PSSR Award Stakeholder Event

5 Dec 2014

Agenda

14:00 – 14:30	Tea & coffee	
14:30 – 14:45	Welcome and overview	Andy Hudson
14:45 – 15:15	Auction design	Luis Gaspar
15:15 – 15:25	Synchronisation	Steve Leach
15:25 – 16:30	Questions	All

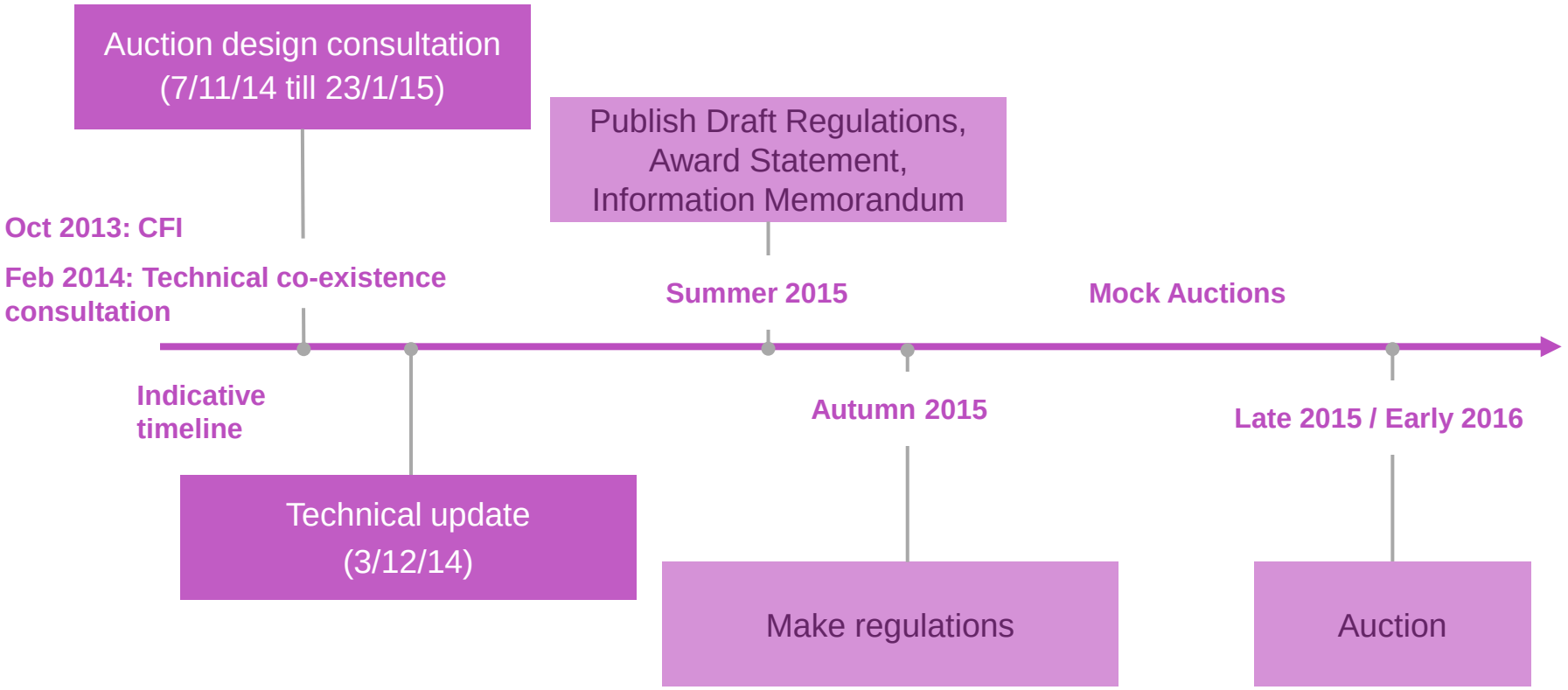
Overview

- Background
- Timeline
- Objectives
- Approach to auction design
- Proposal

Context: *Public Sector Spectrum Release Programme*

- Government has committed to make 500 MHz of sub-5GHz public sector spectrum available for civil use by 2020 (release or sharing)
- Part of a wider move to use market mechanisms to encourage the more efficient use of spectrum by public sector users
- The MOD, with Ofcom's support, are investing significant money and effort to move existing users and carry out technical studies
- We expect the 190 MHz in the 2.3 and 3.4 GHz bands to be valuable, particularly for mobile operators. Both bands are harmonised for mobile use
  - The 2.3 GHz band is likely to be of immediate use due to equipment availability
  - The 3.4 GHz band offers a large amount of contiguous spectrum

Indicative timescales



PSSR Award consultation

- Auction design
- Technical and non-technical licence conditions (including synchronisation)
- Competition measures
- Reserve prices

Also note our update on technical coexistence (3 Dec)

- Sets out the further work on WiFi / LTE in the 2.3 GHz band including
  - Further work around LTE user equipment (phones) and small cells
  - Field testing
  - Extensive stakeholder engagement
- The additional analysis supports our original proposals
  - Interference is unlikely, a range of mitigations are available
  - We are taking steps to ensure ISPs and manufacturers are aware of potential issues, but intervention in the market would be disproportionate

Objectives for the auction

Our duties relate to furthering the interests of consumers and citizens, taking into account:

Efficiency (efficient allocation, no unsold spectrum)

Competition (promote competition and innovation)

We also considered:

Simplicity (complexity must be proportionate to the problem you are trying to solve)

- transparency of prices and financial liability
- how to avoid unwanted partial packages
- how to respond if others engage in strategic bidding

Legitimacy (no regret, no envy, commercial certainty for operators)

Approach to auction design:

Considered a wide range of auction designs

There is no single 'best' auction design

There are inherent advantages and disadvantages of the two dominant auction formats, SMRA and CCA

- Selected preferred SMRA and CCA designs **for this particular auction**
- Optimised the designs based on the residual risks

Residual risks

1. **Ending up with unsold spectrum**
2. **Artificially low prices**
3. **Complexity in bidding for packages**
4. **Exposing bidders to governance difficulties**
5. **Exposing bidders to uncertain financial liability**
6. **'Surprise' or 'unfair' outcome**

Our proposal

- We have designed our proposals in each case to mitigate the potential disadvantages of each for **this particular award**
  - We believe both are robust designs and would deliver a good and efficient outcome
- However, for this particular auction, with two lot categories and a straightforward demand structure, **the SMRA is our preferred option**
  - It is simple to understand, bidders know exactly what they will pay if the auction ends and bidders always have the chance to bid back, so no surprise outcomes
  - We have the right policies to deal effectively with the residual risks of the SMRA in a way which renders the complexity and the uncertainty of the CCA unnecessary
- Our recommendation in this case for an SMRA should not be interpreted as a general endorsement for this format.
    - We have run CCAs successfully in the past, including the 4G auction

There are two particular areas to draw your attention to

Sections 4 and 5

We have made some assumptions about the structure of demand, reserve prices and information policy, for example:

- In order to make a decision on the auction format, we would like your views on our specific proposals, not general comments on SMRA vs. CCA
- We would like evidence to justify your position

Sections 9

- Your views on synchronisation

These will be covered in the next two sessions by Luis and Steve….

Auction Design

Auction design

- The following slides present Ofcom' s proposals for the PSSR auction, on which we are inviting views
- They focus on how the auction would work under those proposals

Stages of the Auction

Application Stage	Qualification Stage	Principal Stage	Assignment Stage	Grant Stage
• Potential bidders submit applications	• Determines who qualifies to bid in the auction	• Determines how much spectrum each bidder wins	• Determines the exact location of the frequencies won by the bidders	• Grants the spectrum

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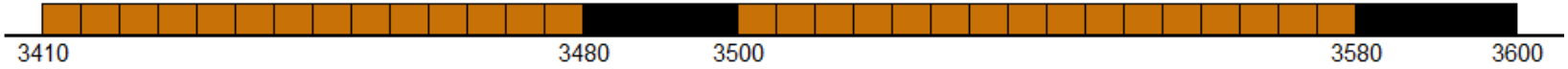
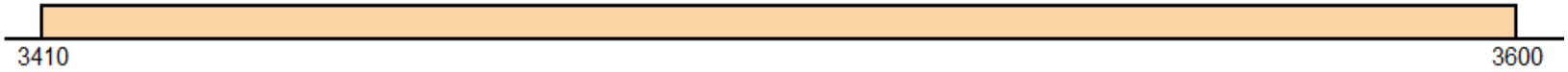
Principal Stage – Spectrum packaging

2.3 GHz band - eight 5 MHz lots



3.4 GHz band

Option A: thirty 5 MHz lots divided by current UKB holdings



Option B: thirty 5 MHz lots within 3410-3600 MHz range in the principal stage

The whole range will be available in the assignment stage

Other information

	2.3 GHz	3.4 GHz
Lot size	5 MHz	
Eligibility points	1 point per lot	
Reserve Prices	2.5 to 5 million GBP per lot	1 million GBP per lot

Spectrum caps	310 MHz of relevant spectrum holdings

Design

SMRA / CCA

- Most multi-band auctions in Europe were either an SMRA or a CCA
- We've tailored both formats for this particular award
- We've introduced some combinatorial elements in the SMRA
- We've attempted to make the clock stage in the CCA more indicative of final outcome

SMRA

- Bids for individual lots and at end of each round highest bids are Standing High Bids
  - Ranking rule guarantees that at most one bidder will be a Standing High Bidder on only a part of their bid in a given category in a given round
- Minimum requirement per band: up to 20 MHz
- Withdrawal rule: unlimited but bidder may be liable for the price of all lots withdrawn
- No information about level of aggregate demand
- Waivers: up to 3

SMRA – mechanics

- First round lots available at reserve price
- Bidders bid for a number of lots in each category
- If in a given category bids at round price are larger or equal to supply:
  - Bidders are randomly ranked and allocated their bids in turn
  - Price goes up in following round
- If not, price remains the same
- Point-based eligibility rule: demand may decrease or remain constant, never increase
- Final round: when there are no bids, no withdrawals and no waivers
- Standing High Bidders are winning bidders and pay as bid
  - Unless they are Standing High Bidders on less than their minimum requirement

SMRA – an example

Round 1 – 10

Bidder	Number of lots	Ranking Order
A	4	1
B	5	3
C	6	2
D	4	4

SMRA – an example

Round 2 – 11

Bidder	Number of lots	Ranking Order
A	0	-
B	4	2
C	6	3
D	4	1

SMRA – an example

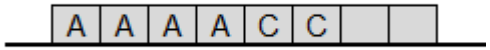
Round 3 – 12

Bidder	Number of lots	Ranking Order
A	4	1
B	0	-
C	2	2
D	0	-

SMRA – an example

Round 4 – 12

Bidder	Number of lots	Ranking Order
A	0	-
B	0	-
C	0	-
D	Withdraws	-



Auction goes on until there are no bids, no withdrawals and no waivers used

CCA

- Basic structure relatively similar to previous Ofcom auctions:
  - Combinatorial bidding: bids either accepted or rejected in their entirety
  - Partially open multiple-round clock stage and a sealed-bid supplementary bid round
  - Opportunity cost pricing
- New features:
  - Final Price Cap
  - Relaxed activity rule

CCA - mechanics

- Clock stage:
  - First round lots available at reserve prices
  - Bidders bid for packages of lots at given prices
  - When demand exceeds supply, price goes up in that category
  - Bids may exceed bidder's eligibility if relative prices changed in such a way as to make the bid consistent with preferences
  - Clock stage ends when demand does not exceed supply in any category
- Supplementary Bids Round:
  - Relative cap
  - Final Price Cap
- The combination of bids (maximum one per bidder) that maximises value wins. Bidders pay opportunity cost, similar to the 2013 auction

Relaxed Activity Rule – an example

Round	Price 2.3 GHz	Price 3.4 GHz	Bid
1	10	10	6A
2	11	10	4B
3	12	11	4B
4	13	12	4B
5	13	13	4B
6	14	14	4B
7	14	15	6A

2.3 GHz – Category A
3.4 GHz – Category B

Relative cap 6A =

Highest bid for 4B +

Price difference between 6A and 4B lots at round 2
Highest bid for 4 B (round 6) is 14 X 4 = 56
Price difference (round 2) is 11 X 6 – 10 X 4 = 26
Relative cap is therefore 82 = 56 + 26

A bid for 6 A lots in round 7 is worth 84 = 14 X 6
That means that bidder needs to increase highest bid for 4 B by 2 units to 58 – they will need to make a chain bid.
Given that price has increased to 15,

Final Price Cap

- Applies to any package other than Final Clock Package
  - Final Clock Package is the package the bidder was bidding on in the last clock round
- The Final Price Cap for any package P is equal to:
  - The highest bid placed on the Final Clock Package +
  - The difference in price between Package P and Final Clock Package at final clock round prices

Final Price Cap – an example

Round	Price 2.3 GHz	Price 3.4 GHz	Bid
Final	25	20	6A

2.3 GHz – Category A
3.4 GHz – Category B

- Final Clock Package is 6 lots of 2.3 GHz
- Let's suppose the bidder places a bid for 6 A lots at 250 in the Supplementary Bid Round
- In that case, Final Price Cap for a package with 6 A lots **and** 2 B lots is:
  - Highest bid for 6A: 250 +
  - The cost of 2 B lots at final clock round price: 40.
- The Final Price Cap for package (6,2) is therefore 290

Final Price Cap – properties

- Bidders may work out Knock-out bid that guarantees they win their Final Clock Package (except when final clock bid is a relaxed bid)
    - This means raising the bid for the Final Clock Package by at least the value of any provisionally unallocated lots at the final clock round prices **and**
    - Not increasing the value of any other packages above their price in the final clock round
- If there are no provisionally unallocated lots at the end of the clock stage, the allocation of packages will not change
- The final price cap therefore increases the predictability of the clock stage

Stages of the Auction

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Assignment Stage – 2.3 GHz band

- We will only consider assignment plans where all bidders are assigned contiguous frequency blocks
- Any unsold spectrum will also form a contiguous block
- Bidders will be invited to bid amongst the permissible assignment plans in a sealed-bid single round. We propose to apply an opportunity cost rule

Assignment Stage – 3.4 GHz band

- If UK Broadband participate in the auction and we are able to move their holdings in the 3.4 GHz band into a contiguous block, we propose a similar rule to the one we propose to apply to the 2.3 GHz band
- If UK Broadband do not participate in the auction, then:
  - If there are assignment plans in which each bidder is assigned a single contiguous frequency range, then only these assignment plans will be considered;
  - If there aren't any such assignment plans, we propose to prioritise assignment plans where no bidder who won at least 4 lots in this band is assigned any block of less than 20 MHz;
  - Of the remaining assignment plans, only those in which the number of winners receiving non-contiguous frequencies is minimised will be considered.
- Bidders will be invited to bid amongst the permissible assignment plans in a sealed-bid single round. We propose to apply an opportunity cost rule.

Synchronisation

Technical Licence Conditions

To Synchronise
or Not to Synchronise

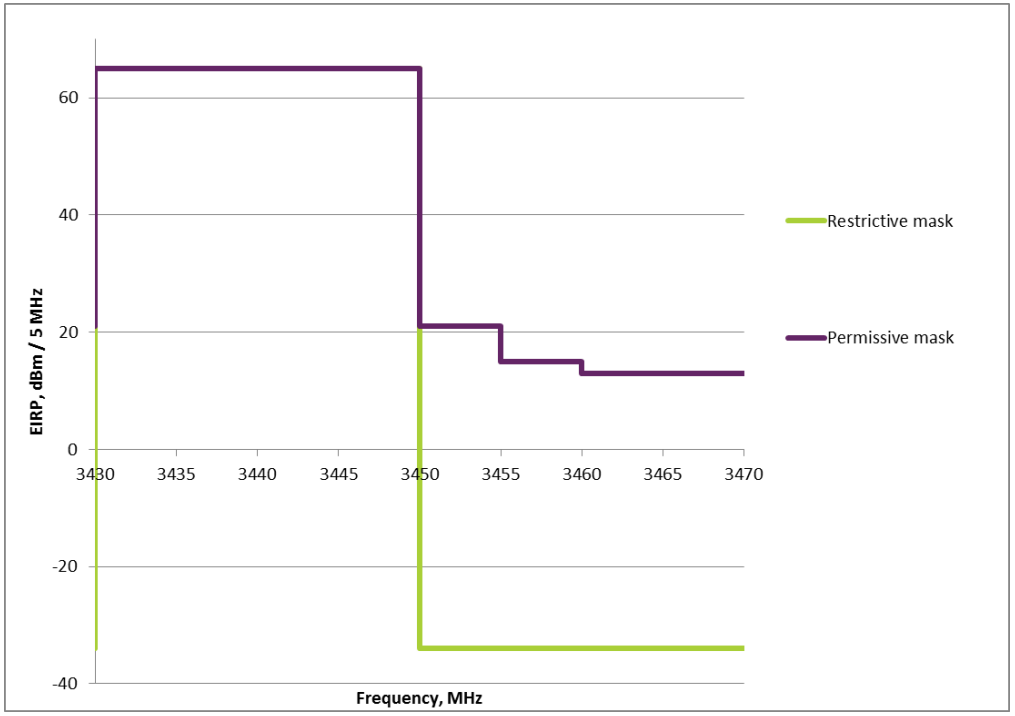
that is the question

and

Restrictive Masks vs Small Cells

Block Edge Masks

- We originally proposed two masks left to licensees to agree between themselves
  - Permissive – higher emissions – with agreement with other licensees
  - Restrictive – lower emissions – where there was no agreement



Consultation – See Section 9

- Condoc responses and follow up conversations with a number of stakeholders:
  - Efficient use of spectrum which means no delays
  - A desire to use global equipment
    - Difficulties with the practicality of the restrictive mask in some cases
    - Operators suggest this means they will need to synchronise
  - Optimising spectrum utilisation/efficiency
    - Guard bands in unsynchronised use may not be as efficient
  - Desire for flexibility in setting downlink and uplink ratios.

- As a result we are now proposing two options regarding synchronisation
  - Provide certainty in advance of the award
  - Details provided in an Inter-operator Synchronisation Procedure (which can be changed to allow additional flexibility).

The Options

- 1) Frame alignment only
  - If using a “preferred” 3:1 frame then can use permissive mask
  - If not then must use restrictive mask
  - Maintains flexibility but with some additional risks of interference

- 2) Identical frame structures:
  - Mandated to use “preferred” 3:1 frame in ALL circumstances
  - Permissive mask only
  - 1 up/down frame structure only

- And we propose:
  - Small indoor cells are exempt from synchronisation
  - Femto cells must have power control
  - Some tweaks to out of band emissions >2403 MHz in line with CEPT

Thank you for listening

We are now accepting questions