



## Exploring IMT spectrum auctions

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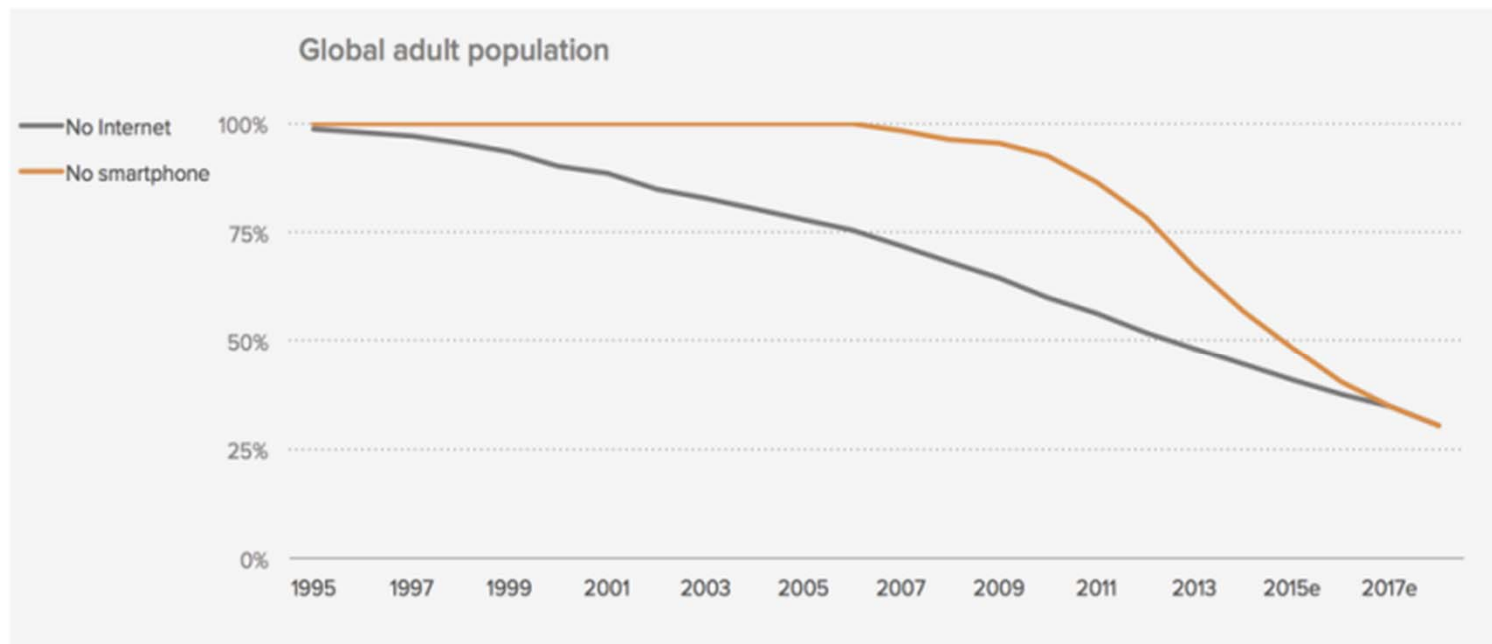
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## Our Starting Point.

"It will soon be possible to transmit wireless messages around the world so simply that any individual can carry and operate his own apparatus."

Nikola Tesla, 1909



Source: Benedict Evans, *Mobile is eating the World*, 28 October 2014

[Source: a16z, World Bank, Apple, Google, Nokia]

## **Outline of WPC's Presentation**

1. Spectrum allocation and assignment
2. Why auction spectrum?
3. Types of spectrum auctions
4. Thailand's spectrum auction experience
5. Spectrum caps to promote competition
6. Closing remarks

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# 1. Spectrum allocation and assignment (1)

## Managing mobile/IMT spectrum

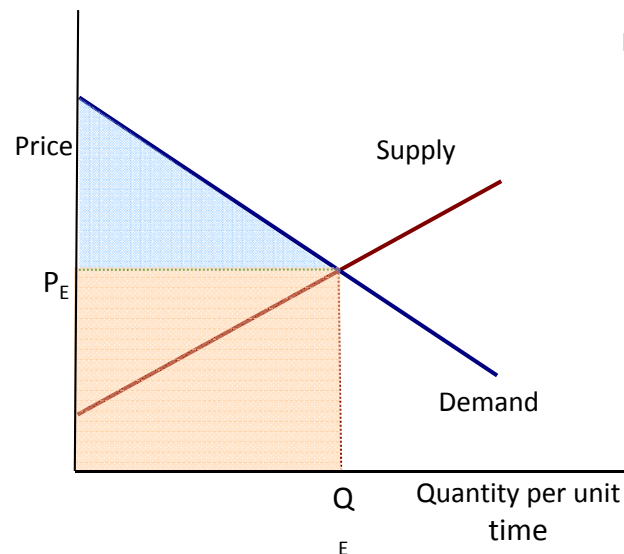
Spectrum must be managed to ensure it is being used in highest value areas. Government and regulator must consider commercial and public benefit value of different types of spectrum. Broadly there are 3 main approaches to allocation:

- **Command & control:** Historical approach. Regulator decides how much spectrum each operator should have and allocates and assigns spectrum accordingly. Beauty contest involves comparison of different potential users based on network, rollout, coverage, technology, etc.
- **Spectrum available for licence-exempt use:** Also known as “spectrum commons” or “unlicensed access”. Regulator allows free access to the spectrum, usually with restrictions on power levels, making it most suitable for short-range devices.
- **Market mechanisms:** Auctions and other price-based mechanisms. Allows market to modify historical allocations towards those more likely to maximise economic efficiency. Spectrum pricing can also inject some market disciplines into the allocation and assignment process.

# 1. Spectrum allocation and assignment (2)

## Economic concepts in spectrum management

- Scarcity and efficiency
- Consumer surplus, economic welfare, social welfare
- Public goods, private goods and commons goods
- Excludability and rivalry
- Market failure



		Rival?	
		Yes	No
Excludable?	Yes	<b>Private goods</b> RIVAL , EXCLUDABLE Exclusive spectrum licences where congestion occurs	<b>'Club' goods</b> NON-RIVAL , EXCLUDABLE Exclusive spectrum licences where no congestion occurs
	No	<b>Common resources</b> 'The tragedy of the commons' RIVAL , NON-EXCLUDABLE Unlicensed or 'commons' spectrum where congestion occurs	<b>Pure public goods</b> NON-RIVAL , NON-EXCLUDABLE Unlicensed or 'commons' spectrum where no congestion occurs

# 1. Spectrum allocation and assignment (3)

## Scarcity of spectrum and efficient use

- Spectrum is increasingly scarce relative to demand especially for sub-1/sub-2 GHz spectrum
- Traditional “command and control” allocation methods often do not consider the need to maximise social welfare.
- As the economic importance of spectrum increases, the costs of not allocating spectrum increases - the returns to good spectrum management increase.
- Spectrum crunch has placed greater pressure on regulators to correctly balance demand for frequencies across an increasingly diverse set of competing uses.
- While governments have generally kept pace with spectrum demand by gradually increasing supply, more recently technological advances and market liberalisation have dramatically increased the rate of growth of spectrum demand.
- Going forward this is going to require more innovative solutions (eg spectrum relocation funds, increased efficiency in Government use of spectrum, and incentive auctions) to provide additional spectrum supply.

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## 2. Why auction spectrum? (1)

### Key benefits of auctions

Auctions are now commonly recognised as the best way of assigning key IMT spectrum. Benefits of auctions are well known to regulators globally.

- Auctions allow spectrum to be allocated to its **highest value use** and to the highest value set at a price that reflects opportunity costs.
- Auctions are **open and transparent**, are not subject to allegations of corruption, and can be verified by third party accountants.
- Auctions are **fair**, with award criteria open and known and bid/prices are not based on subjective criteria.
- Auctions can be **relatively quick** (compared to other methods such as a beauty contest where selection can drag on for long periods).
- Auctions allow the government to **extract the maximum value** of the spectrum through auction revenue, which can then be used for the public benefit.
- Auctions facilitate technology neutral use. Which means that the optimal technology (eg more efficient per GB delivered) can be deployed for the benefit of operators and consumers.



## 2. Why auction spectrum? (2)



### What are the downsides to using auctions?

There are downsides to using auctions. They may require additional preparation, expertise, resources, cost, etc. However, the advantages of using auctions far outweigh the disadvantages.

- Auctions will not achieve an efficient allocation in all circumstances. The auction design will influence the efficiency of the outcome achieved. **However**, the right auction design will ensure efficiency.
- Auctions are resource intensive for regulators and potential bidders.
- Auctions can require more preparation and are more complex. **However**, there is a lot of experience globally that can inform auction processes.
- Auctions are inappropriate for certain public spectrum, e.g. defense, emergency services, etc. It may also be inefficient for low value spectrum used for community access. **However**, it has proven to be the best method for high-value mobile spectrum.

## 2. Why auction spectrum? (3)

### Problem with “beauty contests” and other direct assignment methods

Beauty contest was effective when there was low demand for spectrum. However, as market has become more competitive and value for spectrum has increased, beauty contest has been seen as unfair/not transparent.

- In recent years spectrum demand has started to exceed supply, especially in key mobile spectrum bands. “Command and control” approach is no longer appropriate to allocate spectrum effectively.
- Risk of political process undermining efficient/effective allocation. Risk of legal challenge. Creates uncertainty for operators.
- Large body of economic literature points to benefits of spectrum auction. Beginning with Ronald Coase in 1959. Auctions allow spectrum to be assigned to highest best use. Transparent process with clear rules and outcomes.



## 2. Why auction spectrum? (4)

### Auctions are now the trend in Asia and Pacific

Auctions are now common throughout Asia Pacific, with the exception of Malaysia which still uses beauty contests. Hybrid methods also used for some allocations.

Country	Method of spectrum assignment
Australia	Auctions used for IMT spectrum, including most recent auction of digital dividend spectrum (including 700 and 2600 MHz) in 2013.
Hong Kong	Auctions used for IMT spectrum, including wireless broadband spectrum in 2009 and 2011. OFCA use a hybrid assignment for 3G spectrum.
India	Auctions for IMT spectrum including 2100, 900, 1800MHz etc (although some spectrum has previously been allocated on a first-come, first-served basis).
Indonesia	Assignment of 2.1 GHz 3G spectrum in 2006 and 2.3 GHz WiMax spectrum in 2009 via a prequalification and auction hybrid proces. Previously, spectrum has been allocated on a first come, first served basis.
Malaysia	Beauty contest used for IMT spectrum, with other spectrum allocated on a first-come, first-served basis. But considering moving to more price based spectrum allocation processes.
New Zealand	Auctions for IMT spectrum for many years.
Singapore	Recent 3G spectrum auctions for 1800 and 2100 MHz, with the regulator moving away from administrative allocation.

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### 3. Types of spectrum auction (1)

#### **An ideal auction format**

- Provides price discovery (bidders can respond to increases in price)
- ...while not subjecting bidders to exposure risk
- Is not too complex
- Is transparent
- Limits opportunities for strategic bidding

Therefore, maximising chance of an efficient allocation of spectrum to maximise the benefits to the Thai economy and society.

#### **Auction formats used globally**

- SMRA (simultaneous multiple round ascending)
- Clock auctions - ascending or combinatorial
- Sealed bid auctions



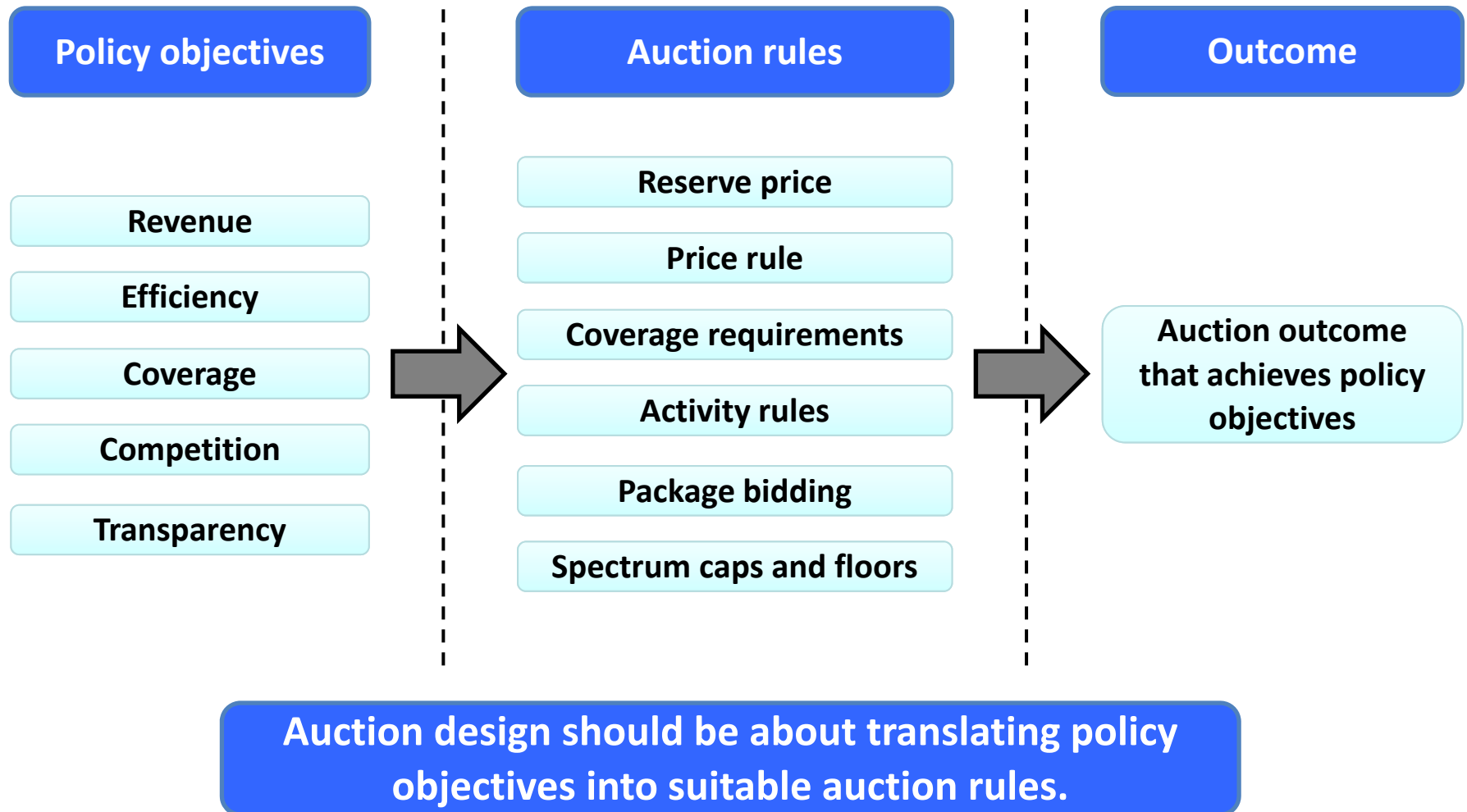
### 3. Types of spectrum auction (2)

#### Comparison of main auction types

<b>SMRA</b> Simultaneous multiple round ascending auction	<ul style="list-style-type: none"><li>• Bid on specific blocks of interest (between minimum and maximum set by auctioneer for each block)</li><li>• 'Standing high bids' for each lot in each round</li><li>• Auction ends when there is no excess demand</li><li>• 'First price' : pay what you bid</li></ul>
<b>CCA</b> Combinatorial clock auction	<ul style="list-style-type: none"><li>• Bid on packages of generic lots rather than on individual lots</li><li>• Pay 'second price' : minimum needed to win and to avoid 'unhappy losers'</li><li>• Separate assignment round for positioning in the band</li><li>• Also pay 'second price' for assignment</li></ul>
<b>Clock +</b> 'First price' CCA	<ul style="list-style-type: none"><li>• Bid on packages of generic lots rather than on individual lots</li><li>• Exit bids allowed (between last and current clock prices)</li><li>• First price: pay what you bid</li><li>• Auction ends when there is no excess demand</li><li>• Separate assignment process (auction or administered)</li></ul>
<b>Sealed bid auction</b>	<ul style="list-style-type: none"><li>• Bidders simultaneously submit sealed bids - no bidder knows the value of other bids</li><li>• Bidders submit one bid and cannot adjust based on competing bids</li><li>• 'First price' : pay what you bid (can use second price or shaded bid)</li><li>• No subsequent rounds of bidding</li></ul>

### 3. Types of spectrum auction (3)

Why should we worry about auction design?





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## 4. Thailand's spectrum auction experience (1)

### Thailand's spectrum management framework

Spectrum management in Thailand is governed by the *Act on Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services*. The amended Act provides for the establishment of the NBTC as the body responsible for planning and managing the radiofrequency spectrum and for the licensing of telecommunications and broadcasting services.

The Act specifies that spectrum licences are to be acquired through an auction, with transition arrangements providing that all persons assigned frequency prior to the Act shall be deemed licensed under the Act (Section 83).

Spectrum licences are not transferable under the Act (Section 46). This means there is a lack of flexibility, both with regard to the use of technology, which is prescribed in the spectrum licence, and the transferability of spectrum rights, which is prohibited under the Act.

The end of concession system and the move to normalise spectrum allocations has not been an easy one but I for one are quietly confident that key IMT spectrum will be returned to the NBTC. This is critical for the Thai economy given early delays in allocating 3G and other spectrum had a material impact on the Thai economy.

## 4. Thailand's spectrum auction experience (2)

### Thailand's 2012 auction of 2.1 GHz spectrum (1)

The NBTC designed the auction of 2x45 MHz spectrum to license nine spectrum blocks, each having the standard minimum amount of 2x5 MHz with the aim of allowing bidders to determine their desired amount of spectrum pursuant to market forces. The main conditions imposed were:

- Licenses issued under the auction had a duration of 15 years.
- Licences required holder to achieve 50% population coverage within two years of issue, and 80% within four years of issue. There were provisions for lesser requirements of 20% and 30% respectively if any bidders had secured only a single 2x5 MHz block, however this did not eventuate.
- A spectrum cap of 2x15 MHz per operator was also enforced for the auction.
- Successful bidders were also required to provide a minimum of 10% of their network capacity to MVNOs on request. This meant that even if the auction itself was not highly competitive, it would still have a positive effect on market competition at the retail level.

The NBTC elected not to impose asymmetric requirements (for example 5%) on bidders who received only a single 2x5 MHz block as the requirement to support MVNOs was generally not seen as a barrier to entry.

## 4. Thailand's spectrum auction experience (3)

### Thailand's 2012 auction of 2.1 GHz spectrum (2)

Format for the auction was a simultaneous multi-round ascending process. Only the three existing operators (AIS, Dtac and True) were qualified bidders. Final price paid was 3% above the reserve price of THB 40.5 billion. Total revenue raised was THB 41.63 billion (USD 1.36 billion).

In summary, the objectives and the outcome of the 2.1 GHz spectrum auction were consistent with international practice and achieved the goals of the NBTC in managing the radio spectrum resource. Namely:

- Spectrum licenses were efficiently and fairly assigned with minimal disruption and without legal challenges from the participants.
- The accompanying licenses incorporate helpful measures to improve competition through access to network capacity for MVNOs.
- The 2.1 GHz 3G licenses include provisions to benefit consumers by requiring price reductions of 15% in comparison to 2G services.
- Prices paid for spectrum by the winners compare reasonably with international benchmark prices for auctioned 2.1 GHz spectrum.

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## 5. Spectrum caps to promote competition (1)

### **Using spectrum caps to promote competition**

Regulators in many global markets implement spectrum caps and rules to avoid perceived spectrum hoarding by one or two major mobile operators. Key question for design of a spectrum auction is the appropriate cap (if any) to apply.

A large number of country markets are imposing, or considering imposing, caps for wireless broadband (including digital dividend spectrum), even where such caps were abolished or not favoured over the past few years.

Spectrum caps may have different characteristics relating to the penalties and conditions that may apply if the cap is breached, the spectrum cap threshold (which may be tight or loose depending on the regulator's concern regarding the potential for anti-competitive conduct) and other characteristics relating to applicability to particular bands and the durability of the cap.

Ensuring Competition is important – spectrum auctions just like beauty contests can favour the leading market player at the expense of other market participants.

Overall spectrum caps are being proposed here in Thailand.

## 5. Spectrum caps to promote competition (2)

### Different types of spectrum cap

Penalties of conditions	Spectrum cap threshold	Other characteristics
<b>'Hard' cap</b> Sets an absolute limit on the amount of spectrum an operator may hold.	<b>'Tight' cap</b> A spectrum cap with a low limit that could potentially be used to address the high risk of non-competitive market structures.	<b>Band-specific</b> A spectrum cap applying only to a particular spectrum band or bands.
<b>'Soft' cap</b> Sets a threshold amount of spectrum an operator may hold. If the operator exceeds the threshold, it may be subject to contingent licence conditions.	<b>'Loose' cap</b> A spectrum cap with a high limit used as a safeguard to prevent large concentrations of spectrum by a single operator.	<b>Event-related</b> A spectrum cap applicable only at the time of a spectrum award, allocation, acquisition, etc.
		<b>Durable</b> A spectrum cap that applies both at the time of allocation and for all subsequent reallocations, acquisitions, etc.

## 5. Spectrum caps to promote competition (3)

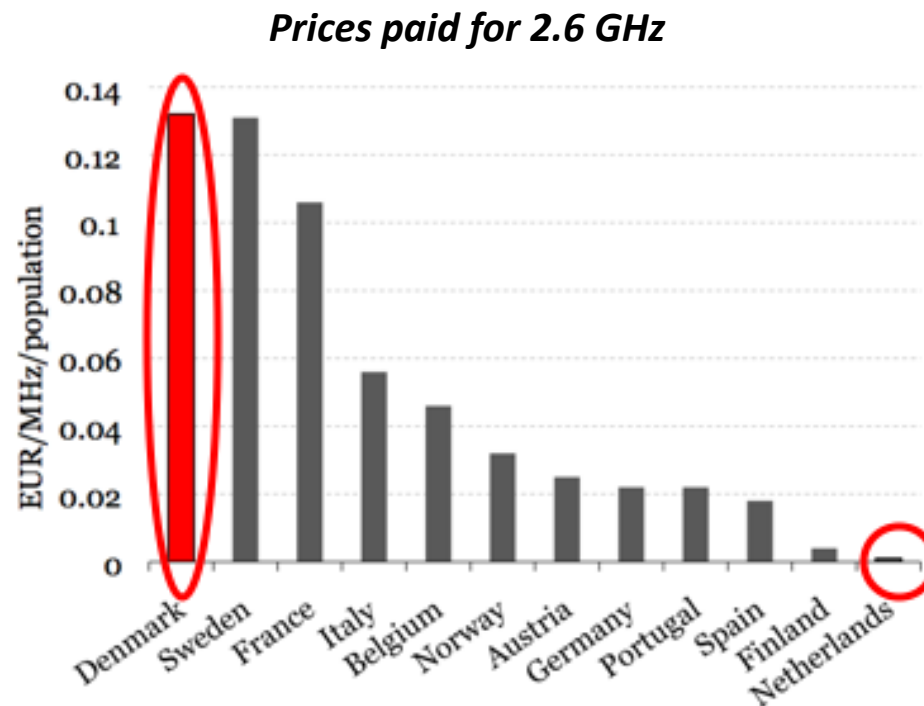


### Example: Dutch and Danish 2.6 GHz Auctions

Same auction format used (CCA), same band for sale, comparable countries.

Different choice of spectrum caps:

- Dutch auction: Very restrictive caps destroyed competition in the auction and meant that all spectrum was sold at reserve prices.
- Danish auction: Tight, but not too tight, caps in a competitive market meant that prices were high but that the smallest operator still won 2x10 MHz.





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## 6. Closing remarks

The overall aim of spectrum management is to maximise welfare by ensuring spectrum is used most efficiently and for the right purpose.



**As recently said at Communicasia, “Spectrum is the lifeblood of wireless services. It effects how we plan, build and optimise networks. To create economic opportunities, administrations must ensure spectrum is allocated to its highest value use. The best outcomes for the community are achieved when carriers and governments work together”. I echo that statement.**

Users have a high degree of certainty as to what, when and how critical spectrum will be made available in Thailand so that they can plan deployments, technologies, investments etc. Thai consumers like all global consumers are investing their own money in buying quality smartphones and other devices. They deserve high speed connectivity which needs usable and harmonised spectrum.

In this context, it is clear that spectrum auctions are the optimal way to allocate in-demand spectrum in the IMT bands. Having said, the release of spectrum should not be artificially reduced or we get too clever in the design of spectrum auctions that we maximise price returns for Government at the expense of efficient allocation.

In closing, for those involved in the upcoming Thai spectrums auctions good luck. To the NBTC I hope it goes smoothly and meet all of the objectives including revenue and competition set. To bidders, bid early and often!

# **Thank you**

**I am happy to answer any  
questions**