

The Tanzania Communications Regulatory Authority 3600 to 3800 MHz spectrum auction

A review of the TCRA's 3.6 GHz spectrum auction
and the learning for other regulators seeking to
award spectrum to support the development of
mobile broadband and 5G

October 2025

Insights from the TCRA's 3600 to 3800 MHz spectrum auction

Introduction

There are many positive aspects of the TCRA auction, but some decisions are likely to have compromised efficiency

The Tanzania Communications Regulatory Authority (TCRA) recently concluded another C-Band auction for spectrum in the 3600 to 3800 MHz band. There are many aspects of the TCRA's award process which are to be commended. However, the choice of block size, auction format and pricing may have resulted in an inefficient outcome although a wide range of factors have to be considered when thinking about auction design and especially lot sizes in the case of Tanzania. In this paper we explore the key features of the TCRA auction.

Auction objectives

A key objective of the auction was to achieve an efficient allocation of spectrum

The National Information Communications and Technology Policy, 2016 (National ICT Policy) of Tanzania sets out the primary objectives of telecoms policy and spectrum management. An objective pertinent to the auction was the objective:

"To strengthen management and promote efficiency in spectrum allocation and utilisation that guarantees its availability and competition in both urban and rural areas."

Section 5 of the TCRA Act, CAP 172 also specifies one of the duties as being:

"Promoting effective competition and economic efficiency."

When regulators discuss "efficiency" this is usually defined in economic terms and implies that spectrum should be assigned to the operators that will generate the greatest socio-economic value from the use of the spectrum. We will see later in this paper that the objective of efficiency was put at risk by the auction design.

Spectrum packaging

Spectrum packaging was a weakness of the TCRA auction design

The spectrum to be awarded was within the 3600 to 3800 MHz range representing 200 MHz of spectrum on a Time Division Duplex (TDD) basis. The TCRA packaged the spectrum into four blocks of 1 x 50 MHz each.

In October 2022, the TCRA conducted a multi-band auction which included frequencies in the 3400 to 3600 MHz range. Some operators, such as Airtel and Yas, will therefore have already deployed radio equipment which, depending on the span of their radios, may be able to accommodate the new frequencies in the 3600 to 3800 MHz range without the need for significant additional investment. Whilst many of today's generation of C-Band radios / active antennas support a 400 MHz (instantaneous) bandwidth, radios with smaller bandwidths of 200 or 300 MHz were very common in 2022. The TCRA may have been concerned about operators with no existing assignment in the C-Band acquiring uneconomic, small amounts of spectrum if a smaller lot size had been selected. Furthermore, if there were no provisions for re-packaging of the band post auction, then operators with existing holdings may have ended up with small holdings of non-contiguous spectrum. With non-contiguous holdings the operators would have to rely on 5G Intra-Band non-contiguous Carrier Aggregation to make use of say an additional, non-contiguous 10 MHz. Whilst top end devices will support carrier aggregation, customers using older devices would only be able to use the 80 MHz carrier. Challenges in using carrier aggregation are likely to be more significant in some African markets where affordability issues restrict the availability of top end devices. A decision to adopt 1 x 50 MHz lot sizes may have been made to ensure at least two sizeable, potentially discontinuous blocks could be acquired which could be efficiently used for 5G capacity.

The choice of auction design would have placed limits on the flexibility the TCRA had in terms of spectrum packaging

The choice of auction design, which we discuss in more detail below, would have placed limits on the flexibility the TCRA had in terms of spectrum packaging. If they had selected an alternative auction format, such a clock auction designed to limit exposure risk and ensure continuity, they could have potentially adopted smaller lot sizes which may have been beneficial from an economic efficiency perspective.

When an operator initially deploys a new band, the first block of spectrum it acquires attracts all the costs of the new equipment to deploy the spectrum along with the costs of meeting any coverage obligations attached to it. As a result, the first block of say only 10 MHz, typically has a low or negative value. However, additional blocks can be deployed at minimal additional cost and generate positive values. As a result, operators typically require a minimum of 30 to 50 MHz of spectrum in order to generate value. When a new band is being awarded it can therefore make sense to auction large blocks to avoid the risk of an operator being awarded a small amount of spectrum with a low value but at a high price – what game theorists call “exposure risk”.

In the case of Tanzania, as some of the operators would be able to deploy the new spectrum at low cost; even an incremental 10 MHz block would likely have a positive value, especially if contiguous. In choosing to package the spectrum into blocks of 1 x 50 MHz the auction design lacked granularity and potentially did not allow bidders to express fully their preferences for additional spectrum.

Some operators, for example, may have required only an additional 20 MHz and would not make good use of the remaining 30 MHz within a 50 MHz block. In contrast, others may have needed say 80 MHz but were unable to acquire sufficient spectrum. By selecting large block sizes of 50 MHz the TCRA compromised the potential efficiency of the auction as the small number of large blocks restricted the range of potential auction outcomes. Achieving the objective of efficiency may have been better served by assigning the spectrum in blocks of 10 MHz and letting a suitable auction mechanism determine what was the most efficient allocation of spectrum between the operators. However, as this discussion highlights, there are a wide range of factors that must be taken into account when determining the appropriate lot size.

Reserve price levels

Reserve price levels were reasonable

The reserve price for each 50 MHz block was set at TZS 30,000,000,000 which is approximately US\$ 12.1 million. A comparison with spectrum auction benchmarks suggests that the reserve price was set at a 30% discount to estimated market prices. We expect that the TCRA may have been concerned about a potential lack of demand and an absence of competitive bidding and therefore set the reserve price at a reasonably high level to ensure that reasonable revenues were raised even if the auction ended at or close to the reserve price.

The TCRA would have been taking some risks that spectrum was left unsold when setting the reserve prices at these levels, but they are not excessively high. As the results show, the reserve price levels did not, in practice, impact the outcome of the auction.

Exhibit 1: 3600 MHz



Source: Coleago Spectrum Auction Database

Concerns about a lack of demand and a desire to maximise revenue may have been another factor in setting a larger lot size. If 10 MHz lots had been adopted, then the reserve price would need to be set on the basis of the value of the last lot to be sold and this marginal value could have been potentially quite low. A low reserve price may have been politically challenging for the TCRA and so a high reserve price and small lot sizes could have resulted in spectrum being left unsold which would not be economically efficient. In selecting a 50 MHz lot size the TCRA reduced the risk of spectrum being left unsold and was also able to set a higher reserve price which reflected the value of all lots within the 50 MHz package.

Payment terms

Introducing staggered payment terms is very positive by they could have been more generous

The fees established by the auction are to be paid in a series of five payments over a period of two years. The first payment of 40% was required within 14 days of the auction and four further payments of 15% each were required every six months thereafter. Whilst staggered payments will have been welcomed, the payment terms are not particularly generous. Payment terms encompassing periods of three to five years or longer are not uncommon and are helpful for an industry that is no longer as cash generative as it once was.

Coverage and quality of service obligations

Coverage and quality of service obligations seem reasonable

Whilst the definition of the coverage obligations contained within the IM are open to interpretation, they do not appear to be particularly onerous. Operators who acquired spectrum in the auction were required to “maintain a geographical presence” in at least six different administrative regions of Tanzania by 2028 and all headquarters of administrative regions by the end of 2033. The requirement to simply be “present” suggests that the coverage obligations were not particularly demanding. In terms of quality-of-service obligations, winning bidders were only required to meeting existing quality of service requirements, which would not materially impact the value of the spectrum.

Licence term and renewal

The licence term of 15 years is reasonable

The licence term was set at 15 years with renewal in favour of the incumbent spectrum holder which is very common. There is a shift towards longer licence terms or even indefinite licences (see the United Kingdom) however, 15 years is reasonable.

Process and timings

The process and timings were pragmatic and appropriate

The TCRA followed a logical and sensible approach to the award process. The process commenced with the publication of a draft Information Memorandum (IM) for comments and questions which was then followed by the publication of the final IM which defined the terms for the actual award. There were then a series of milestones including the deadline for applications, confirmation of bidders, the auction date, publication of results, initial payments and the grant of licences.

Mobile operators, when faced with a spectrum auction, typically require a minimum of three to four months in which to prepare. Operators usually require six to eight weeks for a spectrum valuation exercise, additional time to prepare their bidding strategy and then a significant amount of time for their approvals process which may require gaining approval at the local and then group level.

The TCRA auction process allowed a period of almost five months in total from the publication of the draft IM to the bidder application deadline. Within this timeframe, there was a period of 25 days from the publication of the final IM to the application deadline. Operators will have begun their business planning and valuation activities on the basis of the draft IM and then this would have been refined and finalised once the final IM was published. These timescales are reasonable and would have allowed operators sufficient time to prepare.

Auction design

The TCRA selected a first price, sealed bid auction format

The TCRA adopted a first price, sealed bid auction format. In the auction design, bidders were required to indicate the price they were prepared to pay for a 50 MHz block and the number of blocks they wanted to acquire at that price (subject to the cap). In addition, they were able to indicate the number of additional blocks they would be prepared to acquire above the cap.

Once the bids were submitted, the bids were arranged in descending order and the blocks allocated in accordance with the demand of the bidders, subject to the cap and the available spectrum. If, after this first stage, any block or blocks remained unsold, they were then assigned to those that had expressed a willingness to acquire spectrum above the cap and the assignment was based on the order of bids, the highest bidder first.

Whilst a first price, sealed bid auction may appear simple and easy and quick to organise, it creates very significant bidding strategies for operators and can result in auction outcomes that are not efficient.

Risk of bidding errors

There was a significant risk of bidding errors

In a well-designed auction bidders will have “dominant strategy” - a strategy which is optimal to follow, regardless of what any other bidders do. For example, in a classic ascending auction, the dominant strategy is to keep bidding until you reach your valuation and then stop bidding. The strategy is optimal regardless of the bidding of anyone else.

In the case of a first price, sealed bid auction there is no “dominant strategy”. In a first price, sealed bid auction it never makes sense to bid more than the value you place on the spectrum because if you win, you have destroyed value. It also does not make sense to bid your value because if you win you have neither made a profit nor a loss and so a bid at your value is pointless. So, the only rational bid is to bid below your valuation. However, economics and game theory offers little comfort as to how much below your valuation you should bid. Ideally, you want to bid one dollar more than the next highest bid, but you do not know what the next highest bid will be. In the case of a first price, sealed bid auction, your bid depends on what you think other bidders will bid, who in turn, will be bidding based on what they think you will be bidding. Bidding strategy quickly descends into what you think, they think, you think about what they

think and so on, as to how much to bid. The risk of bidding error and therefore an inefficient outcome is very high.

Inefficient outcomes

A first-price, sealed bid auction is not efficient

First-price, sealed-bid auctions can generate inefficient outcomes. Suppose two bidders are bidding for one block of spectrum. Bidder A values it at 100 and Bidder B values it at 110. An efficient outcome would see the block awarded to Bidder B and the price would be determined by the value of the block to the strongest, losing bidder, i.e., 100.

In a first price, sealed-bid auction it never makes sense to bid more than your value or an amount equal to your value. It only makes sense to bid less than your valuation. The problem is that it is impossible to determine with confidence how much less to bid than your value. Suppose Bidder B decides to bid 80 and Bidder A decides to bid 90 (both bids are below their respective values), then Bidder A will win but from an efficiency perspective, Bidder B should have been awarded the spectrum. Also note that Bidder B would have been prepared to pay more than 90 and could still have created value. The need to bid less than your valuation combined with the risk of bidding errors can give rise to inefficient outcomes.

Diminishing marginal returns and fixed prices

The auction design offered limited flexibility in relation to expressing bidders' values for spectrum

Coleago has supported operators in over 150 spectrum auctions, and we have seen that after the first one or two blocks of spectrum, there are diminishing marginal returns to additional spectrum. In other words, the value and therefore the price you are prepared to pay for each block of additional spectrum reduces. In the case of the TCRA auction, bidders are only permitted to submit a single price that is applicable to all the potential blocks they could win. Bidders in the TCRA auction do not have the opportunity to express their reducing valuations for additional blocks which can give rise to inefficient outcomes.

Consider the table below where a set of hypothetical valuations are presented for three bidders and for simplicity, we will assume no bidder wants more than two blocks and there are four blocks available. If we assume that every bidder always bids less than their valuations and that all bidders bid, say 10% less, then the valuations will determine the order of winners.

Block	Bidder A	Bidder B	Bidder C
Block 1	100	60	75
Block 2	40	50	
Total	140	110	75
Average value	70	55	75

Consider Bidder A. Bidder A is prepared to pay up to 100 for the first block and 40 for the second block. However, bidders in the TCRA auction are only allowed to bid a single price for all blocks. Suppose Bidder A decides to bid on the basis of the average value for both blocks of 70 (note it would not make sense to bid more than 70 because if it wins both blocks it would make a loss). In being forced to express a single price for both blocks it is under-expressing its value for the first block and overstating its value for the second block.

If the TCRA auction rules are applied and bidders bid on the basis of their average value (in practice they will each bid 10% less than their average value), Bidder C will be the highest ranked bidder, followed by Bidder A and Bidder B. The results will be:

- Bidder C: one block for 75

- Bidder A: two blocks for 140
- Bidder B: one block for 55
- Total bids: 275
- However, if bidders were able to express their values for individual blocks, then result would have been
- Bidder A: one block for 100
- Bidder C: one block for 75
- Bidder B: one block for 60 and a second block for 50
- Total bids: 285
- The TCRA auction rules, permitting only one price for every block, results in the potential for an inefficient outcome as bidders cannot express their diminishing valuations for incremental spectrum.

This issue is further exacerbated by the choice of large block sizes. The difference in value between the first, second and potentially third and fourth blocks will be high which increases the likelihood of inefficient outcomes. The TCRA would have been better served by an auction design with smaller block sizes and one that allows bidders to express their valuations for each individual, additional block.

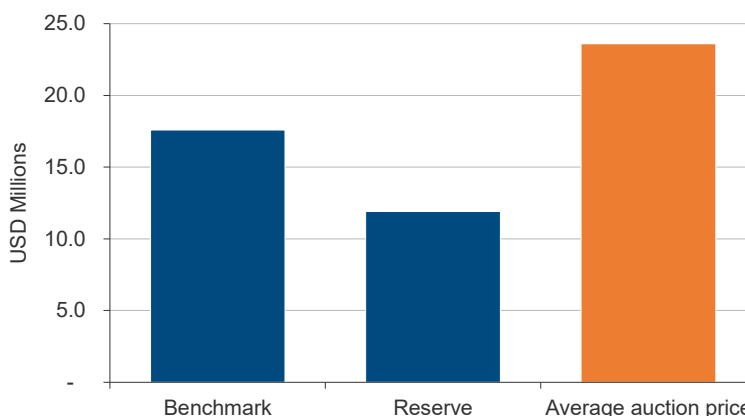
Auction results

The results of the auction are shown in the table below.

Bidder	No. of blocks	Total USD Millions	Per Block USD Millions
Viettel (Halotel)	2	52.2	26.1
Honra (Yas)	1	22.2	22.2
Vodacom	1	19.1	19.9

In the chart below we compare the average auction price with the benchmark price and also the reserve. The final auction prices were ahead of the benchmark levels and 96% higher than the reserve prices indicating that this was a relatively expensive auction for the operators in Tanzania.

Exhibit 2: Comparison of Auction Results



Source: Coleago, TCRA

Regret risk

If you went to the supermarket to buy a loaf of bread and you paid US\$ 1 and then learnt that someone else had only paid US\$ 0.50 for an identical loaf, then this may leave you feeling unhappy because this would not be equitable. In a first-price, sealed bid auction, bidders can end up paying very different amounts for identical spectrum. This is exactly what happened in the Tanzanian auction as we discuss below.

Viettel paid a price which was more than 30% higher per block than Vodacom and 24% higher than the combined price paid by Yas and Vodacom for two blocks. In value terms, Viettel paid just over US\$ 10 million more than it needed to.

Coleago has worked alongside a large number of mobile CEOs in auctions, and CEOs are generally competitive individuals and do not like to be seen to have overpaid. Whilst it should not matter if you paid more than a competitor provided you paid less than your valuation, it does matter to CEOs, and they will often bid to try and minimise the risk of regretting have paid more than they needed to. Unfortunately, seeking to avoid regret risk can also give rise to inefficient auction outcomes.

Furthermore, auction outcomes where different bidders pay dramatically different amounts for essentially the same thing are often regarded as inequitable and unfair. Many regulators prefer auction outcomes that are perceived as being reasonable and fair by the public.

Efficiency

It is impossible to determine whether the final auction outcome was indeed efficient as this would only be possible with knowledge of each bidder's valuation which are not in the public domain. However, it is reasonable to presume that efficiency is likely to have been increased by adopting smaller block sizes and an auction design which allowed bidders to better express their range of valuations for different spectrum blocks.

Alternative auction format

This paper has argued that the TCRA's choice of block size and auction format presented bidders with difficult choices in terms of bidding strategy which is likely to have resulted in an outcome that did not maximise efficiency. The issues highlighted in this paper could have been overcome by adopting a lot size of 10 MHz and an auction format such as an ascending clock auction.

In an ascending clock auction format, the auctioneer announces an auction price per 10 MHz lot and bidders express how many lots they are prepared to buy at that price. If there is more demand than the available lots the auction clock price is increased. As the auction clock prices increase, bidders will eventually reduce their demand. The auction ends when demand is equal to (or possibly less than) supply. Bidding strategy is much simpler, and the outcome will be efficient.

Summary of key insights

The TCRA should be applauded for a number of aspects of the award process:

- making spectrum available in a timely manner;
- setting reasonably conservative reserve prices;
- following a logical process and procedure for the award;
- providing some flexibility over payment terms, although they could have been more generous;
- setting reasonable coverage and quality of service obligations; and
- setting a reasonable licence term.

An ascending clock auction format with 10 MHz block sizes would have addressed many of the issues in the Tanzanian auction

- However, there were a number of key issues with the TCRA award process:
- the block sizes were too large to support an efficient allocation;
- the choice of a first price, sealed bid auction created the risk of bidding errors and inefficiencies; and
- a single price for all blocks further damaged the efficacy of the design.

The TCRA's auction may have appeared at first glance to be simple and straightforward but in practice it presented significant complexity for bidders and is likely to have resulted in an inefficient outcome. The TCRA's objectives would have been better served with a smaller block size and an ascending clock auction format.

How Coleago can help

An understanding of spectrum from an operator's perspective is key to developing appropriate spectrum management strategies

Coleago has over 20 years of experience in advising both operators and regulators on issues related to spectrum including spectrum management strategies, roadmaps, pricing and award process design and implementation, including auctions and spectrum renewals. We can provide regulators with the "operators' perspective" to ensure that our recommendations take account of the practical real-world realities faced by mobile operators to ensure that our regulatory advice will achieve the regulator's objectives.

About Coleago Consulting Ltd

Graham Friend, M.A., M.Phil., (Cantab), ACA, is an economist, an award-winning author and the Managing Director and Co-Founder of Coleago Consulting. Coleago is a specialist telecoms strategy consulting firm and advises regulators and operators on issues relating to spectrum, regulation and network strategy. If you would like to discuss any of the issues raised in this paper, then please contact Graham.



Email: graham.friend@coleago.com

Mobile: +41 798 551 354