



Commission for  
**Communications Regulation**

## **Workshop**

### **3.6 GHz Band Spectrum Award**

## Purpose

- provide an overview of the entire Award Process
- walk through the auction stages of the Award Process from the perspective of a bidder
- explore the implications of the Main Stage auction rules for bidding decisions - Activity Rules, Supplementary Bids and the consequences of the rules for winner determination and pricing
- explain how Assignment Options for specific frequencies will be created and how bids can be made in the Assignment Stage for specific frequency ranges.



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**Communications Regulation**

## **Workshop**

### **3.6 GHz Band Spectrum Award**

# Agenda

Overview of the award process

*ComReg*

Q&A

Overview of the auction process

*DotEcon*

Q&A

Walk through the Main Stage

Coffee Break

*DotEcon*

Q&A

Walk through the Assignment Stage

*DotEcon*

Q&A

Next Steps

*ComReg*

Q&A

## Questions and Answers

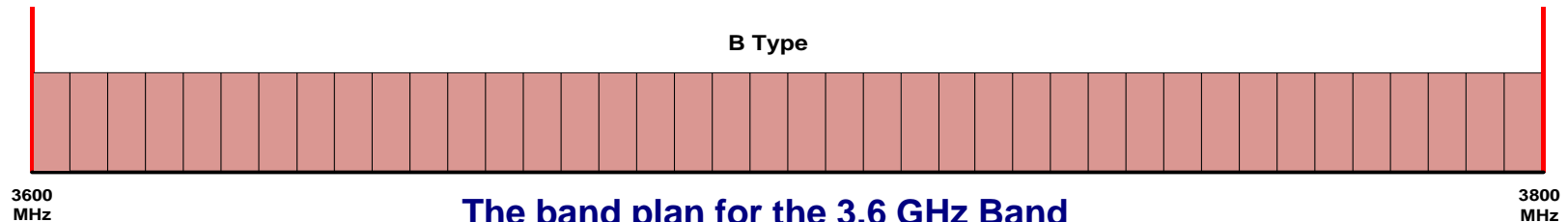
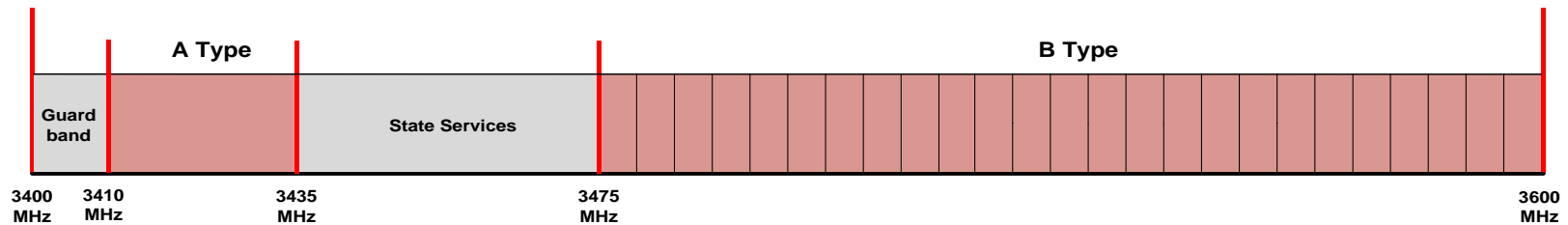


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## **Overview of the Award Process**










# The Spectrum

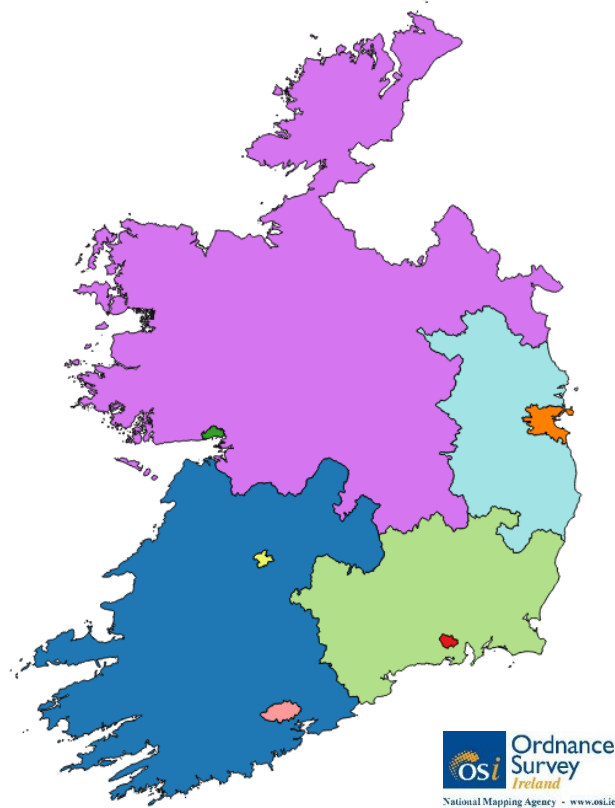
Frequency Band	Frequency range	Spectrum available	Lots available for award	Lot Type
3.6 GHz	3 410 – 3 435 MHz	25 MHz	1 x 25 MHz	A Type
	3 475 – 3 800 MHz	325 MHz	65 x 5 MHz	B Type



**The band plan for the 3.6 GHz Band**

# The Regions

-  Borders, Midlands and West
-  South West
-  East
-  South East
-  CSO boundary Dublin City & Suburbs
-  CSO boundary Cork City & Suburbs
-  CSO boundary Limerick City & Suburbs
-  CSO boundary Galway City & Suburbs
-  CSO boundary Waterford City & Suburbs



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## The Licence

### 3.6 GHz Band Liberalised Use licence

- Allows Licensee to use the spectrum (i.e. provide services)
- Contains licence conditions to facilitate co-existence, rollout, quality of service etc.
- Licences will commence on 1 August 2017 (or such other date as may be specified by ComReg) and shall expire on 31 July 2032
- Spectrum Fees will consist of an Upfront Fee which has a Reserve Price per Lot and an ongoing Spectrum Usage Fee (SUF). The amount of the SUF is already fixed whereas the amount of the Upfront Fee is determined by competition in the Auction.

Region	Reserve Price per A-Lot (€)	Reserve Price per B-Lot (€)
Border, Midlands & West	114,000	22,800
South-West	72,000	14,400
East	64,000	12,800
South-East	44,000	8,800
Dublin City & Suburbs	178,000	35,600
Cork City & Suburbs	34,000	6,800
Limerick City & Suburbs	16,000	3,200
Galway City & Suburbs	14,000	2,800
Waterford City and Suburbs	8,000	1,600

Reserve Prices per Lot per Region

### Spectrum Usage Fee (SUF)

- CSO Consumer Price Index-linked annual fee paid at defined intervals over the duration of the Licence. The first SUF is due prior to the initial grant of the Licence and subsequently payments are due prior to 1 August of each calendar year for the term of the Licence.

Region	Annual SUF before CPI Adjustment per A-Lot (€)	Annual SUF before CPI Adjustment per B-Lot (€)
Border, Midlands & West	17,670	3,534
South-West	14,400	2,232
East	12,800	1,984
South-East	8,800	1,364
Dublin City & Suburbs	35,600	5,518
Cork City & Suburbs	6,800	1,054
Limerick City & Suburbs	3,200	496
Galway City & Suburbs	2,800	434
Waterford City and Suburbs	1,600	248

Annual SUF before CPI adjustment per Lot per Region

## Award Process

- Application Stage
- Qualification Stage
- Main Stage
  - Primary Bid Rounds
  - Supplementary Bids Round
- Assignment Stage
  - Assignment Round
  - Negotiation Phase
- Notification & Grant Stage
- Transition phase

Auction Stages

## The Application Stage Timelines

Milestone	Timeline
Publication of Information Memorandum (16/71) on ComReg's website	24 August 2016
Presentation to Interested Parties on the Award Process and the Auction Rules	14 September 2016
Deadline for submission of questions regarding the Award Process	16:00 hours on Wednesday 28 September 2016
Final date for the responses to questions on the Award Process to be published on ComReg's website	Wednesday 12 October 2016
Application Date – deadline for receipt of Application Forms	16:00 hours on Wednesday 26 October 2016
Deadline for receipt of Deposits	23:59 hours on Wednesday 26 October 2016
Restriction on Auction-related communications comes into effect	On submission of first Application to ComReg

# Application Form

- The **Application Form** consists of three Parts.
- All Parts must be completed and must be signed as appropriate.

## Part 1: Administrative Information

- Requests administrative information (see Table 1 of Annex 3 of the Information Memorandum), including:
  - Appropriate evidence for signatory of Application (as per paragraph 3.38 of the Information Memorandum)
  - Ownership Structure Document (as per paragraph 3.41 of the Information Memorandum)

## Part 2: Applicant Declaration

- Requests the Applicant to agree to be bound by the Auction Rules
- Delete paragraph 17, if appropriate, regarding the Applicant entering into an Alliance in the Assignment Stage.

## Part 3: Initial Bid Form

- Requests the Applicant to specify the Lots that it is applying for in the Award Process.
- Additionally a monetary **Deposit must be submitted** with its Application Form.
- Sum of the Reserve Prices of Lots requested in its Initial Bid Form

## Award Process

- Application Stage
- Qualification Stage
- Main Stage
  - Primary Bid Rounds
  - Supplementary Bids Round
- Assignment Stage
  - Assignment Round
  - Negotiation Phase
- Notification & Grant Stage
- Transition phase

Auction Stages

## Qualification Stage Timelines

Milestone	Timeline
Deadline for withdrawal of Application	16:00 hours on Wednesday 16 November 2016
Each Applicant to be informed by ComReg about whether or not it has become a Bidder.	Wednesday 7 December 2016
Confirmation of the requirement for a Main Stage of the Auction and notification to Bidders of scheduled start date of the mock auctions; <u>or</u>	
Confirmation that there is no requirement for a Main Stage and notification to Winning Bidders of Winning Bids and scheduled start date of the mock auctions; <u>or</u>	
Confirmation that there is no requirement for a Main Stage or an Assignment Stage and notification to Winning Bidders of Winning Bids and progression to Notification and Grant Stage	
Return of Deposits to Applicants that have not become Bidders	14 December 2016
Circulation of Bidder Materials for accessing and using the EAS to Bidders and proceed to the start of Mock Auctions for Bidders	Week beginning 12 December 2016

## Later Stages Timelines

- The subsequent stages of the Award Process include:
  - Main Stage
  - Assignment Stage
  - Notification and Grant Stage (see section 3.7 of the Information Memorandum) and
  - Transition Phase (see section 3.8 of the Information Memorandum).
- ComReg will provide further information on the timings of subsequent stages to the appropriate parties (e.g. Bidders, Winning Bidders etc.) as and when it becomes available
- The timelines for these stages will be in accordance with the Information Memorandum





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## **Overview of the Award Process**

**Q&A**

# The Irish 3.6 GHz Band Spectrum Award

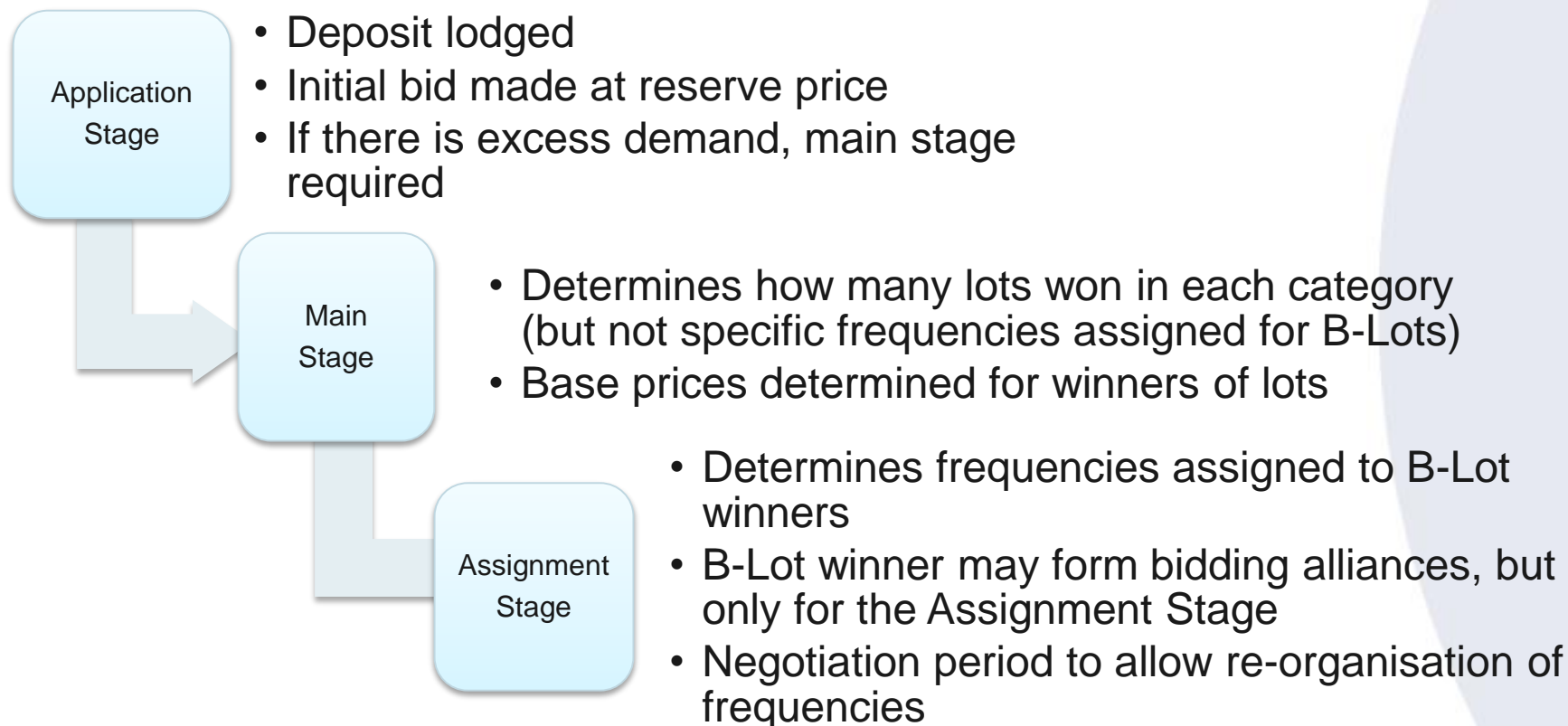
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Key features of the auction process

# Lot categories, eligibility points and reserve prices

	Region	A-Lots 25 MHz per lot 1 available per Region (3410 - 3435 MHz)		B-Lots 5 MHz per lot 65 available per Region (3475 - 3800 MHz)	
1	Border, Midlands and West	50 EP/lot	€114,000/lot	10 EP/lot	€22,800/lot
2	South West	25 EP/lot	€72,000/lot	5 EP/lot	€14,400/lot
3	East	25 EP/lot	€64,000/lot	5 EP/lot	€12,800/lot
4	South East	25 EP/lot	€44,000/lot	5 EP/lot	€8,800/lot
5	CSO Boundary for Dublin City and Suburbs	75 EP/lot	€178,000/lot	15 EP/lot	€35,600/lot
6	CSO Boundary for Cork City and Suburbs	10 EP/lot	€34,000/lot	2 EP/lot	€6,800/lot
7	CSO Boundary for Limerick City and Suburbs	5 EP/lot	€16,000/lot	1 EP/lot	€3,200/lot
8	CSO Boundary for Galway City and Suburbs	5 EP/lot	€14,000/lot	1 EP/lot	€2,800/lot
9	CSO Boundary for Waterford City and Suburbs	5 EP/lot	€8,000/lot	1 EP/lot	€1,600/lot

**No bidder may be awarded more than 150 MHz in any Region**



# The Main Stage

- Multiple Primary Bid Rounds ...
- Followed by a single Supplementary Bids Round
- In each Primary Bid Round, can bid for one package at prices per lot set by the auctioneer
- In the Supplementary Bids Round, can bid for multiple packages and choose the price bid (subject to constraints)
- All bidding through an electronic auction system

- Through the Main Stage, every bid is made for a package of lots, rather than individual lots
- Packages of lots will not be subdivided or broken apart
- Bidders can make many package bids over the course of the main stage ...
- ... but win at most one of these bids i.e. one of the packages bid for in its entirety, or nothing

- Each round, auctioneer will announce prices for each lot category
- Each round will start and finish at times notified by the auctioneer (expected duration 30 mins to 2 hrs, with a minimum of 30 mins between rounds)
- If bidding deadline missed, it will extend automatically for 30 minutes, but use up an extension right (of which bidders initially have two)
- At round end, bidders will be informed about the level of total demand for each category



# Price increases for categories with excess demand

- Round prices for each Primary Bid Round set by auctioneer (in units of €100)
- Round prices for the first round equal to reserve price plus a single price increment for any lot category for which there was excess demand in Initial Bids
- In subsequent rounds, price increased for any lot category for which there was excess demand in the previous round
- Price increase will not be more than 20% of the previous round price
- Primary Bid Rounds end when there is no excess demand in any category

# Constraints on Primary Round Bids

## Eligibility point 'safe harbour'

- Can bid for any package with Eligibility that does not exceed the bidder's eligibility at the start of the round
- Eligibility in next round will be reduced if a bidder bids for a package with fewer eligibility points than its current Eligibility

## Relaxed bidding provides additional flexibility

- It may also be possible to make a Relaxed Primary Bid for packages exceeding current Eligibility (and even Initial Eligibility) depending on how Round Prices have changed
- Requires consistency with bidding behaviour in previous eligibility-reducing Primary Bid Rounds (and Application Stage), which could require increasing the bid amount for other packages bid for in eligibility-reducing rounds (so-called Chain Bids)

## Stopping primary bids

- If a bidder submits a 'zero bid', its eligibility falls to zero and it will no longer be able to participate in the Primary Bid Rounds

- Single round in which Bidders can submit multiple package bids simultaneously
- Minimum 3 working days between the end of the Primary Bid Rounds and the start of the Supplementary Bids Round
- Auctioneer will announce start and finish times (between 9 am and 6 pm on a single working day)
- Bidders can add, delete or modify multiple package bids, including for packages that did not receive Primary Bids
- Bid amounts are specified by the bidder (subject to certain constraints set out in the auction rules)

# Constraints on Supplementary Bids

- Maximum of 1,000 distinct packages (including those subject to Initial Bid and Primary Bids)
- Bid amounts in units of €100
- No lower than the reserve price of the package
- No lower than the highest Primary Bid submitted for the package (if any)
- No higher than the applicable cap for the package:
  - based on prices in the final Primary Bid Round (**Final Price Cap**) and
  - any Primary Bid rounds in which a bidder reduced eligibility (the **Relative Caps**).
- Caps require that differences in bid amounts need to be consistent with value differences implied by choices in the final Primary Bid Round and eligibility-reducing rounds

# Determining winners and base prices

- Initial Bids, Primary Bids, and Supplementary Bids all taken to establish Winning Bids
- Algorithm looks for outcome with maximum value of accepted bids, subject to lot availability
- Base Prices calculated using an opportunity cost pricing rule ...
- ... with the property that Winning Bidders pay the minimum amount they could have bid and still won
- Bidders informed of Lots won by all bidders, and their individual Base Price

- Where a bidder's deposit has fallen to less than 50% of its highest bid so far, it may be required to increase its deposit to at least 50% and not more than 100% of its highest bid
- Following the Supplementary Bids Round (and before the notification of the Main Stage results), ComReg may require a bidder to increase its deposit to up to 100% of the highest bid it has submitted
- At least 3 working days will allowed for a deposit top-up to be made from notice being given

# The Assignment Stage

- Main Stage determines how many lots bidders win in each lot category and base prices
- B-Lots are frequency-generic at this point
- Assignment stage determines frequencies for winners of B-Lots only (A-Lots already have a specific frequency assignment)
- Winners will always receive a single frequency range in each region corresponding to the number of B-lots won
- Winners will pay an Additional Price for specific frequencies



- Winning Bidders will be given 10 working days following the end of the Main Stage in which to form any Alliances:
  - An Alliance is a group of Winning Bidders that have agreed to participate in the Assignment Stage as one
  - The Assignment Stage will initially proceed as if the Alliance members were a single entity awarded the total number of B-Lots in each Region awarded to the group
- Each Alliance must notify ComReg of:
  - the identity of each Winning Bidder included in the Alliance;
  - the identity of a nominated “Leading Member”
- A Winning Bidder may be part of at most one Alliance
- An Alliance will not be allowed if the total spectrum to be awarded to the Alliance would exceed the spectrum cap of 150 MHz in any region

Only open to bidders having won B-Lots in the Main Stage

- Determines provisional assignment of specific frequencies to Assignment Bidders
- Assignment Bidders can be Alliances or individual Winning Bidders

Bids made for Assignment Options for frequency locations

- Various possible frequency locations determined for each Assignment Bidder prior to start of bidding in the Assignment Round

Single bidding round

- At least 2 clear working days between notification of Assignment Options and the start of the Assignment Round
- Auctioneer will announce start and finish times for bidding between 9am and 6pm on a single working day, with the Assignment Round lasting at least 2 hours

## Bidders will be given Assignment Options

- Based on number of B-Lots won by different Assignment Bidders
- Requirement that assignments are contiguous in each Region
- An Assignment Bidder awarded the same number of B-Lots in every Region is awarded the same frequencies in each Region
- For other Assignment Bidders, the frequency assignments are aligned across Regions to the maximum extent (potentially using unsold lots as padding)
- Unsold lots form a contiguous block where possible (subject to previous requirements)

## Bidders can express preference for specific assignments

- A bidder may submit bids for multiple assignment options, expressing preferences across its options, but will win exactly one option
- The bid amount associated with each assignment bid is discretionary (units of €1)
- The minimum bid amount for an Assignment Option is €0
- No obligation to submit assignment bids: zero bid will be generated automatically by the system if no positive bid for an Assignment Option is received

# Deposit calls after the Assignment **dot**•econ Round

- Following the Assignment Round (and before the notification of the Assignment Round results) ComReg may require a bidder to increase its deposit up to an amount that covers its Base Price and the highest Assignment Bid it submitted.
- For an Alliance:
  - it is the Base Price and current deposit of the Leading Member that will apply in the calculation of deposit requirements
  - the Leading Member is responsible for paying any deposit top-up (although Alliance members are jointly and severally liable)
- At least 3 working days will allowed for a deposit top-up to be made from notice being given

- Winning assignment bids and Additional Prices will be determined
  - Frequency assignments and Additional Prices apply to Assignment Bidders (who might be Alliances or individual Winning Bidders)
  - Alliance members will need to decide amongst themselves how their frequencies and additional price should be split (payment of Additional Prices is the responsibility of the Leading Member)
- Outcome of the Assignment Round will be notified to the Winning Bidders
  - Identity of winning Assignment Bidders in the Assignment Round
  - Specific frequency ranges assigned to each Assignment Bidder
  - Additional Prices applying to winning assignment bids
- The outcome of the Assignment Round establishes the Provisional Frequency Plan

- Commences on announcement of Assignment Round results and will run for 10 working days
- Assignment Bidders may negotiate a re-organisation of the frequency assignments above state services (relative to the Provisional Frequency Plan) in any given Region:
  - All parties must receive the same amount of contiguous spectrum within the Region as before the re-organisation
  - All other assignment bidders must unaffected
- Any re-organisation is subject to the approval of ComReg
- Additional Prices established in the Assignment Round will still apply
- Leading Members of each Alliance must inform ComReg of the specific frequency assignments to be awarded to each Alliance member

- Final Frequency Plan established on the basis of the Provisional Frequency Plan and any accepted re-organisation of frequency assignments
- Bidders will be informed (on release of final results) of:
  - the identity of the Winning Bidders;
  - the frequency ranges awarded to each Winning Bidder in each Region;
  - the Base Price to be paid by each Winning Bidder; and
  - any Additional Price for specific frequency assignments to be paid by each Assignment Bidder.
- Award Process will proceed to the Notification and Grant Stage

# Q&A



# The auction from a bidder's perspective

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Main Stage

- *We will discuss some possible bid strategies, but this is not a recommendation to bid in any particular way*
- *Potential bidders should conduct their own analysis of bidding strategies and business cases for spectrum*
- *You will see some screenshots of preliminary software, but these are subject to change and the final version may differ*

# Approaches to bidding in a CCA

- CCA allows bidders to make **multiple bids**
  - Single bids in response to changing Round Prices in the Primary Bid Rounds
  - Multiple bids at prices chosen by the bidder (but subject to constraints) in the Supplementary Bids Round
- For each bidder, **at most one** of these bids will be winning
- Bidders can bid flexibly, expressing their **relative willingness** to accept **alternative** packages of spectrum

# Package bidding and aggregation risks

- Package bidding eliminates the possibility of winning some, but not all, lots wanted...
- ... which creates risks when there are synergies
  - For example, 1 lot is worth 10, but 2 lots worth 30
  - What if I bid for 2 lots at 12 per lot, but only win one?
- Synergies could arise naturally for a bidder
  - Seeking multiple lots to deploy high-bandwidth services
  - Deploying across multiple regions

- A bidder will **never pay more than it bid** for the package it wins
- Each and every lot must **cover its Reserve Price** to be allocated (it is as if there were a pretend bidder for each lot bidding at the Reserve Price)
- Prices are determined by **opportunity cost** – what **other** bidders would be prepared to pay for the lots allocated to a winning bidder on the basis of the bids they have made
- Therefore, what a winner pays is determined by the extent of **competition from other bidders**

# No regrets properties of winner determination and pricing rule

- **Happy losers** –the winners pay prices such that no bidders could propose an alternative outcome (in terms of who gets what and what they pay) that:
  - would be preferable to these bidders given the valuations of packages indicated by their bids and
  - provides the same or greater revenue to the seller
- **Happy winners** – collectively the winners are paying the least possible subject to still winning what they win; if they paid any less, there would be unhappy losers

# Straightforward bidding at value is **dot**•econ typically an attractive strategy

- Bidding less than value risks losing at a price you might have wanted to win at ...
- ... but typically\* if you do still win, it will not reduce the price paid, as this depends on what everyone else bids

*Caveat:(\*) There are some cases in which you might reduce what you pay by bidding less, but this is very difficult to predict and does not happen often given typical structure of valuations in spectrum auctions*



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- ... but typically\* if you do still win, it will not reduce the price paid, as this depends on what everyone else bids
- Suppose that you bid above value for a package and win it when you would have lost or won something else had you bid at value. Then you will pay a sufficient amount that you would prefer to have lost or won something else.

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- ... but typically\* if you do still win, it will not reduce the price paid, as this depends on what everyone else bids
- Suppose that you bid above value for a package and win it when you would have lost or won something else had you bid at value. Then you will pay a sufficient amount that you would prefer to have lost or won something else.
- Bidding above value for packages you lose can sometimes increase the amount other winners pay, but if it has such an effect then it typically risks winning a unwanted package

*Caveat:(\*) There are some cases in which you might reduce what you pay by bidding less, but this is very difficult to predict and does not happen often given typical structure of valuations in spectrum auctions*

# Making primary bids

# What do the Primary Bid Rounds **dot**•econ do?

- Primary Bid Rounds reveal information about aggregate demand for - and potential relative pricing of - different lot categories
- Bidders can respond to changing round prices by switching target lots to seek better value
- To a limited extent, bidders may be able to update (or at least validate) their assumptions about the value of different alternatives
- The Primary Bid Rounds finish with a possible feasible outcome (as demand does not exceed lot availability), but this might not be efficient (e.g. because of unsold lots)

- We need activity rules to stop bidders from ‘hiding in the grass’ and avoiding declaring their hand until late in the auction
- Activity rules provide **flexibility to switch** between different packages ...
- ... but also require bidders to make decisions that are **consistent** with some stable underlying valuations for different packages

## Aside: consistent bidding to a set of valuations

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- Package A has a valuation of 20 and a price of 10
- Package B has a valuation of 40 and a price of 25
- At these prices, would chose Package B as it has the largest surplus ( $15 = 40 - 25$ )
- If the price of Package B rose to 35, but the price of Package A remained at 10, then Package A would be preferable
- If the price of Package A were above 20 and that of Package B above 40, then would prefer to get nothing

# Aside: consistent choice and revealed preference

- We don't know what values a bidder ascribes to Package A and Package B
- Suppose Package A cost 10 and Package B cost 25. The bidder chooses Package A
- Infer that value of Package B to that bidder is no more than 15 greater than the value of Package A
- Suppose that at a later round Package A cost 20 and Package B cost 40. If the bidder were to choose Package B now, this would be inconsistent with its previous revealed preference
- Suppose instead that Package A cost 20 and Package B cost 30. Bidding for Package B could now be consistent with previous choice, as the price difference has narrowed

- Eligibility points define a 'safe harbour'
  - You can bid for any package with eligibility not exceeding your current Eligibility
  - If you do not drop Eligibility, then there are no constraints on future (primary or supplementary) bids arising from your current decision provided the Primary Bid Rounds continue
- Bidding less than your current Eligibility creates consistency constraints on future bids
  - Your Eligibility to make Primary Round Bids is reduced
  - Certain subsequent Relaxed Primary Bids and Supplementary Bids will need to be **consistent** with the choice expressed in this round (**relative caps**)



# Relative caps and eligibility reductions in Primary Bid Rounds

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- Suppose I have Eligibility 100 and bid in round R for a package X with eligibility 80
- I might be able to bid subsequently for a package with eligibility  $>80$  as a **Supplementary Bid** or a **Relaxed Primary Bid**
- If I bid subsequently for a package Y with eligibility of more than 80 and less than (or equal to) 100, my bid for Y will be capped relative to my bid for X (the **constraining package**) to require consistency with my choice to drop down to package X in round R
- **Relative cap:** the difference can't exceed the price difference between Y and X in round R

# Final Primary Bid Round and Final Price Cap

- The Primary Bid Rounds stop when there is no excess demand in any category
- The final primary bid determines constraints on the Supplementary Bids that can be made for other packages
- ... by assuming that you were bidding on whatever package you preferred in the final Primary Bid Round
- **Final Price Cap:** Supplementary Bid for a package X can't exceed what I bid for the Final Primary Package plus the price difference between X and the Final Primary Package in the final round

# Entering Primary Round Bids in the EAS

- Used for entering, checking and submitting bids
- Manages round deadlines
- Communications from auctioneer
- Uses standard web-browser and does not require any special software
- Digital certificates used for authentication as well as passwords

# Logging in to the auction system **dot.econ**



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## 3.6 GHz Band Spectrum Award

**Please enter your password:**

Log in

By accessing this system you consent to all activity being logged.

The EAS uses session cookies to manage login sessions, and therefore you need to consent to the use of cookies by the auction server in order to be able to use the EAS. No personal data or bid decision data is stored in these cookies. By logging in to this system, you consent to the session management cookie being set on your computer.

If you do not grant consent to the setting of such session cookies, then you should not log in to this system. You may not access this system without granting such consent, as session cookies are necessary to providing secure access.

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WebBidder

- Bid submission is always a two-step process
- Making a bid requires first entering a decision which is checked by the EAS for compatibility with the auction rules
- The EAS acknowledges the bid and asks for confirmation that the bid should be submitted

# Example bid entry form

## Round 2 in progress

- Please enter your Bid for round 2

Round: 2  
 Start time: 08 September 2016 15:32 BST  
 Duration: 3 minutes  
 End time: 08 September 2016 15:35 BST

### Selection

Lot Category	Frequency range	Region	Lot size	Eligibility Points per Lot	Lots available	Round Price in round 2	Your demand in round 2	Eligibility by Lot Category	Expenditure by Lot Category
A1	3410 - 3435 MHz	Borders, Midlands and West	25MHz	50	1	€136,800	1	50	€136,800
B1	3475 - 3800 MHz	Borders, Midlands and West	5MHz	10	65	€27,360	15	150	€410,400
A2	3410 - 3435 MHz	South West	25MHz	25	1	€86,400	1	25	€86,400
B2	3475 - 3800 MHz	South West	5MHz	5	65	€17,280	10	50	€172,800
A3	3410 - 3435 MHz	East	25MHz	25	1	€76,800	0	0	€0
B3	3475 - 3800 MHz	East	5MHz	5	65	€15,360	0	0	€0
A4	3410 - 3435 MHz	South East	25MHz	25	1	€44,000	1	25	€44,000
B4	3475 - 3800 MHz	South East	5MHz	5	65	€8,800	10	50	€88,000
A5	3410 - 3435 MHz	Dublin City & Suburbs	25MHz	75	1	€178,000	0	0	€0
B5	3475 - 3800 MHz	Dublin City & Suburbs	5MHz	15	65	€35,600	0	0	€0
A6	3410 - 3435 MHz	Cork City & Suburbs	25MHz	10	1	€34,000	0	0	€0
B6	3475 - 3800 MHz	Cork City & Suburbs	5MHz	2	65	€6,800	0	0	€0
A7	3410 - 3435 MHz	Limerick City & Suburbs	25MHz	5	1	€16,000	0	0	€0
B7	3475 - 3800 MHz	Limerick City & Suburbs	5MHz	1	65	€3,200	0	0	€0
A8	3410 - 3435 MHz	Galway City & Suburbs	25MHz	5	1	€14,000	0	0	€0
B8	3475 - 3800 MHz	Galway City & Suburbs	5MHz	1	65	€2,800	0	0	€0
A9	3410 - 3435 MHz	Waterford City & Suburbs	25MHz	5	1	€8,000	0	0	€0
B9	3475 - 3800 MHz	Waterford City & Suburbs	5MHz	1	65	€1,600	0	0	€0

Reset

Check

# Entering a number of lots

## Round 2 in progress

- Please enter your Bid for round 2

Round: 2  
 Start time: 08 September 2016 15:32 BST  
 Duration: 3 minutes  
 End time: 08 September 2016 15:35 BST

### Selection

Lot Category	Frequency range	Region	Lot size	Eligibility Points per Lot	Lots available	Round Price in round 2	Your demand in round 2	Eligibility by Lot Category	Expenditure by Lot Category
A1	3410 - 3435 MHz	Borders, Midlands and West	25MHz	50	1	€136,800	1	50	€136,800
B1	3475 - 3800 MHz	Borders, Midlands and West	5MHz	10	65	€27,360	15	150	€410,400
A2	3410 - 3435 MHz	South West	25MHz	25	1	€86,400	1	25	€86,400
B2	3475 - 3800 MHz	South West	5MHz	5	65	€17,280	10	50	€172,800
A3	3410 - 3435 MHz	East	25MHz	25	1	€76,800	0	0	€0
B3	3475 - 3800 MHz	East	5MHz	5	65	€15,360	0	0	€0
A4	3410 - 3435 MHz	South East	25MHz	25	1	€44,000	✓ 1	25	€44,000
B4	3475 - 3800 MHz	South East	5MHz	5	65	€8,800	10	50	€88,000
A5	3410 - 3435 MHz	Dublin City & Suburbs	25MHz	75	1	€178,000	0	0	€0
B5	3475 - 3800 MHz	Dublin City & Suburbs	5MHz	15	65	€35,600	0	0	€0
A6	3410 - 3435 MHz	Cork City & Suburbs	25MHz	10	1	€34,000	0	0	€0
B6	3475 - 3800 MHz	Cork City & Suburbs	5MHz	2	65	€6,800	0	0	€0
A7	3410 - 3435 MHz	Limerick City & Suburbs	25MHz	5	1	€16,000	0	0	€0
B7	3475 - 3800 MHz	Limerick City & Suburbs	5MHz	1	65	€3,200	0	0	€0
A8	3410 - 3435 MHz	Galway City & Suburbs	25MHz	5	1	€14,000	0	0	€0
B8	3475 - 3800 MHz	Galway City & Suburbs	5MHz	1	65	€2,800	0	0	€0
A9	3410 - 3435 MHz	Waterford City & Suburbs	25MHz	5	1	€8,000	0	0	€0
B9	3475 - 3800 MHz	Waterford City & Suburbs	5MHz	1	65	€1,600	0	0	€0

Reset

Check



# Making supplementary bids

# What does the Supplementary Bids Round do?

- Cannot assume the outcome at the end of the final Primary Bid Round is necessarily the efficient outcome
- Bidders might not have bid on other packages of interest during the Primary Bid Rounds, but can in the Supplementary Bids Round
- Winner determination algorithm sifts through all these alternatives to look for efficient outcome
- Possible to increase final primary bid to a level that guarantees winning one's Final Primary Package (see Annex 7 of the IM)

# Bidding in the Supplementary Bids Round

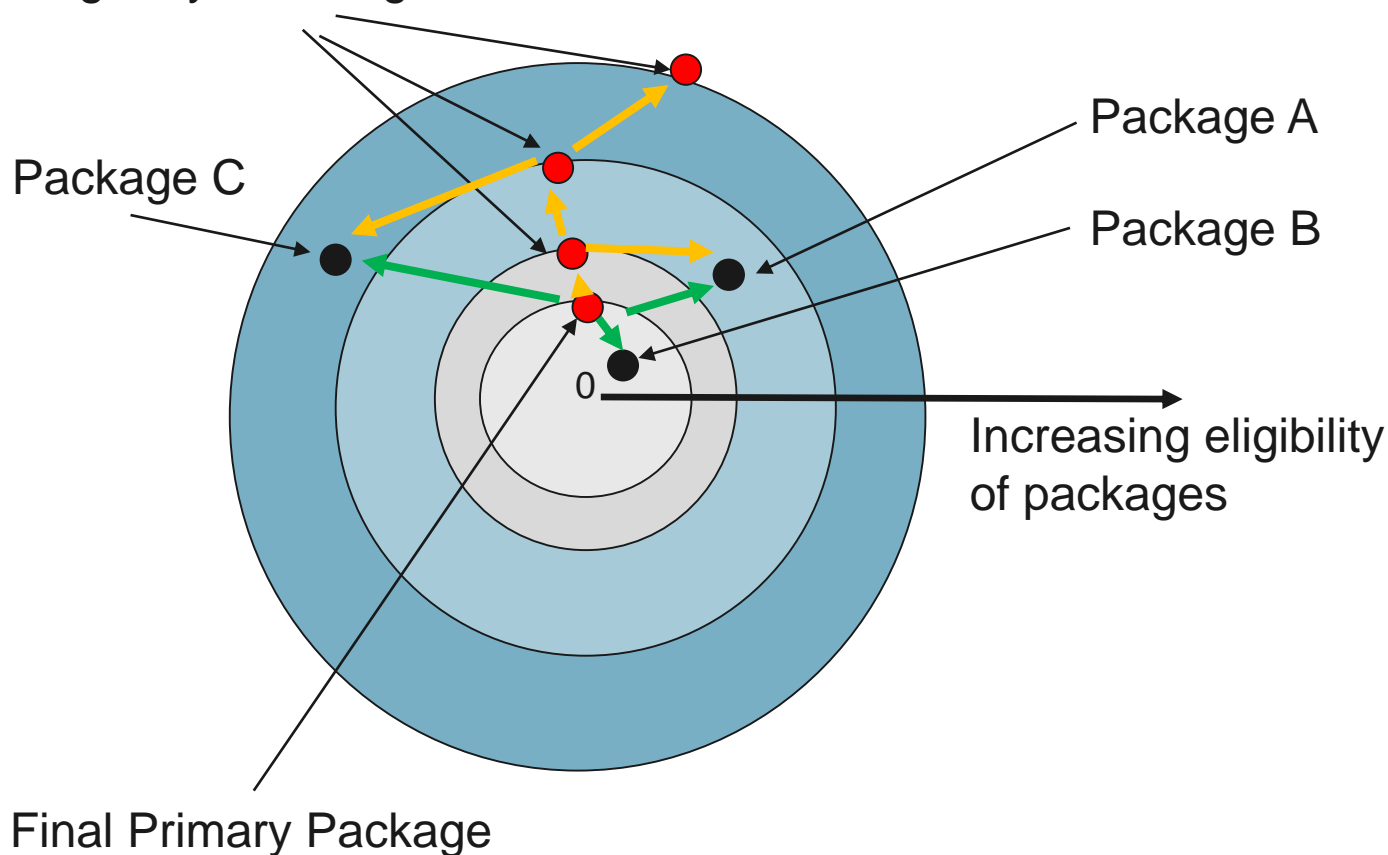
- Submit a list of package bids
  - Can bid for packages not bid for in Primary Bid Rounds
  - Can increase bids made in Primary Bid Rounds
  - EAS allows list of packages to be assembled prior to or during the Supplementary Bids Round
  - Initial Bid and Primary Bids automatically entered into the list
- Bid amounts discretionary subject to constraints
- EAS provides up to date information on bid amounts and constraints that apply to aid bidding

# Constraints on Supplementary Bids

Relative caps in orange

Final Price Caps in green

Packages chosen in eligibility reducing rounds



# Consequences of Final Price Cap **dot•econ**

- Risk of Primary Bid Rounds finishing creates incentive to bid for most preferred package
- Final Price Cap limits the differentials that can be bid for packages other than the Final Primary Package, so need to be careful not to finish bidding on a package which is not preferred at the final Round Prices, otherwise will be constrained in the Supplementary Bids that can be made
- Final Price Cap limits what rivals can bid in the Supplementary Bids Round to shift away from their Final Primary Packages, which creates the possibility of guaranteeing winning your own Final Primary Package through a knock-out bid

- Increase the bid for the Final Primary Package by the value of any unallocated lots at the end of the Primary Bid Rounds at the final Round Prices (plus €100 to avoid ties) ...
- ... and don't increase bids for any other packages above their price in the final Primary Bid Round
- Somewhat more complex if finish with a Relaxed Primary Bid (see Annex 7 of the IM)
- Caveat: default on a deposit call might affect the effective number of unallocated lots at the end of the Primary Bid Rounds

# Some pointers for making Supplementary Bids

- Hopefully bidding for preferred package at the end of Primary Bid Rounds
- Can lock in this package with a knock-out bid provided the bid amount below valuation, otherwise could increase to valuation
- If not guaranteeing Final Primary Package, consider making bids for back-up options ...
- ... with bid differentials reflecting relative valuations

# Entering supplementary bids in the EAS



# EAS facilitates management of supplementary bids

- The EAS maintains a list of packages that might be subject to Supplementary Bids
  - Automatically includes all Primary Round Bids and the Initial Bid
  - Can add packages to this list
  - Can edit list
  - Download/upload functionality for offline bid creation
- EAS shows constraints on Supplementary Bids and updates these as the auction progresses
- List can be used as a starting point for making bids during the Supplementary Bids Round

# Supplementary bids editing

## The Supplementary Bids Round is in progress

- Please enter your decision for the Supplementary Bids Round

Start time: 08 September 2016 16:09 BST  
Duration: 10 minutes  
End time: 08 September 2016 16:19 BST

6 packages in package list

Add package

### Selection

Package ID	A1	B1	A2	B2	A3	B3	A4	B4	A5	B5	A6	B6	A7	B7	A8	B8	A9	B9	Eligibility associated with package	Package Reserve Price	Highest Bid Amount	Relative Cap	Constraining Package UID	Modify	Total price	Delete
8	0	15	1	10	1	12	0	0	0	0	0	0	0	0	0	0	0	0	310	€775,600	€974,496	Not capped	N/A	<input type="checkbox"/>	€1,000,000	N/A
3	1	15	1	15	1	15	0	0	0	0	0	0	0	0	0	0	0	0	400	€1,000,000	€1,000,000	€1,000,000	2	<input type="checkbox"/>	€1,000,000	N/A
2	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	360	€870,400	€870,400	€981,360	5	<input type="checkbox"/>	€870,400	N/A
6	1	15	1	10	1	12	0	0	0	0	0	0	0	0	0	0	0	0	360	€889,600	€1,098,480	€1,098,480	5	<input type="checkbox"/>	€1,098,480	N/A
5	1	15	1	10	0	0	1	10	0	0	0	0	0	0	0	0	0	0	350	€804,000	€969,360	€1,078,228	8	<input type="checkbox"/>	€969,360	N/A
12	0	0	1	20	1	20	1	15	0	0	0	0	0	0	0	0	0	0	350	€856,000	N/A	€1,127,280	8	<input type="checkbox"/>	€860,000	<input type="checkbox"/>

Export options: [CSV](#) | [Excel](#) | [Bids File](#)

Add

Reset

Check

### Upload a Supplementary Bids file

Select the file you wish to upload, then upload the file by clicking "Upload Bids". The file can be either tab separated (tsv) or comma separated (csv), all other formats will be rejected by the system.

SB file

Bids file to upload:  No file chosen

Clear existing Bids in your list of provisional Supplementary Bids before uploading ☐

Upload Bids

## Making relaxed primary bids

- May be able to bid for package exceeding current Eligibility in certain circumstances depending on evolution of Round Prices
- Provides greater opportunity for bidders to bid for their most preferred lots than the eligibility rule alone
- Based on the idea of 'revealed preference'
- No obligation to submit Relaxed Primary Bids
- Relaxed Primary Bids are nothing other than a rule allowing you to make a valid Supplementary Bid now rather than waiting

# When are Relaxed Primary Bids possible? **dot.econ**

- RPBs can only be made if Round Prices have evolved such that the bid is compatible with revealed preferences
- A bid at current Round Prices must be possible within the relevant relative caps created by previous eligibility reductions
- Put simply, if a package you switched away from becomes relatively cheaper later, you can switch back

- A RPB may be made for package X at current Round Prices if it is permissible to make bids on all relevant constraining packages that
  - conform to the relative caps; and
  - do not exceed current Round Prices
- Bids required on constraining packages at minimum levels necessary to satisfy the relative caps are termed Chain Bids
- Example:
  - RPB for package X at current Round Prices
  - Constraining package Y that the bidder is currently eligible to bid for (so Y is not subject to a further relative cap)
  - Relative cap sets floor on bid for package Y, which will result in a Chain Bid if the current highest bid for Y is not sufficiently high
  - If floor above current price of Y, RPB not currently possible
- This is a similar process as occurs with making supplementary bids, where there may be constraining packages whose bids need to be raised to permit a bid at a certain level

- EAS will assist in identifying packages for which RPBs may be possible in the current round
- On checking an RPB any associated Chain Bids will be notified to the bidder
- The rules on RPBs are formulated such that bidders are not penalised if they fail to make an RPB and the Primary Bid Rounds continue
- However, if the Primary Bid Rounds stop, then constraints arise on Supplementary Bids
- If a bidder is not bidding on its most preferred package in the final Primary Bid Round, it may find itself unable to make Supplementary Bids at its valuations

# Making a relaxed primary bid

## Round 3 in progress

- Relaxed primary bid possible
- Please enter your Bid for round 3

Round: 3  
 Start time: 08 September 2016 15:50 BST  
 Duration: 10 minutes  
 End time: 08 September 2016 16:00 BST

### Selection

Lot Category	Frequency range	Region	Lot size	Eligibility Points per Lot	Lots available	Round Price in round 3	Your demand in round 3	Eligibility by Lot Category	Expenditure by Lot Category
A1	3410 - 3435 MHz	Borders, Midlands and West	25MHz	50	1	€150,480	1	50	€150,480
B1	3475 - 3800 MHz	Borders, Midlands and West	5MHz	10	65	€27,360	15	150	€410,400
A2	3410 - 3435 MHz	South West	25MHz	25	1	€103,680	1	25	€103,680
B2	3475 - 3800 MHz	South West	5MHz	5	65	€17,280	10	50	€172,800
A3	3410 - 3435 MHz	East	25MHz	25	1	€76,800	1	25	€76,800
B3	3475 - 3800 MHz	East	5MHz	5	65	€15,360	12	60	€184,320
A4	3410 - 3435 MHz	South East	25MHz	25	1	€55,000	0	0	€0
B4	3475 - 3800 MHz	South East	5MHz	5	65	€11,000	0	0	€0
A5	3410 - 3435 MHz	Dublin City & Suburbs	25MHz	75	1	€178,000	0	0	€0
B5	3475 - 3800 MHz	Dublin City & Suburbs	5MHz	15	65	€35,600	0	0	€0
A6	3410 - 3435 MHz	Cork City & Suburbs	25MHz	10	1	€34,000	0	0	€0
B6	3475 - 3800 MHz	Cork City & Suburbs	5MHz	2	65	€6,800	0	0	€0
A7	3410 - 3435 MHz	Limerick City & Suburbs	25MHz	5	1	€16,000	0	0	€0
B7	3475 - 3800 MHz	Limerick City & Suburbs	5MHz	1	65	€3,200	0	0	€0
A8	3410 - 3435 MHz	Galway City & Suburbs	25MHz	5	1	€14,000	0	0	€0
B8	3475 - 3800 MHz	Galway City & Suburbs	5MHz	1	65	€2,800	0	0	€0
A9	3410 - 3435 MHz	Waterford City & Suburbs	25MHz	5	1	€8,000	0	0	€0
B9	3475 - 3800 MHz	Waterford City & Suburbs	5MHz	1	65	€1,600	0	0	€0

- Relaxed primary bid selected

Summary of minimum Bids for Constraining Packages required and Chain Bids

Package ID	A1	B1	A2	B2	A3	B3	A4	B4	A5	B5	A6	B6	A7	B7	A8	B8	A9	B9	Eligibility associated with package	Highest Bid Amount	Price of package in current round	Required Bid Amount	Requires Chain Bid	
5	1	15	1	10	0	0	1	10	0	0	0	0	0	0	0	0	0	0	0	350	€938,400	€1,002,360	€969,360	true

Reset

Check



# Importance of understanding the **dot**·econ business case

- We have seen that the CCA allows bidders to keep alternative packages of interest in play, switch around and then allow the auction mechanism to select whichever turns out better value
- To make use of this flexibility, it is important to have in mind target packages and business case valuations for these
- Bidding on most preferred packages against fixed valuations will never be constrained by the activity rules

# Q&A

# The 3.6 GHz auction from a bidder's perspective

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Assignment options and  
bidding in the Assignment Round

- Auction rules recognise that some winners of B-lots may have interests in common frequencies across regions (or other forms of frequency coordination)
- Bidders are permitted to form Alliances in the Assignment Stage, subject to not exceeding the spectrum cap in any region
- Any coordination of decisions or communication amongst bidders prior to the Assignment Stage would be a breach of the auction rules

- Bidders can bid in the main stage safe in the knowledge that within each region, any B-lot frequencies won will be assigned as a **single frequency block**
- A bidder winning the same number of B-lots in every region will have a further guarantee to receive the **same frequencies in each region**
- Otherwise, winners will be given options that
  - Typically provide some measure of choice about the frequency location in the band
  - Try to minimise misalignment in frequencies allocated to a winner in different regions
- Annex 9 of the IM sets out the details of how assignment options are determined using an algorithmic approach

# Informal description of algorithm to create Assignment Options **dot•econ**

Step 1: Split the band up between bidders to avoid “untidy ends”, splitting recursively until we get down to single bidders. Use this to create orderings of bidders within the band that are “tidy”.

Step 2: Use any unsold lots as ‘padding’ to see if overall alignment of frequencies can be improved

# Step 1: Defining 'untidy ends'

- Untidiness metric is **Regional Bandwidth Variation (RBV)**, defined for a bidder or group of bidders to be
  - The greatest number of B-lots assigned in a region less
  - The smallest number of B-lots assigned in a region
- Example with 2 regions
  - Bidders 1 has 6 B-lots in region 1 and 2 B-lots in region 2.  
**Bidder 1 has RBV of 4**
  - Bidders 2 has 2 B-lots in region 1 and 6 B-lots in region 2.  
**Bidder 2 has RBV of 4**
  - Together, **Bidders 1 and 2 have RBV of zero**

	Bidder 1						Bidder 2	
Region 1								
Region 2								

# Step 1: Creating a tree of bidders **dot**•econ by recursive splitting

- Split set of all bidders into smaller groups (a ‘partition’) so that the total RBV of all the groups is as small as possible
- Take each of these groups and split to minimise the total RBV ...
- ... and so on ...
- until the groups are reduced to single bidders
- This process has the effect of organising the bidders into a tree



- Simplified example with three bidders and four regions

	Bidder <sub>1</sub>	Bidder <sub>2</sub>	Bidder <sub>3</sub>	Unassigned
Region <sub>1</sub>	3	7	0	0
Region <sub>2</sub>	4	5	1	0
Region <sub>3</sub>	3	5	1	1
Region <sub>4</sub>	4	3	3	0

# Possible partitions of bidders

Cases with lowest  
Total RBV of 2

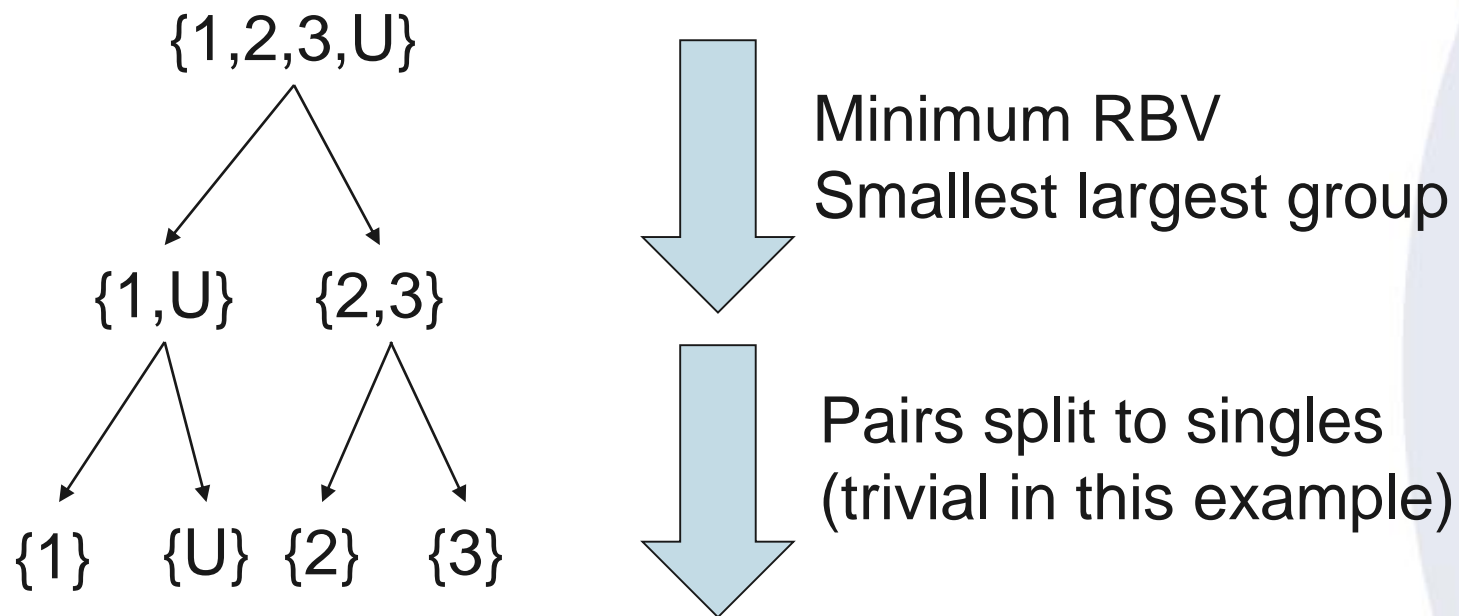
Tie break rule:

- Greatest number of groups
- Smallest largest group
- Random

{1}, {2,3,U}	{1}, {2}, {3,U}
{2}, {1,3,U}	{1}, {3}, {2,U}
{3}, {1,2,U}	{1}, {U}, {2,3}
{U}, {1,2,3}	{2}, {3}, {1,U}
{1,2}, {3,U}	{2}, {U}, {1,3}
{1,3}, {2,U}	{3}, {U}, {1,2}
{1,U}, {2,3}	{1}, {2}, {3}, {4}
{2,3}, {1,U}	
{2,U}, {1,3}	
{3,U}, {1,2}	

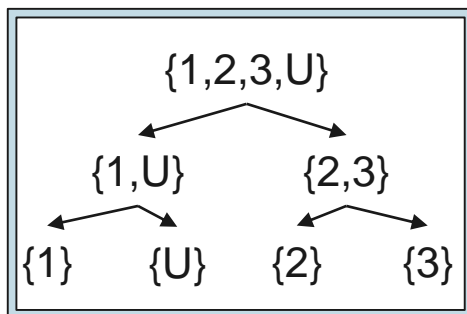
Largest group of size 2,  
so take this one

# Tree of successive splittings

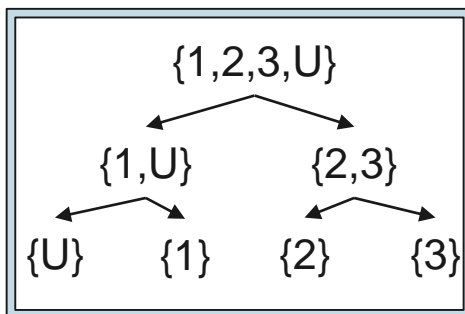
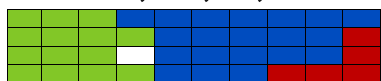


# Swapping order of branches

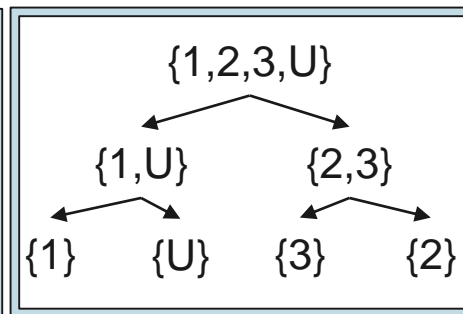
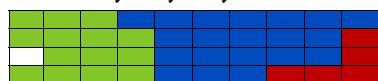
dot.econ



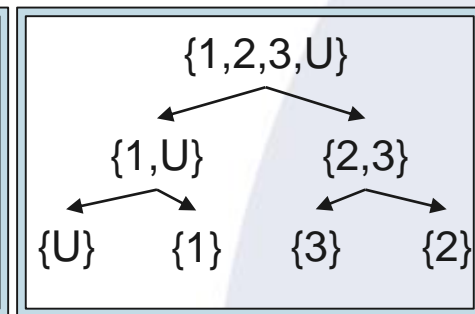
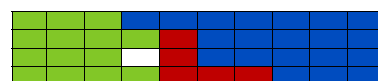
1,U,2,3



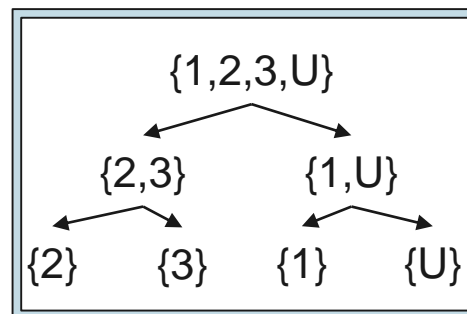
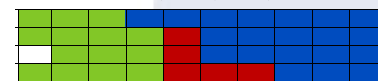
U,1,2,3



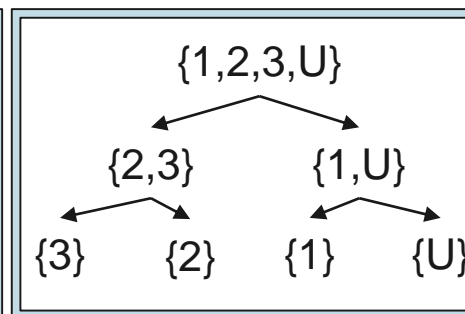
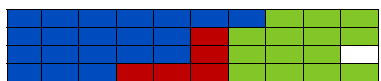
1,U,3,2



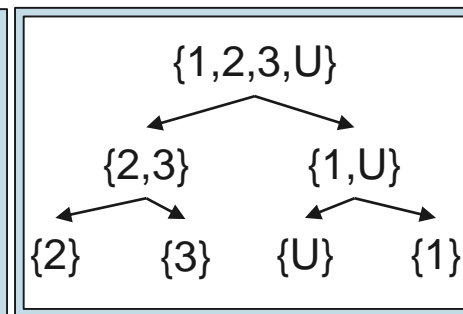
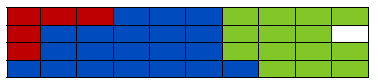
U,1,3,2



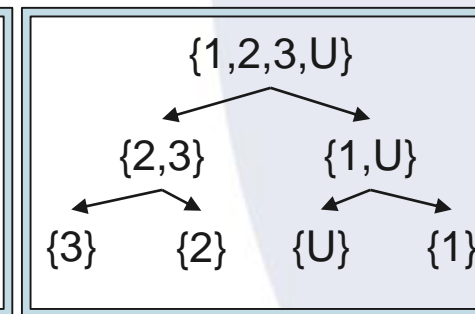
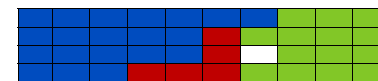
2,3,1,U



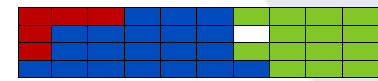
3,2,1,U



2,3,U,1



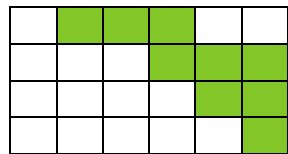
3,2,U,1



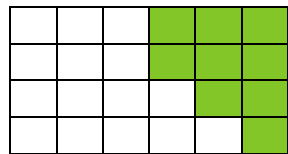
Creates only 8 of the possible 24 orderings of 4 bidders

## Step 2: Using unsold lots to improve frequency alignment

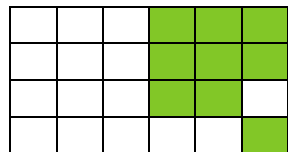
- Measuring frequency misalignment for a bidder:
  - Number of frequency blocks in which a bidder has a lot in a least one region, less
  - The maximum number of frequency blocks in any region



Misalignment = 2



Misalignment = 0

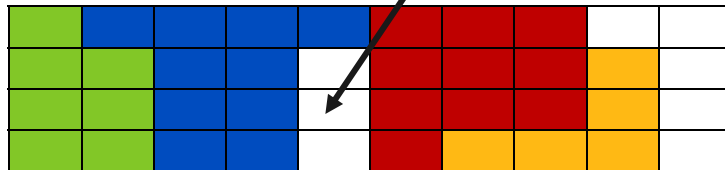


Misalignment = 0

## Step 2: Example of moving unsold blocks to improve alignment



$$0 + 0 + 1 + 0 = 1$$



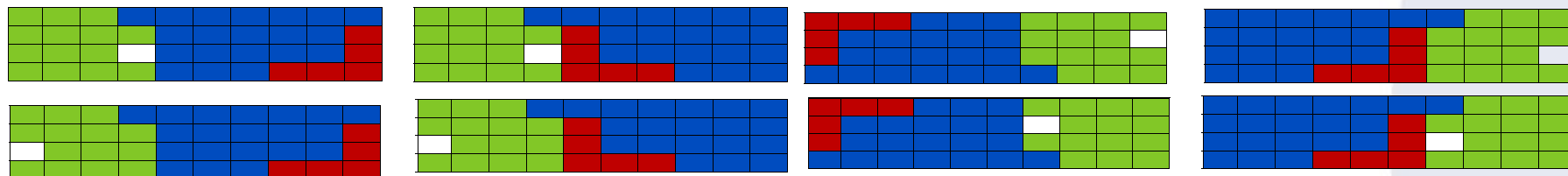
$$0 + 0 + 0 + 0 = 0$$

Unallocated lots only moved to the extent this reduces misalignment

- Generate various orderings of bidders in the band using Step 1 (recursive splitting)
- Step 2: For each option created at Step 1, move unsold lots if this can reduce total misalignment
- For each bidder, the Assignment Options are the various positions they might be in within the band

# Options for Bidder 3 (Red)

Return to Example 5 in Annex 9



Zero misalignment on all band plans

4 assignment options presented to Bidder 3



- Bid for Assignment Options should reflect *relative* preference for different frequency outcomes
- All that matters for determining winners (and additional prices) is the *differences* between a bidder's bids for its Assignment Options, as it will always win exactly one
- For example, adding €100m to all assignments make no different at all – except for deposit calls!
- Therefore, least favoured option can be left at zero, and bids for other options be made

- Additional Prices are determined by opportunity cost (i.e. how others value the option you win)
- Cannot exceed amount of winning assignment bid
- Therefore, for similar reasons as the main stage, bidding less typically will not reduce the price paid, but may result in not winning

# Q&A



Commission for  
**Communications Regulation**

**Workshop**

**3.6 GHz Band Spectrum Award**

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**Next Steps**

## Next steps

- The webinar recording, the presentation materials and any substantive clarifications will be made available on the ComReg website in due course.
- The process for submitting questions on the Award Process is set out in section 3.3.1 of Document 16/71
- The Application Procedure is set out in section 3.3.6 of Document 16/71

Milestone	Timeline
Deadline for submission of questions regarding the Award Process	16:00 hours on Wednesday 28 September 2016
Final date for the responses to questions on the Award Process to be published on ComReg's website	Wednesday 12 October 2016
Application Date – deadline for receipt of Application Forms	16:00 hours on Wednesday 26 October 2016
Deadline for receipt of Deposits	23:59 hours on Wednesday 26 October 2016
Restriction on Auction-related communications comes into effect	On submission of first Application to ComReg

Thank you