Spectrum Auctions in Thailand
Challenges Before and Ahead
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Background

- Thailand is upper-middle income country with 67 million population
  - 71% internet penetration in 2018
- Leading in mobile internet usage (We Are Social, 2019)
  - Ranked 1st globally in time spent using mobile internet
  - 7th globally for Facebook penetration
  - Top-10 globally for Youtube watch time, upload and subs (2018)
- Legislation mandates that all commercial spectrum must be assigned by mean of auction

How do we design spectrum auction that works under such constraints?
Spectrum Auctions

Spectrum for commercial telecommunications uses must be assigned via auctions

First spectrum auction. Transitioned from concession to licensing systems

Extremely competitive auction + default

Digital dividend and govt overruling

**2004**
- Founded independent telecom regulator

**2012**
- 2.1 GHz auction

**2015**
- 900 /1800 MHz auction

**2019**
- 700 MHz “assignment”

**2020**
- 700 MHz/1800 MHz 2.6 GHz/26 GHz auction

Expected Q1 2020
2.1 GHz Auction (2012)

Auction Design
• Standard SMRA design with generic lots

Results
• Three incumbents, 9 generic lots of 2x5 MHz, spectrum cap of 3 lots
• Final price is a few percent above reserve price (one bidder topped-up to get a chance to choose frequency assignment first)
• $0.23 per MHz-pop
• Coverage obligation: 80% of population in 4 years

• Weak competition leads to many lawsuits against NBTC
• On-site auction becomes standard way to auction spectrum in Thailand
1800/900 MHz auction (2015)

Auction Design

- Sequential SMRA with specific lots
- On-site auction: 1800 MHz takes 33 hours straight and 900 MHz takes 4 days

Results

- 1800 MHz: $0.66 per MHz-pop, 900 MHz: $1.87 per MHz-pop
- One of 900 MHz winners fail to make first payment. Loser takes the license at the final price

On-site auction locked up all bidders making it impossible to increase deposit
3G and 4G Coverages

Source: AIS, DTAC, TRUE
1800/900 MHz Auction (2018)

Auction design
- Sequential SMRA with specific lots
- 2x45 MHz of 1800 MHz and 2x5 of 900 MHz
- Reserve price = final price from the last auction

Results
- No competition
- Operators stayed out at first
- AIS and DTAC got 2x5 MHz of 1800 MHz, each
- DTAC got 2x5 MHz of 900 MHz

Reserve price stickiness. Price can only go up.
700 MHz Assignment (2019)

Spectrum assignment
- 2x45 MHz of 700 MHz from analog switch off
- Three 2x10 MHz licenses are up for sale
- NBTC will extend payment term of 900 MHz, from 5 to 10 installments if an operator “purchase” 700 MHz license

Results
- All three operators purchased one license each
- $0.46 per MHz-pop
Spectrum Holdings

<table>
<thead>
<tr>
<th>Operator</th>
<th>Subscribers (millions)</th>
<th>Spectrum holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS</td>
<td>41.1 (44%)</td>
<td>140 MHz (29%)</td>
</tr>
<tr>
<td>TRUE</td>
<td>29.2 (31%)</td>
<td>130 MHz (27%)</td>
</tr>
<tr>
<td>DTAC</td>
<td>21.1 (22%)</td>
<td>130 MHz (27%)</td>
</tr>
<tr>
<td>CAT</td>
<td>1.9 (2%)</td>
<td>30 MHz (6%)</td>
</tr>
<tr>
<td>TOT</td>
<td>0.9 (1%)</td>
<td>60 MHz (12%)</td>
</tr>
</tbody>
</table>

Bandwidth (MHz)
## 5G Spectrum Auction

<table>
<thead>
<tr>
<th>Band</th>
<th>Lot size</th>
<th>No. of lots</th>
<th>Spectrum cap</th>
<th>Reserve price</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 MHz</td>
<td>2x5 MHz</td>
<td>3</td>
<td>2x15 MHz</td>
<td>$0.43/MHz-pop</td>
</tr>
<tr>
<td>1800 MHz</td>
<td>2x5 MHz</td>
<td>7</td>
<td>2x20 MHz</td>
<td>$0.62/MHz-pop</td>
</tr>
<tr>
<td>2600 MHz</td>
<td>10 MHz</td>
<td>19</td>
<td>100 MHz</td>
<td>$0.092/MHz-pop</td>
</tr>
<tr>
<td>26 GHz</td>
<td>100 MHz</td>
<td>27</td>
<td>1200 MHz</td>
<td>$0.001/MHz-pop</td>
</tr>
</tbody>
</table>

- First multiband auction
- Relaxed payment terms
- Little substitution across bands
- Other bands in consideration 3.4 GHz and 28 GHz
2.6 GHz

- Refarm from a broadcaster who holds entire band
  - No supply competition
  - By negotiation with NBTC
- Geographic coverage obligation for 2.6 GHz
  - 50% of key economic areas (11 provinces)
  - Relaxed payment terms if operator builds 5G network covering 50% of EEC geographically
5G Spectrum Auction (expected Q1/2020)

**Allocation stage**
- Determine the number of lots each bidder wins
- Simultaneous ascending clock auction for generic spectrum lots in multiple bands

**Assignment stage**
- Determine specific frequency assignments
- Combinatorial sealed-bid first-price auction
Candidate Auction Formats

SMRA
- Status quo auction format
- Can be easily ruled out because of multiple generic lots
- Impossible to conduct on-site auction in a day or two

Simultaneous clock
- Faster auction
- Simplest clock design for multi-band auction
- Works well with weak substitution across bands

CCA
- Ruled out because of its complexity
- Works well with strong substitution across bands

Simultaneous but independent clock auction with monotonic activity rule
Dealing with On-site Auction

- Use large bid increments to speed-up auction
- Allow intraround bids to avoid overshooting and increase efficiency
- Only allow single intraround bid for simplicity
- Highest-rejected bid for less strategic bidding incentive
- Proceed to the next round immediately after every bidder confirms bids

### Overshooting

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<th>Quantity</th>
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<tr>
<td>4</td>
<td>40</td>
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<tr>
<td>5</td>
<td>50</td>
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### Intraround bidding

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Market clearing price: 47
Nationwide vs Regional Licenses

- At first, NBTC considered regional lots for 26 GHz
- 27 generic lots in each of 18 service areas
- And also a mix of regional and nationwide lots
- Auction design becomes overly complicated
  - Regional licenses require substitution within bands
  - Need to introduce aggregate activity rule and switching rule
  - More complicated bid processing
  - No interests from verticals or local operators
- Switch back to with nationwide lots
Assignment Stage

- Status quo: bidder with the highest total bid chooses frequency assignment first
- Cannot do this with clock auction
- Band-by-band combinatorial first-price sealed-bid auction
- Pay-as-bid for simplicity
### Challenges Ahead

| Public opinions                                                                 | • Weak demand for 5G spectrum  
|                                                                                   | • Expect large revenue as in 1800/900 MHz auction |
| Policy advocacy                                                                 | • Government pushes 5G for special economic area  
|                                                                                   | • Trade-off between large revenue and fast roll-out |
| Auction design                                                                  | • New auction format for multi-band auction  
|                                                                                   | • Steppingstone towards more efficient and flexible design |
| Other 5G spectrum                                                               | • Refarming 3.4 GHz and 28 GHz for 5G  
|                                                                                   | • Smaller 28 GHz lots for local operators |