buying frequencies in the South, but there may also be another company that wants all of California coverage for its services and therefore a one-part California license is of little value to them. If a spectrum auction is announced for the entire US, those interested in objects in much more complex packaged forms will show up. The allocation of an auction object is said to be efficient if the combined evaluation of bidders reaches a maximum point. This is a very basic problem, but on the other hand, the income received by sellers is also an important consideration, especially when it comes to government revenues, so it also plays a role in price setting. However, the mechanism should continue to encourage buyers to

disclose their true valuation, ideally in a strategy-resistant manner, although bid prices that are close to the actual or temporary estimates may also be satisfactory when evaluating auction results. Finally, an important aspect is the simplicity of the auction mechanism or design.

An example of the problem is as follows. There is an apartment and a garage that the owners wish to sell by auction, either together or separately. Three interested parties come, namely buyer A who is only interested in the apartment and will give 43 million for it, buyer B is only interested in the garage and will buy a maximum of 12 million, while buyer C will buy both 50 million but only for one apartment and garage packages. An efficient allocation in this case is when buyer A gets an apartment and buyer B gets a garage. Then the question that arises next is how the auction can achieve efficient results and most importantly, what price must be paid by the buyer.

#### 1) VCG Auction.

This auction is based on three theories from three different figures, namely Vickrey (1961), Clarke (1971) and Groves (1973). Among them, Vickrey's work also won the Nobel Prize in 1996. In the case of multi-unit auctions, the theory works as follows: any buyer can bid on any package of

objects. The solution for allocating auction objects to the bid prices that occur will also be efficient for disclosing the judgments of buyers because the mechanism individually encourages each bidder to disclose their true valuation. Meanwhile, the price is determined as follows: each buyer pays for the type of package they choose as much as the total utility of the other bidders minus the type of package he chooses. In the previous example, buyer A will pay 38 million, because the two objects are worth a maximum of 50 million for buyer C, whereas without an apartment, the garage will be worth 12 million for buyer B, so the difference between the two is the price for buyer A, which is 38 million. Likewise, it can be calculated that buyer B must pay 7 million for the garage, which results from calculating the maximum value of the package (apartment and garage) provided by buyer C of 50 million minus the value of the apartment for buyer A, which is 43 million. So it is found that the seller's total income is 45 million, resulting from the sum of the total prices paid by buyers A and B. When compared to the previous settlement of this case, it can be

seen that the seller's income is less than 10 million, which also shows that this is a deficiency of the mechanism VCG auction.

VCG auctions have the main feature that the best individual strategy for each buyer is to provide a true appraisal. Therefore, the solution allocation is always efficient for the actual valuation. But in practice, VCG auctions are not used in many applications for several reasons. On the one hand, as previously explained in the case of apartments and garages, VCG auctions can generate low income for sellers. In the example above, if buyer C exits the market, then buyers A and B will receive the apartment and garage for free. Some of these problems can be avoided by imposing a minimum price for each object sold. But the next problem is that buyers can work together on this and get a better price between them. In the example, if C reduces his bid, the other two buyers will get a better price because they have to pay less and may be able to share the profit with each other afterwards. In larger markets, calculating efficient allocations will be more difficult, because no fast algorithm is expected to calculate to reach the expected solution.

This is also a significant problem because using an estimation solution can not only be less than optimal for the final allocation result, but can also make the pricing highly inaccurate. In more complex markets, as an alternative to VCG auctions, simultaneous-price-increase (SMRA) auctions based on relatively simple principles emerged in more applications in the 1990s. One of the most significant is the spectrum market which will be explained in the next section.

### 2) Frequency spectrum auction.

The US Federal Communications Commission (FCC) is responsible for regulating the US radio frequency market. In 1994, as proposed by Milgrom, Wilson, and McAfee, the radio frequency market was implemented through simultaneous-price-up auctions (SMRA), which generated more revenue than expected and then spread to many countries around the world (Bichler-Goeree, 2017). The essence of the mechanism analyzed in detail by Milgrom (2000) is that bids are received in several rounds on an iterative basis. And after the last round is over, each item is given to the buyer who offered the most and the price paid is the amount with

the final bid. In the example above, all three buyers must have actively increased their bids until the combined price of the apartment and garage reaches 50 million, say 40 million for the apartment and 10 million for the garage, at which point buyer C exits the market. From this it can be seen that even though the efficiency allocation obtained is the same, the seller's income here will be higher than in the VCG auction.

The advantage of this method is that it is clearly simpler and more transparent than VCG because the buyer only needs to make an offer in response to the given price, so they do not need to evaluate all available packages and the price will contain all relevant information. This mechanism is expected to generate more revenue for sellers than VCG. Finally, under certain conditions the final allocation remains efficient, for example, in the absence of complements or in the case of substitute products, assuming a direct offer from the customer (Milgrom, 2000).

On the other hand, the possible disadvantages of this method are manipulation by reducing demand and exposure problems. The exposure problem can be illustrated in the following

example. Let's assume player A and B are now the same first-time buyer, so they would only buy an apartment for 43 million or only a garage for 12 million, but they don't want to buy both. Buyer C doesn't change, he will be the second player. In that case, following their judgment, the price would start rising. The first player (A + B) always bids on only one item, and the second player (C) continues to match bids until the combined price reaches 50 million. On the other hand, when they have achieved that, for example at 40 million for an apartment and 10 million for a garage, buyer C will face the following problem: he is leading with his bid on only one item, whether it is an apartment or a garage, and one of the items that if he wins, it will be of no value to himself because he is targeting the object as a complete package with other objects. If the auction stopped, then he would incur a heavy loss (winning the auction for a sizable price for only one item that would not meet his needs). Hence, he would prefer to continue bidding in order to cut his losses even if the total price exceeded 50 million. Therefore, buyers who prefer larger packages are faced with the fact that, in the end, they may not be

able to get the package they want in full or they will have to pay more than its real value to get it and suffer losses.

The exposure problem is most severe when there is significant complementarity between products, and the value of the product package is much higher to the customer than the sum of their sub-values. This problem can be avoided with combinatorial auctions, the mechanism developed by Milgrom and others is called a combinatorial clock auction (Ausubel & Milgrom, 2002).

Regarding the problem of reducing demand, it is illustrated that apart from the first player (A + B) before, for the second player (C) now, in addition to the apartment + garage pair of 50 million, the apartment itself is also worth 38 million. This follows the actual valuation in the bidding which leads to the result that the first player buys a garage for 12 million, while the second player buys an apartment for 38 million, so neither of them profit because in the end the final price that occurs equals the efficient allocation, that is 50 million. Conversely, if the second player surrenders the apartment and does not bid on the garage at all, the garage will go to the first

player with a minimum price of 1 million, and in return the second player will not pay more than 32 million to buy the apartment, because the profit will not be higher than garage case (12 - 1 million). That is, by reducing his demand, the second player achieves the goal that the first player is satisfied with the price he gave for the garage, so he can get an apartment at a better price. So that both buyers will be better off with this manipulation. The third problem with SMRA auctions is that there may be a buyer who waits until the end, and then in the last round finds out the right price and ends up taking the package of auction objects he likes best and leaving other eager participants to bid and give up empty hopes; this action is called *sniping*.

Led by Paul Milgrom, the 2017 FCC spectrum auction was designed to respond to special situations. Most of the previous radio frequency licensees used the frequency to operate TV channels. However, with the times and several studies conducted, the use of frequencies for cellular services is far more profitable. The task of Paul Milgrom as the designer of the auction design at that time was to sell the frequencies purchased

from TV channel operators to cellular operators. The procedure was proposed by Milgrom and others (Milgrom et al. 2012), then implemented in 2017 also under their leadership (Milgrom-Segal 2017).

The essence of the procedure is that first the price is set in a reverse auction in which most TV operators are willing to sell their licenses. In parallel, the frequencies sold by TV operators are auctioned off to cellular operators in a forward auction in such a way as to generate additional profit for the government from the price difference. However, it is also important to have the technological possibility to change the band of the service provider who retains the license, thereby enabling the released frequencies to be provided in bands that are close to each other and with a wide coverage area to adequately meet the needs of the community. This bidding process was ultimately successful, and with the US state taking back licenses of around 10 billion US dollars of TV channels and selling them to mobile operators for around 20 billion. State intervention, on the one hand, generates significant revenue. And on the other hand it

also successfully completes the exchange of use rights, which places resources in the hands of the companies that make the most efficient use of them.

## **B. Implementation of Frequency Spectrum Auction in Indonesia**

Prior to 2005, all matters regarding transmitter licenses for cellular telecommunication operations used Radio Station Permits (ISR) which were charged per BTS per channel. This often complicates the verification process in the field, because BTS development changes can take days, or channel changes are very dynamic based on traffic, while the calculation of BHP for ISR Frequency is charged annually. After the enactment of Regulation of the Minister of Communication and Informatics No.17 of 2005 regarding Licensing Procedures and Operational Provisions for the Use of Radio Frequency Spectrum, there are alternative permits, namely Radio Frequency Band Permits and Class Permits. Radio Frequency Band Permit is applied to operators who get exclusive frequency band allocation in a service area specified in the permit. The granting of radio frequency band licenses is carried out based on the selection method. Meanwhile, the License Fee (BHP) for Radio Frequency Band Frequency will be determined based on the results of the selection (auction). For cellular operators who obtained frequency license allocations prior to 2005, the ISR with Radio Frequency BHP will still apply in accordance with applicable regulations (PM.19/2005) up to 2010 maximum.

## **1. Legal Foundation**

The legal basis for the use or utilization of frequency spectrum auctions in Indonesia is found in many provisions, for example:

- a. Law Number 36 of 1999 concerning Telecommunications (State Gazette of the Republic of Indonesia of 1999 Number 154, Supplement to the State Gazette of the Republic of Indonesia Number 3881) which was amended by Law no. 11 of 2020 concerning Job Creation;
- b. Law Number 20 of 1997 concerning Non-Tax State Revenue (State Gazette of the Republic of Indonesia of 1997 Number 43 Supplement to the State Gazette of the Republic of Indonesia Number 3687) which was revoked by Law Number 9 of 2018 concerning Non-Tax State Revenue;
- c. Government Regulation Number 52 of 2000 concerning Telecommunications Operations (State Gazette of the Republic of Indonesia of 2000 Number 107, Supplement to the State Gazette of the Republic of Indonesia Number 3980) which was amended by Government Regulation Number 46 of 2021 concerning Post, Telecommunications and Broadcasting;
- d. Government Regulation Number 53 of 2000 concerning Use of Radio Frequency Spectrum and Satellite Orbit (State Gazette of the Republic of Indonesia of 2000 Number 108,

Supplement to State Gazette of the Republic of Indonesia Number 3981) which was amended by Government Regulation Number 46 of 2021 concerning Post, Telecommunications and Broadcasting;

- e. Regulation of the Minister of Communication and Informatics Number 9 of 2018 concerning Operational Provisions for the Use of Radio Frequency Spectrum;
- f. Regulation of the Minister of Communication and Informatics Number 2 of 2006 concerning Selection of IMT-2000 Cellular Mobile Network Operators at the 2.1 GHz Radio Frequency Band.

## 2. Auction Object

The radio frequency spectrum band blocks being auctioned include:

- a. 1940 - 1945 MHz and 2130 - 2135 MHz;
- b. 1945 - 1950 MHz and 2135 - 2140 MHz; And
- c. 1950 - 1955 MHz and 2140 - 2145 MHz.

The auction for the block of radio frequency spectrum band is carried out simultaneously and is not sequential. The maximum number of radio frequency spectrum blocks that can be bid by bidders is only two blocks. If the auction participant does not relinquish the right to continue using the frequency band allocation of *ex-Fixed Wireless Access* (FWA) with the frequency setting according to B1 in Recommendation ITU-

R M 1036-2 after not using the PCS 1900 pattern setting, the participant can only bid 1 (one) block.

## 3. Base Price Offer

Base Price Offer (*Reserve Price*) is the minimum price acceptable to the State for each block of radio frequency spectrum band auctioned. Base Price Offer (*Reserve Price*) for each block of radio frequency spectrum band that is auctioned is determined differently. For the Basic Offer Price (*Reserve Price*) for each selection object in the 2.1 GHz radio frequency band is IDR 296,742,000,000. Meanwhile, the Reserved Price for the selection object on the 2.3 GHz radio frequency band is IDR 183,360,000,000. The Auction Team conveys the basic bidding price to bidders prior to the prequalification.

## 4. Auction Procedures

The Director General forms the Auction Team which has the task of preparing the terms and conditions of the auction and carrying out the tender process. The auction process is carried out using the Two-Stage Closed Cover method (*2-Stage Sealed Bid Auction*) together for the three auctioned frequency blocks. The stages of the auction process consist of stage I auction and stage II auction.

## 5. Prequalification Stage

The prequalification stage is carried out based on an evaluation of the completeness of the requirements made based on the format determined by the Auction Team. All complete

requirements must be submitted by the end of the submission period for the completeness of the requirements determined by the Auction Team, unless there is additional information requested by the Auction Team in the context of checking and checking. The opening of the completeness of the requirements for the purpose of pre-qualification is carried out by the Auction Team in the presence of a notary and may be attended by representatives of a maximum of three bidders per bidder. Then, based on evaluation through matching and research, the Auction Team proposes the names of selection participants who pass the prequalification to the minister who then determines the selection participants who pass the prequalification. The Auction Team delivers notification of the result of passing the prequalification to each selection participant in writing. Upon notification of the Auction Team regarding the results of the prequalification, bidders may make a written objection within the allotted period. The Auction Team evaluates the participants' written objections to the pre-qualification results and will provide answers to the objections before the auction process is carried out. The answer to the participant's written objection to the results of the prequalification is final and binding. The final stage is the Auction Team announcing to the public the results of passing the prequalification.

## **6. Bid Guarantee**

Each bidder is required to submit a bid bond in the form of a bank guarantee addressed to the Chairman of the Auction Team. The amount of bid security per block of radio frequency spectrum band that is in demand is Rp. 5,000,000,000. The bid guarantee validity period is at least 3 (three) months.

## **7. Level I Auction**

The bidder enters the bid value using the format provided, is given sufficient stamp duty, stamped by the company participating in the auction, and signed by an authorized official of the company participating in the auction. The bid is put in a closed envelope without any signs and must be received by the Auction Team within the period of receiving the first stage of the bid value. The bid value is submitted in integer format with units of billions of rupiah per 2X5 MHz block. The bid price must be at least above the basic bid price (*reserve price*). At the specified time, the Auction Team opens all bid covers. The opening of each cover of the price offer will be made in front of a notary and an official report will be drawn up for that purpose. The opening ceremony of the Phase I bid cover may be attended by representatives of the bidders. The Auction Team checks the validity of each envelope of the Phase I bid.

## **8. Phase II auction**

It is carried out in the same manner as in the Phase I auction with the bidding

value having to be at least equal to the Phase I bidding value. In the event that the Phase II bidding value is smaller than the Phase I bidding value and has the potential to create auction results that are detrimental to the state, then the Phase II bidding value that applies is the value of Phase I bids. The maximum bid price increase from Phase I bids by each auction participant is not limited. Legitimate participants from the results of Phase I who do not bid in Stage II or bid lower, may be deemed to bid in the second round with the same value as Stage I if this can provide better auction results for the interests of the State. A valid participant from the results of Phase I who makes an illegal bid in Stage II, it can be considered as bidding in the second stage with the same value as the first stage if this can provide better auction results for the interests of the State. If it does not provide better auction results for the interests of the State, the participant's bid is deemed absent.

#### **9. Determination of Auction Winners**

The winner of the auction is determined based on the rating of the highest bid price for license to use radio frequency spectrum bands and based on the availability of frequency band blocks. The Auction Team allocates the number of auction objects according to the bid block submitted by the bidders starting from the bidder who submits the highest bid. The auction object is allocated to the auction winner according to availability.

For bidders bidding for 2 blocks of radio frequency spectrum bands and the ranking position of the bidding is in a sequence that only allows for allocation of radio frequency spectrum bands for one block, the auction participant concerned will only receive one block of radio frequency spectrum bands. In the event that the bid prices are the same, especially in Stage II, then the frequency band allocation priority is based on the time of submission of bids within the time limit set by the Auction Team. Bids submitted earlier are placed at a higher rating or in other words have more priority to get the frequency band allocation being auctioned according to availability.

#### **10. Implementation Guarantee**

The amount of implementation guarantee per block won for the first year is IDR 20,000,000,000 or 5% of the auction price, whichever is higher. The amount of the performance guarantee per block of radio frequency spectrum band won for the second to tenth year is IDR 20,000,000,000 or 5% of the projected frequency band license rate to be paid in the following year, whichever is higher. The validity period of the performance guarantee is at least 1 (one) year. When the performance guarantee is executed, then the auction winner must immediately replace it with a new performance guarantee.

#### **11. Collusion, Manipulation and Sanctions**

That it is forbidden to practice any form of collusion and manipulation in the

auction process, whether carried out by one or more or jointly among the bidders. For participants who practice collusion and manipulation, their participation will be cancelled, including the rights they have obtained as auction winners.

### **C. Differences between the Implementation of Frequency Spectrum Auctions in Indonesia and Paul Milgrom's and Robert Wilson's Auction Theories**

From the discussion regarding the auction theory put forward by the two economists from the US, namely Paul Milgrom and Robert Wilson, as well as a brief discussion regarding how the design of the frequency spectrum auction in Indonesia, regardless of the various factors and conditions related to what underlies the two auctions to be designed in such a way, In the following, the researcher summarizes the various differences that have been concluded.

1. The implementation of auctions in Indonesia uses two stages, both of which use a closed price auction method, whereas according to what is recommended by the auction theory, namely conducting an auction in two stages, in which the first stage is carried out openly, and using a closed price auction for the second stage; to find out information and motives for bid price determination by other bidders.
2. The allocation of frequency spectrum auctions in Indonesia is still not fully maximized. This is caused by the

possibility that the frequency spectrum is not utilized efficiently, one of which comes from the frequency spectrum used by TV channel companies which no longer generates optimal revenue in line with the development of the digital age. According to auction theory, this can be solved by carrying out an auction using the method *reverse and forward*.

3. The implementation of spectrum auctions in Indonesia has not considered a solution to opportunities for fraudulent acts by bidders, other than by providing requirements for a minimum auction price. The intended acts of fraud are such as the winner's curse, monopoly action, obstruction of bidders from registering, manipulation of demand reduction, and collusion, which ends in the inaccuracy of the target allocation of frequency spectrum rights.

### **D. The Role of Possible Auction Theory Can Be Applied in the Implementation of Frequency Spectrum Auctions in Indonesia**

According to the researcher, the lesson that can be drawn after analyzing the auction theory is the implementation of an auction mechanism which is divided into two stages like an Anglo-Dutch auction, namely the first stage uses an open price auction mechanism while the second stage uses a closed price mechanism. This mechanism can solve various problems that have been previously disclosed. Since the auction bidding is carried out in several stages, it can reduce the risk of '*the winner's curse*' According to Robert Wilson,

the reason bidders are more likely to place their bids below their own best estimate of common values is that they are concerned about *the winner's curse*, in which those who win the auction pay a much higher price and are far from the average bid price. This would end up being the party's own loss.

In addition, by using this mechanism, bidders can have time to re-evaluate their strategy with the new information they obtained from other buyers in the previous stage. On the other hand, to prevent bidders from canceling bids, a new sanction can be applied to enforce this impropriety, namely by for example the application of "*activity rule*" in which bidders must make reliable bids at each stage. Thus, the conventional form of auction where auction winners obtain goods and services no longer results in exorbitant prices, so that both the seller and the buyer can take advantage of the proper use of frequency spectrum, which is supported by their level of profit in obtaining spectrum. that frequency.

Furthermore, it is highly recommended to apply the incentive auction that was used in the FCC auction in 2017, considering how this auction mechanism succeeded in helping to generate significant state revenues with its unique strategy. Utilization of the frequency spectrum in Indonesia has not been fully centralized to produce optimal output and benefit many parties, especially the welfare of the general public. So, with the new idea to implement *reverse auction* and *forward*

*auction* it is hoped that it can further optimize the use of this limited natural resource, namely the frequency spectrum and thus also have a good impact on the development of the GNP and the welfare of society.

### **CONCLUSION**

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Based on the previous discussion, the conclusions that can be drawn include the following: (1) Auction theory plays an important role in providing the main idea of how frequency spectrum auctions are executed so that they can help generate optimal state revenues and allocate these limited natural resources to the right company hands. Auction theory also makes a lot of efforts in solving various problems that occur, not only in frequency spectrum auctions, but which can also be found in the implementation of auctions in general. (2) The implementation of frequency spectrum auctions in Indonesia uses a closed price auction mechanism consisting of two stages. The bidders who participated in the second stage were the composition of all legal bidders who also participated in the first stage. Herein lies one of the fundamental differences between frequency spectrum auctions in Indonesia and what Paul Milgrom and Robert Wilson recommended in their auction theory. (3) The difference is seen between the implementation of frequency spectrum auctions in Indonesia and the auction theory initiated by Paul Milgrom and Robert Wilson. (4) The possible role of auction theory can be applied in the

implementation of frequency spectrum auctions in Indonesia, among others: (5) Conducting frequency spectrum auctions in two stages, where the first phase is carried out with open prices and closed prices for the second stage; (6) Conduct incentive auctions, namely auctions with reverse and forward methods to change the allocation of frequency spectrum in TV channel companies to telecommunications companies for better optimization of frequency spectrum use and utilization.

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