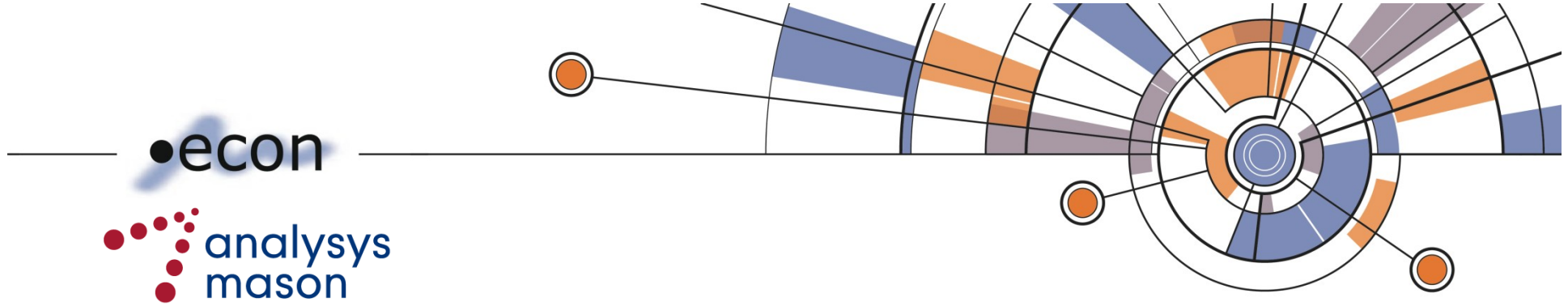


Auction of the 2.5GHz and 2010MHz bands: consultation seminar 26 August 2009

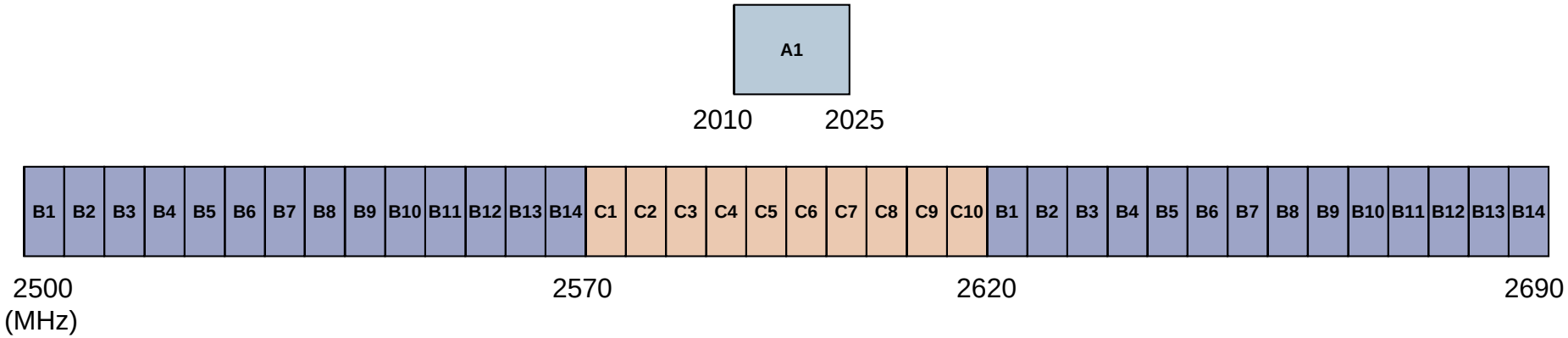
Presented by DotEcon and Analysys Mason on behalf of the National IT and Telecom Agency

Available spectrum and licence conditions

Spectrum to be auctioned

- There are three categories of lots being auctioned:

Category	Band	Description
A	2010MHz	15MHz of spectrum auctioned as a single lot
B	2.5GHz paired	2500-2570MHz paired with 2620-2690MHz, divided into 14 lots of 2x5MHz separated by 120MHz
C	2.5GHz unpaired	2570-2620MHz, divided into 10 lots of 5MHz



- Bidders that win lots in the same category are guaranteed to be assigned contiguous spectrum
- Bidders that win lots in multiple categories will be awarded one licence for each category

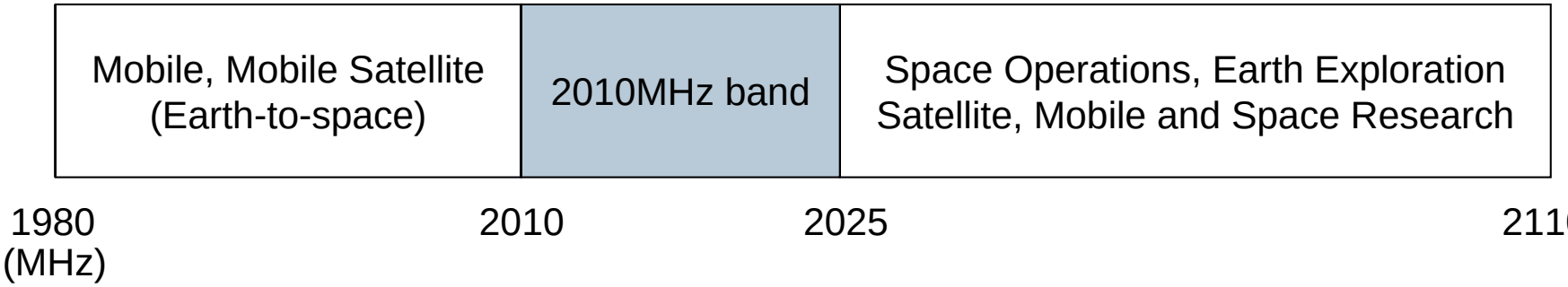
Spectrum cap

- A cap applies to all spectrum being auctioned
- The cap is expressed in the form of eligibility points
- Initial eligibility is capped at 9 points per bidder, sufficient to buy:
  - four 2.5GHz paired (B) lots plus the 2010MHz lot (A)
  - all 2.5GHz unpaired (C) lots plus the 2010MHz lot (A)
  - any sub-set of these two packages or any other combination of A, B and/or C lots with combined eligibility ≤ 9 points
- The cap is designed to:
  - enable bidders to win sufficient spectrum to provide communication services efficiently
  - stimulate a competitive market development after the auction
- The cap only applies in this auction; it does not affect your ability to trade lots *after* the auction (which will be subject to the trading rules of the new Frequency Act)

Licence conditions and general regulation

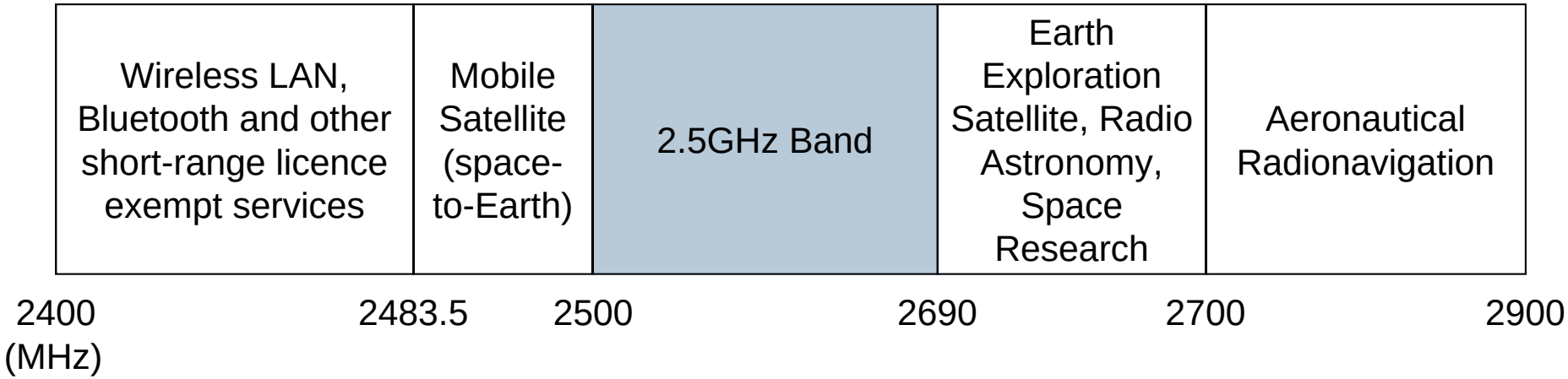
- Licence conditions
  - All licences will be for 20 years with no option for extension
  - Prior to the auction the bidders will be required to sign the auction terms (due to provisions of 3G Act)
  - All licences will be nationwide, covering land territory plus inner and outer territorial waters (12 nautical miles from the baseline)
  - All licences will be service and technology neutral
  - There will be no coverage obligations
- General regulation e.g.
  - Network sharing is not regulated and is not subject to NITA's prior approval, but is subject to the requirements of competition law
  - Licensees will be required to provide financial, statistical, frequency-related, and other information to assist NITA in preparing reports, statistics etc.
  - Licensee and their employees will be required to keep secret all communications made over any network that uses licensed spectrum

2010MHz Band – technical conditions



- The 2010MHz Band is clear and is available for use immediately
- The maximum mean transmitted power in-band (2010.5-2024.7MHz) is:
  - +61dBm/(5MHz) EIRP for the downlink
  - +31dBm/(5MHz) TRP for the uplink
- The block-edge mask (BEM) is as described in CEPT Report 19
- International coordination arrangements are described in the Information Memorandum (published on NITA's website)

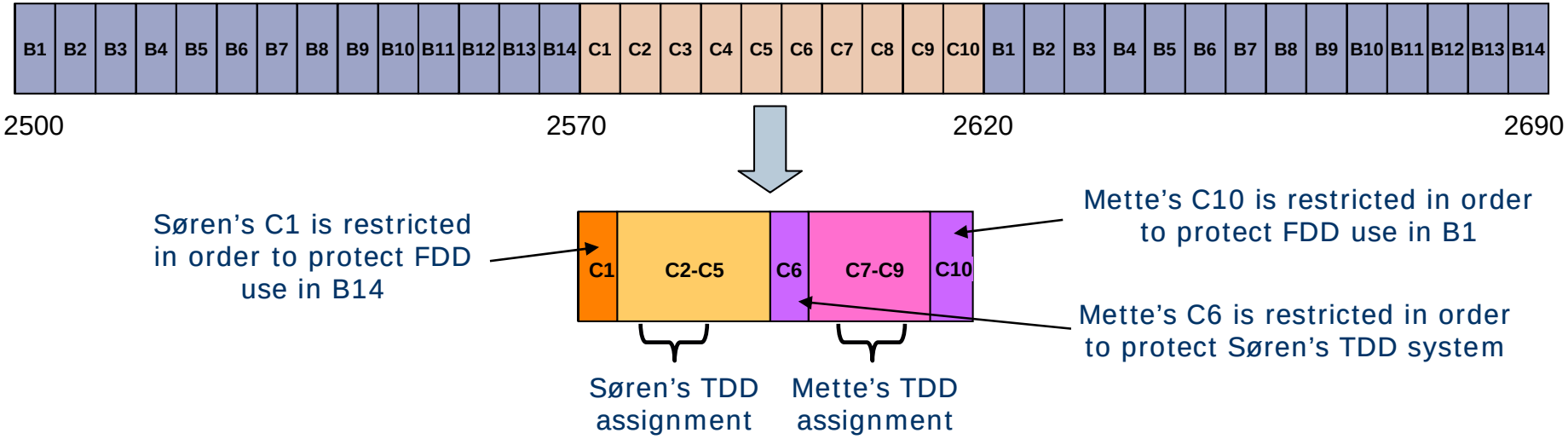
2.5GHz Band – technical conditions



- The 2.5GHz Band will be cleared and available for use by the new licensees from the date of licence issue
- The maximum mean transmitted power in-band and the BEM are as described in CEPT Report 19 and the European Commission's 2.5GHz Decision
- Note, however, that some unpaired lots (C) are categorised as restricted, and are subject to special conditions
- International coordination arrangements are described in the Information Memorandum

2.5GHz Band – restricted unpaired blocks

- Some unpaired lots (C) are restricted:
  - those adjacent to spectrum used for FDD operation (i.e. C1 and C10)
  - one lot between spectrum blocks used for uncoordinated TDD systems (i.e. between allocations to different licensees)
- C10, which is always restricted, is **not** included in the bidding phase of the award but is assigned as part of the licence for adjacent unpaired lots
- The lowest 5MHz lot assigned to each winning bidder of unpaired spectrum is also restricted
- For example, if Søren won C1-C5 and Mette won C6-C10:
  - Søren's C1 would be restricted; C2-C5 would be unrestricted
  - Mette's C6 and C10 would be restricted; C7-C9 would be unrestricted



2.5GHz Band – maximum transmitted power

- The maximum mean transmitted power in **unrestricted** lots (paired or unpaired) is:
  - +61dBm/(5MHz) EIRP for the downlink
  - +31dBm/(5MHz) TRP for the uplink
- The maximum mean transmitted power in **restricted unpaired** lots is:
  - +25dBm/(5MHz) EIRP for the downlink
  - +31dBm/(5MHz) TRP for the uplink

Payment terms and costs

Payment terms

- The licence price will be paid in instalments:
  - an initial payment of 20% is payable on completion of the assignment stage
  - a deferred payment of 80% payable in eight equal annual instalments, starting on first anniversary of licence issue
- Bidders shall provide a demand guarantee for a third of the maximum agreed penalty that may be imposed on the Bidder for violating the auction rules
- Bidders will also be required to provide a cash deposit or a demand guarantee for the deposit
- A winning bidder's deposit will be used to offset the initial payment if the deposit was paid in cash
- Winning bidders will be required to provide a rolling guarantee for the deferred payment which must be:
  - payable on demand to NITA
  - issued by a bank or an insurance company which:
    - does not control the bidder, nor is controlled by the bidder nor is controlled by a person who controls the bidder,
    - is registered in the EEA
    - has, as a minimum, a long-term Debt A rating from Standard & Poors or A2 from Moody's
  - for an amount equal to the total instalments payable over next 36 months or, if shorter, that due in remaining period

Recovery of costs for organising and implementing the auction

- NITA will charge licensees a fee to cover its costs, currently estimated at DKK15 million in total
- Costs will be allocated in proportion to licence prices
- For example:
  - Søren wins a single licence for 2×20MHz paired spectrum
  - Søren's licence price is DKK20 million
  - The total of all licence prices is DKK100 million
  - Søren will be charged 20% of the total costs (DKK3 million based on the current estimate above)

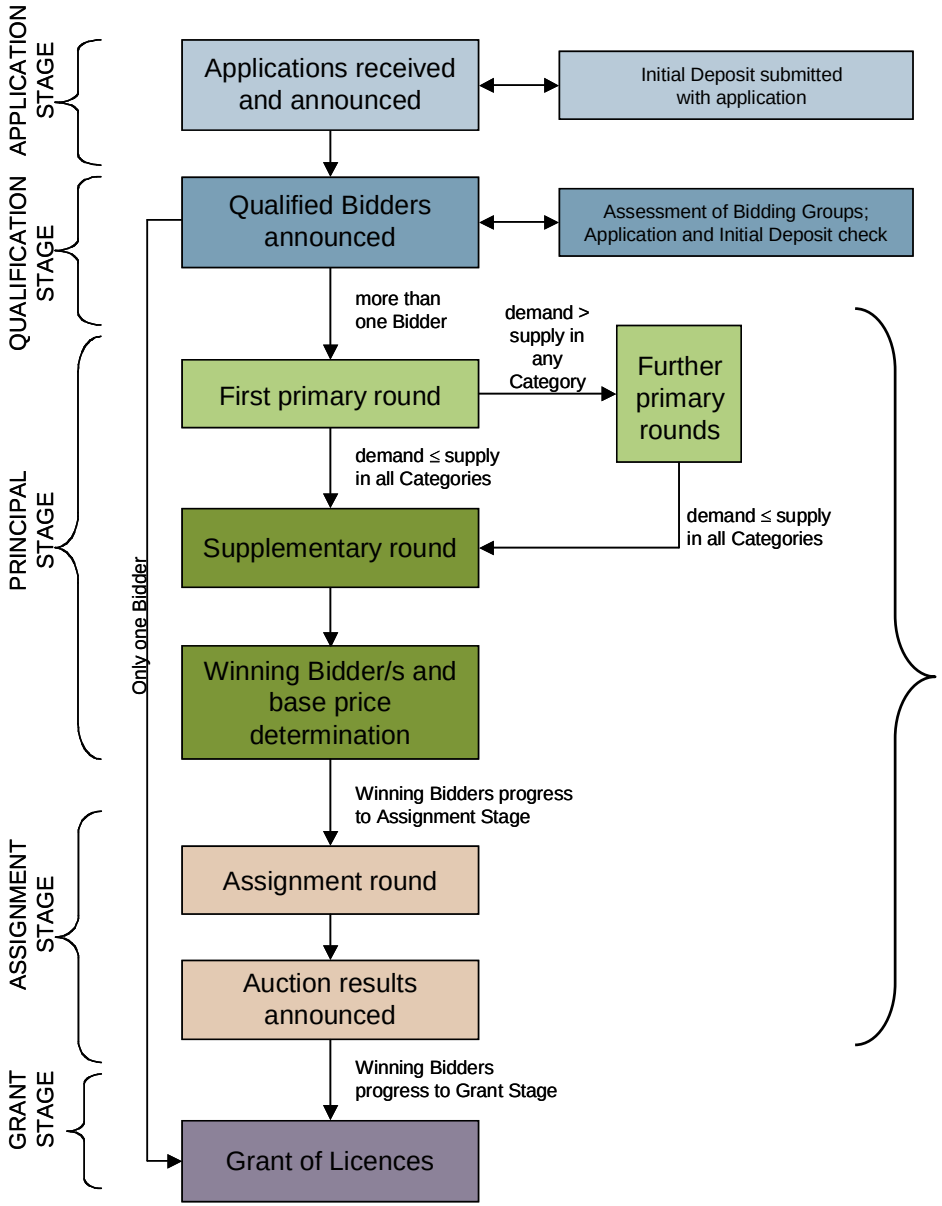
Annual frequency charges

- From 1 January 2010, annual frequency charges will have both a fixed and a variable component
  - note that Lot C10 will also be subject to frequency charges
- Rates will be set annually in the Finance Act
- For 2010, the rates are expected to be:
  - fixed component: DKK300 per licence
  - variable component: DKK56 405 per MHz
  - for example, the total cost for 2×20MHz in 2010 would be:

$$300 + (2 \times 20 \times 56\,405) = \text{DKK}2\,256\,500$$

Bidding in the auction

Overview of the auction process



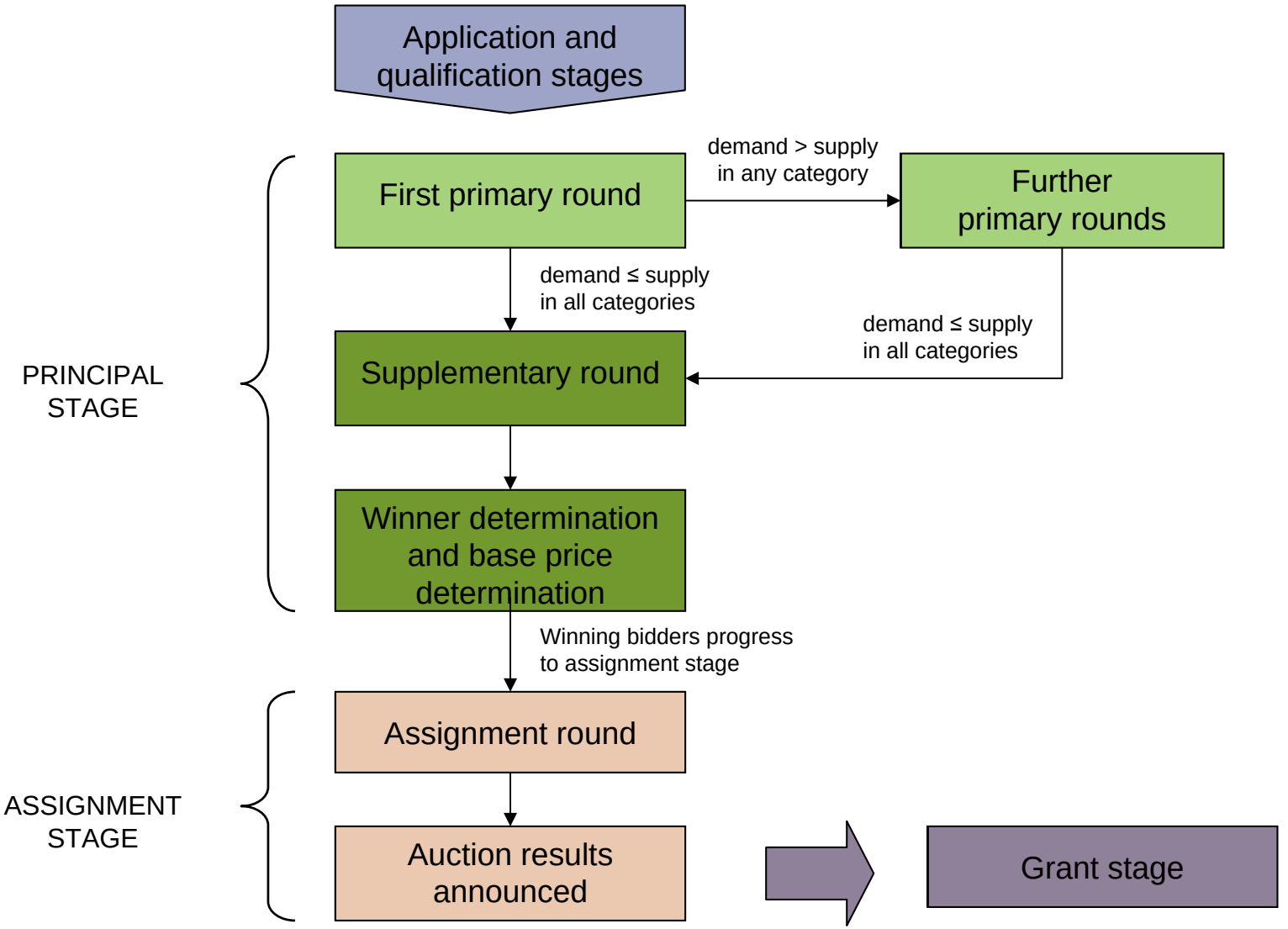
The principal stage and assignment stage together form the bidding phase

This section of our presentation will focus on the bidding phase of the auction

The auction format is a CCA

- It has been decided to use a combinatorial clock auction (CCA) format for this award
- This is a multiple-round, ascending-bid auction
  - package bidding means there is no risk of winning a combination of lots you do not want
  - lots are initially auctioned on a 'generic' basis – you bid for a number of lots within a category, not specific frequencies
  - the second stage assigns specific frequencies – if you win multiple lots in the same category, they are always next to each other
  - the auction is designed to encourage bidding in a straightforward way for the lots you want
- This format has previously been used for two auctions in the UK and is proposed for 2.6GHz awards in Austria and the Netherlands

The CCA takes place in two stages



Eligibility points and cap

- Each bidder starts the auction with a number of eligibility points, based on their deposit
- Each lot in the auction also has an eligibility, which creates an 'exchange rate' between the three categories

Category	Number of lots	Eligibility points	Reserve price per lot
A: 2010MHz	1	1 pt per lot	DKK 500 000
B: 2.5GHz paired	14	2 pts per lot	DKK 1 000 000
C: 2.5GHz unpaired	10 (9 in the principal stage)	n-1 (where n is the number of 2.5GHz lots in the package bid)	DKK 500 000

- During the primary rounds, bidders can use their eligibility to bid for packages of lots
- Initial eligibility is capped at 9 points and thus an initial deposit of **DKK 4 500 000** will enable you to bid for:
  - four 2.5GHz paired (B) lots plus the 2010MHz lot (A) or
  - all 2.5GHz unpaired (C) lots plus the 2010MHz lot (A) or
  - any sub-set of these two packages or any other combination of A, B and/or C lots with combined eligibility ≤ 9 points

Primary rounds

- NITA announces round prices per lot:
  - in round 1 the round prices equal the reserve prices
- Bidders submit a single package bid in each round consisting of one or more lots in each category
- At the end of each round, NITA determines the aggregate demand for each category across all package bids
  - If demand exceeds supply in any category, NITA will raise the price for that category and start a new round
  - The primary rounds end when there is a round in which demand is less than or equal to supply in all three categories
- The information available at the end of each round is restricted:
  - each bidder is told the level of aggregate demand for each category
  - no information is provided about individual bids

Supplementary round

- The supplementary round provides a single round opportunity for each bidder to submit their best offer for all available packages
- The supplementary round is necessary because:
  - there may be additional packages of lots that you are interested in that you did not bid for during the primary bid rounds
  - you may not have been able to submit your best offer for each package of lots that you want to bid for
- Your supplementary bids will be subject to caps based on your primary bids
- Each bidder has a 'final primary bid' – your most recent (non-zero) primary bid:
  - if this bid was submitted in the last primary round, the bid amount is uncapped
  - if it was submitted in any other round, the bid amount is capped according to the prices for the component lots in the last round when you had eligibility
- Supplementary bids for all other packages are subject to a 'relative cap', linked to:
  - your highest bid for your final primary bid; and
  - (if relevant) your primary bid in the round when you reduced eligibility

Primary rounds – an example

Round	Price per paired lot (DKK)	Price per unpaired lot (DKK)	Adam's package bid	Adam's bid amount
1	1 000 000	500 000	4 paired	4 000 000
2	1 250 000	600 000	4 paired	5 000 000
3	1 500 000	600 000	4 paired	6 000 000
4	1 750 000	600 000	3 paired	5 250 000
5	2 000 000	750 000	3 paired	6 000 000
6	2 500 000	750 000	3 paired	7 500 000
7	3 000 000	750 000	2 paired	6 000 000
8	3 500 000	750 000	2 paired	7 000 000
9	4 000 000	750 000	2 paired	8 000 000

Adam's preferred package at the reserve prices is 4 paired

Adam drops demand to 3 paired owing to rising prices

Adam drops demand to 2 paired owing to rising prices

Adam is bidding on 2 paired when the primary rounds end

Supplementary bids – an example

Package	Adam's highest primary bid for this package (DKK)	Last primary round when Adam was eligible to bid for this package	Cap on Adam's bids (DKK)	Adam's supplementary bid (DKK)
2 paired	8 000 000 (round 9)	9 (bid for this package)	Uncapped This is Adam's final primary bid and was submitted in the last primary round	9 000 000
1 paired	No bid	9 (bid for 2 paired instead)	Capped at bid for 2 paired minus price difference in round 9 Cap = 9 000 000 - 4 000 000 = 5 000 000	4 600 000
3 paired	7 500 000 (round 6)	7 (bid for 2 paired instead)	Capped at bid for 2 paired plus price difference in round 7 Cap = 9 000 000 + 3 000 000 = 12 000 000	11 700 000
4 paired	6 000 000 (round 3)	4 (bid for 3 paired instead)	Capped at bid for 3 paired plus price difference in round 4 Cap = 11 700 000 + 1 750 000 = 13 450 000	13 300 000
9 unpaired	No bid	4 (bid for 3 paired instead)	Capped at bid for 3 paired plus price difference in round 4 Cap = 11 700 000 + 150 000 = 11 850 000	6 200 000

Winner determination

- Winning bids are the combination of valid primary and supplementary bids with the greatest total value, subject to the conditions that:
  - no more lots are awarded than are available; and
  - at most one bid is accepted from each bidder
- If there is a tie between two sets of bids:
  - the set of bids with the highest number of eligibility points will be selected
  - if there is still a tie, a random process will be used to choose between the tied sets of bids
- A software algorithm will be used to verify the winning combination (more information will be available on NITA's website)

Base price determination

- Each winning bid has an associated base price, which is calculated using a second-price rule:
  - winners only pay an amount large enough that there is/are no alternative bidder(s) prepared to pay more than any winning bidder or group of winning bidders
  - this amount may be less than the winning bid, depending on how much other bidders bid
  - the base price cannot be lower than the sum of reserve prices for component lots
- A base price applies to a winning package – there is no price for individual lots
- Base prices are also calculated using a software algorithm (more information will be available on NITA's website)

Winner and base price determination – an example

1. Take all bids made in auction*

Bidder	Package	Highest bid amount
Adam	4 paired	13 300 000
	3 paired	11 700 000
	2 paired	9 000 000
	1 paired	4 600 000
	9 unpaired	6 200 000
Benny	4 paired	17 200 000
Carl	4 paired	16 000 000
Dan	3 unpaired & 3 paired	15 900 000
	5 unpaired & 2 paired	15 502 000
Emma	3 paired	10 500 000
Fred	9 unpaired	4 888 000
	6 unpaired	3 700 000

2. Identify highest value combination

Winning bidder	Winning package	Bid amount
Adam	3 paired	11 700 000
Benny	4 paired	17 200 000
Carl	4 paired	16 000 000
Dan	3 unpaired & 3 paired	15 900 000
Fred	6 unpaired	3 700 000
		DKK 64 500 000

3. Identify base prices

Base price
10 500 000
12 100 000
12 100 000
11,688,000
3 002 000
DKK 49 390 000

* We only show each bidder's high bids on individual packages here, as lower bids on same packages do not determine the outcome

Assignment stage

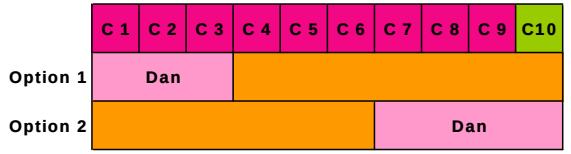
- The assignment stage will determine the specific frequencies allocated to bidders in the 2.5GHz Band
- A sealed bid assignment round is required for each category where there is more than one winning bidder
- If there is more than one winning bidder for both 2.5GHz categories, then there will be two separate but simultaneous sealed bids
- Each winner will receive an exhaustive list of bid options for contiguous frequencies (lots next to each other) within a category, such that:
  - it is also possible for all other winners to receive contiguous frequencies
  - the number of lots in the package equals the number of lots won by that bidder (plus C10, if applicable)
  - any unsold paired lots are located at the top of the duplex bands
  - any unsold unpaired lots are located at the bottom of the band
- Each bidder may submit one bid for each option
- Winning bids and prices are calculated in a similar way to the principal stage
- It is not mandatory to submit a bid in the assignment stage

Assignment options – an example

- Unpaired spectrum:
  - there are two winning bidders (Dan & Fred)
  - there are two possible ways of arranging their bids
  - each bidder has two possible bid options

Assignment round required

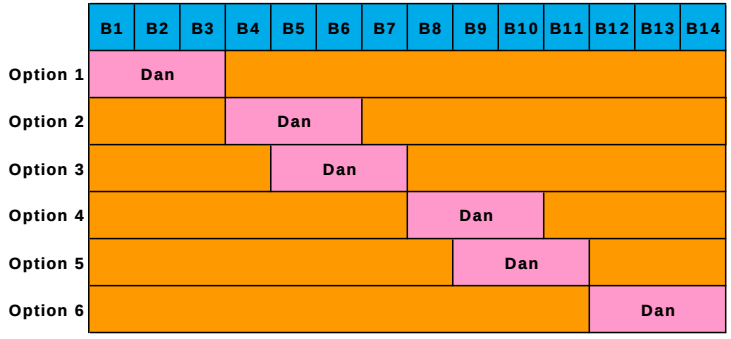
Dan's unpaired bid options



- Paired spectrum:
  - there are four winning bidders (Adam, Benny, Carl & Dan)
  - there are 24 possible ways of arranging their bids
  - Adam (3 lots) and Dan (3 lots) each have six bid options
  - Benny and Carl (both 4 lots) have eight bid options

Assignment round required

Dan's paired bid options



Example: unpaired assignment options

- Suppose that each winner of unpaired spectrum has the following preferences:
  - Fred has a modest preference for the highest frequency package
  - Dan has a much stronger preference for the highest frequency package

Dan's bids		Fred's bids	
Option	Amount	Option	Amount
C1-C3	zero	C1-C6	zero
C7-C10	15 000	C4-C10	350

- Dan is awarded C7-C10
- Fred is awarded C1-C6
- Dan pays an additional price of DKK 350
- Fred pays zero

Note that the higher frequency bid option includes the guard block lot C10

Example: paired assignment options

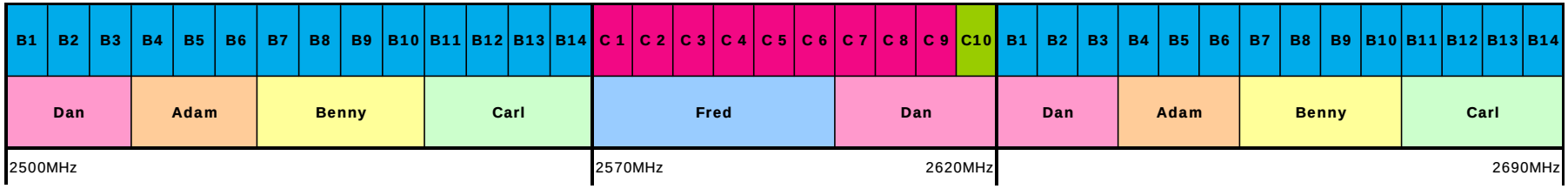
- Suppose that each winner of paired spectrum has the following preferences:
  - Adam prefers low frequency lots
  - Dan prefers the lowest frequency package
  - Carl and Benny do not have a preference

Adam's bids		Dan's bids	
Option	Amount	Option	Amount
B1-3	6 000	B1-3	12 000
B4-6	4 000	B4-6	zero
B5-7	3 000	B5-7	zero
B8-10	2 000	B8-10	zero
B9-11	1 000	B9-11	zero
B12-14	zero	B12-14	zero

Carl's bids		Benny's bids	
Option	Amount	Option	Amount
All options	zero	All options	zero

- Dan is awarded B1-B3
- Adam is awarded B4-B6
- A random process is used to assign the remaining lots (e.g. Benny = B7-B10 and Carl = B11-14)
- Dan pays an additional price of DKK2 000
- Adam, Benny and Carl each pay zero

Final assignment, prices & payment



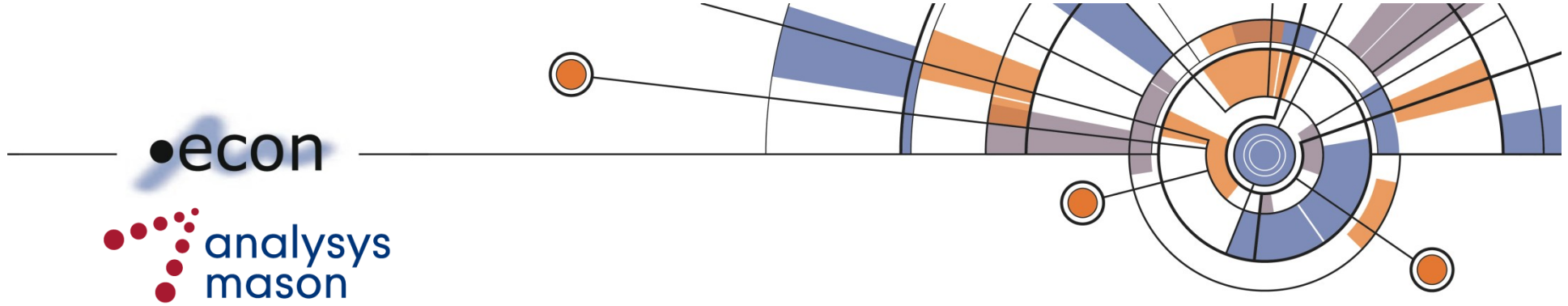
Winning bidder	Lots won	Base price	Additional price for unpaired	Additional price for paired	TOTAL PRICE
Adam	3 paired	DKK 10 500 000	0	0	DKK 10 500 000
Benny	4 paired	DKK 12 100 000	0	0	DKK 12 100 000
Carl	4 paired	DKK 12 100 000	0	0	DKK 12 100 000
Dan	3 paired, 3 unpaired + C10	DKK 11 688 000	DKK 350	DKK 2 000	DKK 11 690 350
Fred	6 unpaired	DKK 3 002 000	0	0	DKK 3 002 000

- Payment terms:
  - 20% upfront
  - remaining 80% in eight equal instalments

- Example: Adam's payments
  - upfront payment of DKK 2 100 000
  - eight instalments of DKK 1 050 000

Bid strategy in the auction

- **It is the responsibility of each bidder to determine their own bid strategy**
- However, the principal stage is designed to encourage you:
  - in each primary round, to bid straightforwardly on the lots you prefer
  - in the supplementary round, to bid your maximum willingness to pay for each package that you are willing to buy
- Deviation from straightforward bidding in the primary rounds, may result in bid options in the supplementary round that are undesirably constrained
- If you are a winning bidder competing in the assignment stage, you are guaranteed to win one of your bid options:
  - there is no benefit from bidding more than zero for your least valuable bid options
  - if you have no preference between options, there is no benefit from submitting a non-zero bid for any option



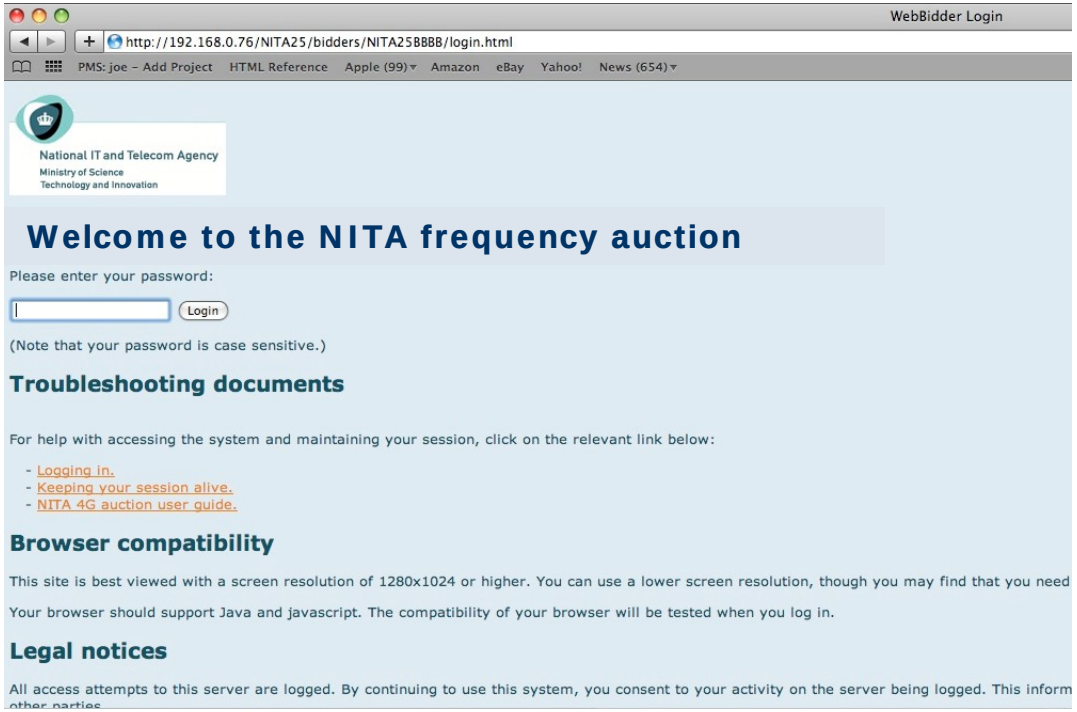
The electronic auction system

Introduction

- The auction will be conducted using an electronic auction system:
  - pre-qualified bidders log in to the auction system via the Internet
  - no specialist software or hardware is required, only:
    - a PC running Windows Vista or XP with a recent version of Internet Explorer or Firefox; or Mac 10.x with Safari;
    - the latest version of Java installed (free download); and
    - a broadband Internet connection
- Bidders will receive a user manual (Danish and English language versions) prior to the auction
- The auction interface will be in English
- There will be a mock auction prior to the real auction

Log in

- Pre-qualified bidders will receive login details prior to the mock auction
- This will include a digital certificate, which must be installed on the computer(s) used to log in
- You can only log in from one computer at a time

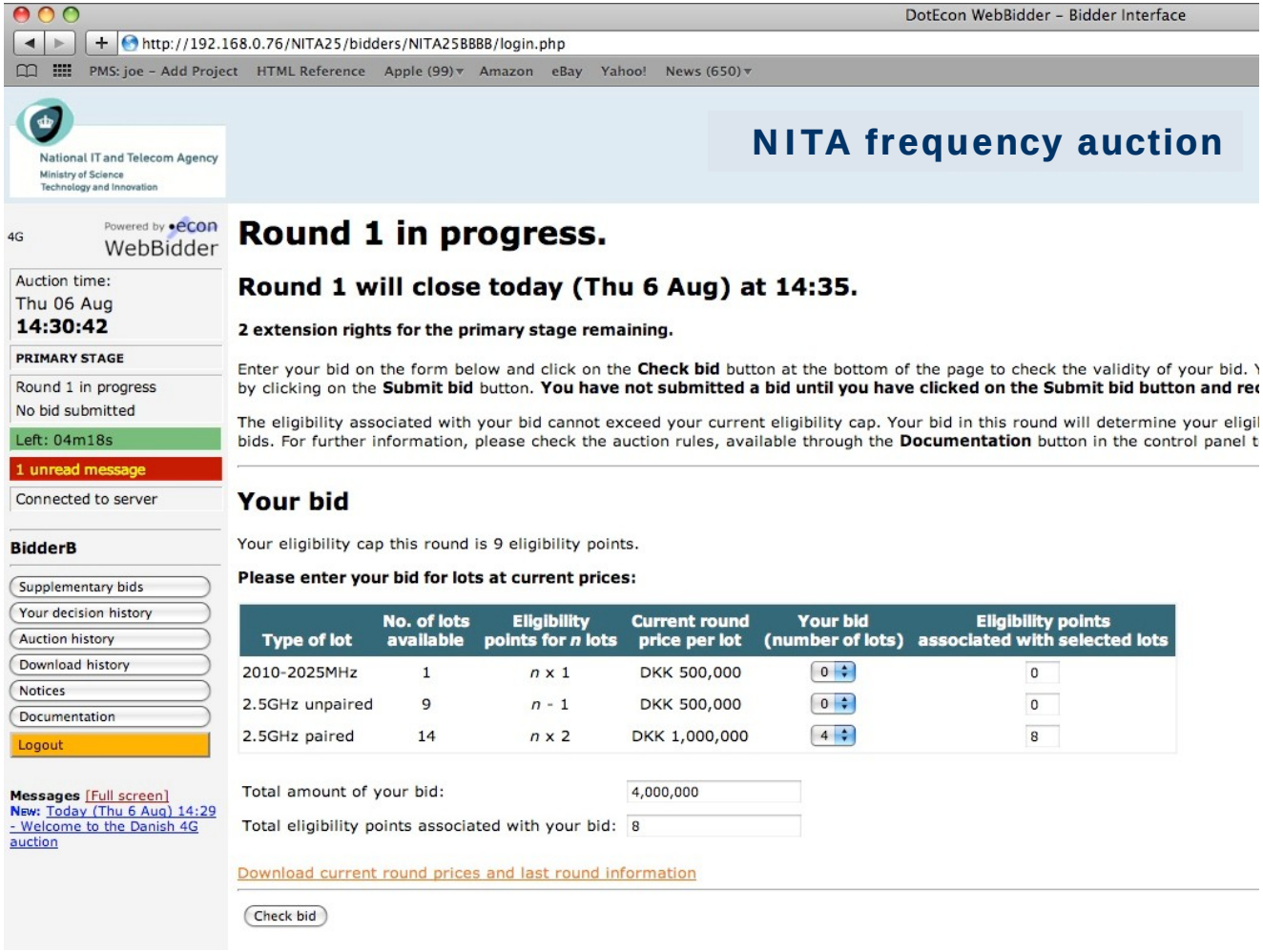


The login screen will look like this

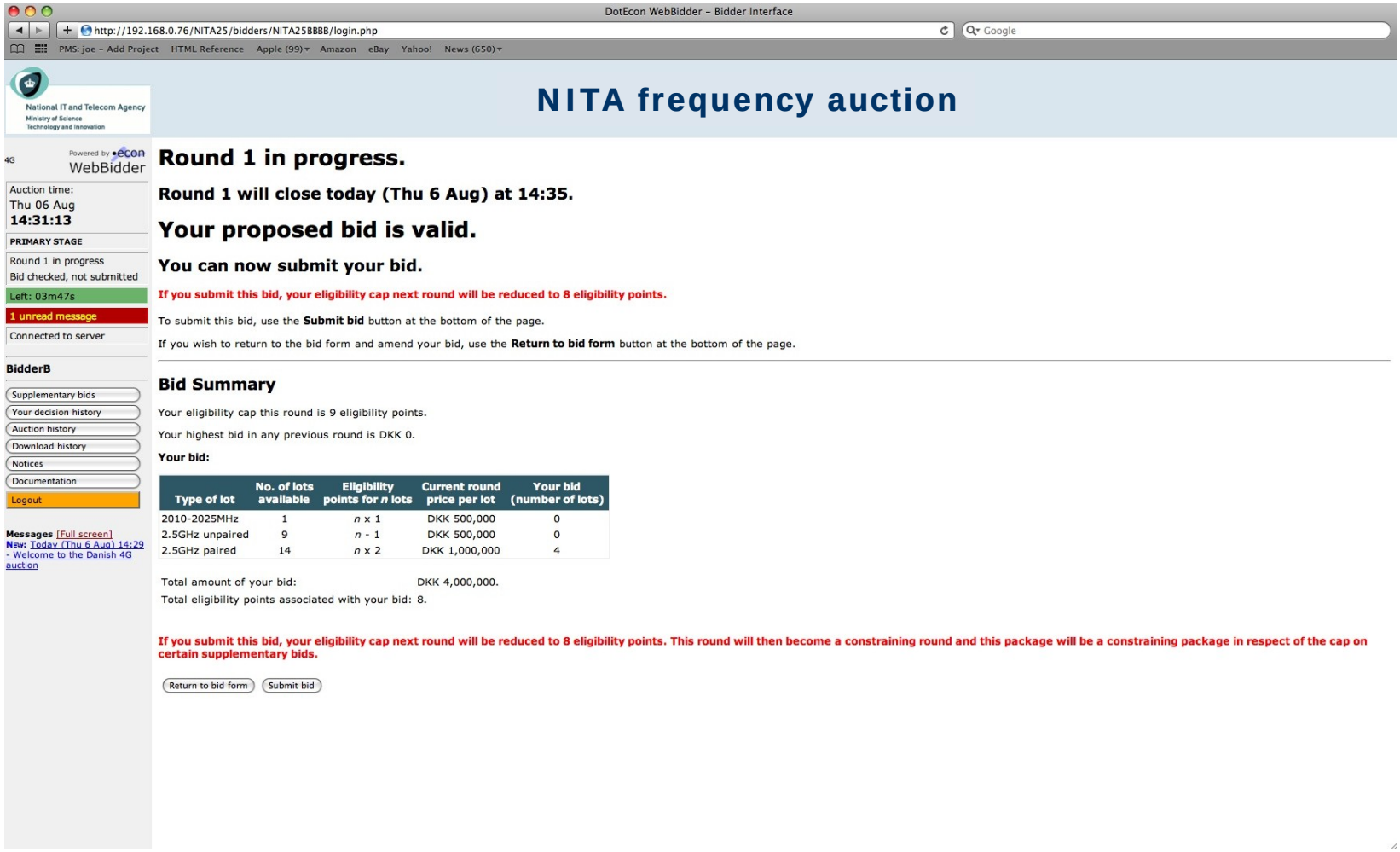
Bid submission

- There are two steps to bid submission:
  - bid entry and checking by the system
  - confirmation of bid
- A bid is NOT considered by the auction server until the bidder has confirmed
- You will be notified when the bid has been accepted by the auction server
- It is not possible to submit an invalid bid
- ALL bids received and confirmed within the round are considered by the system
- There is no advantage in bidding first or last

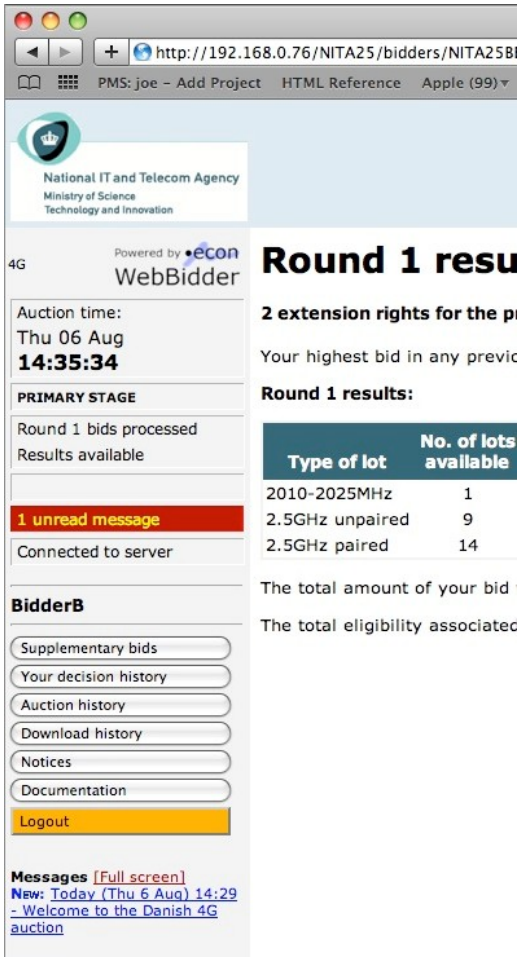
Bid submission form – bid entry



Bid submission form – confirmation

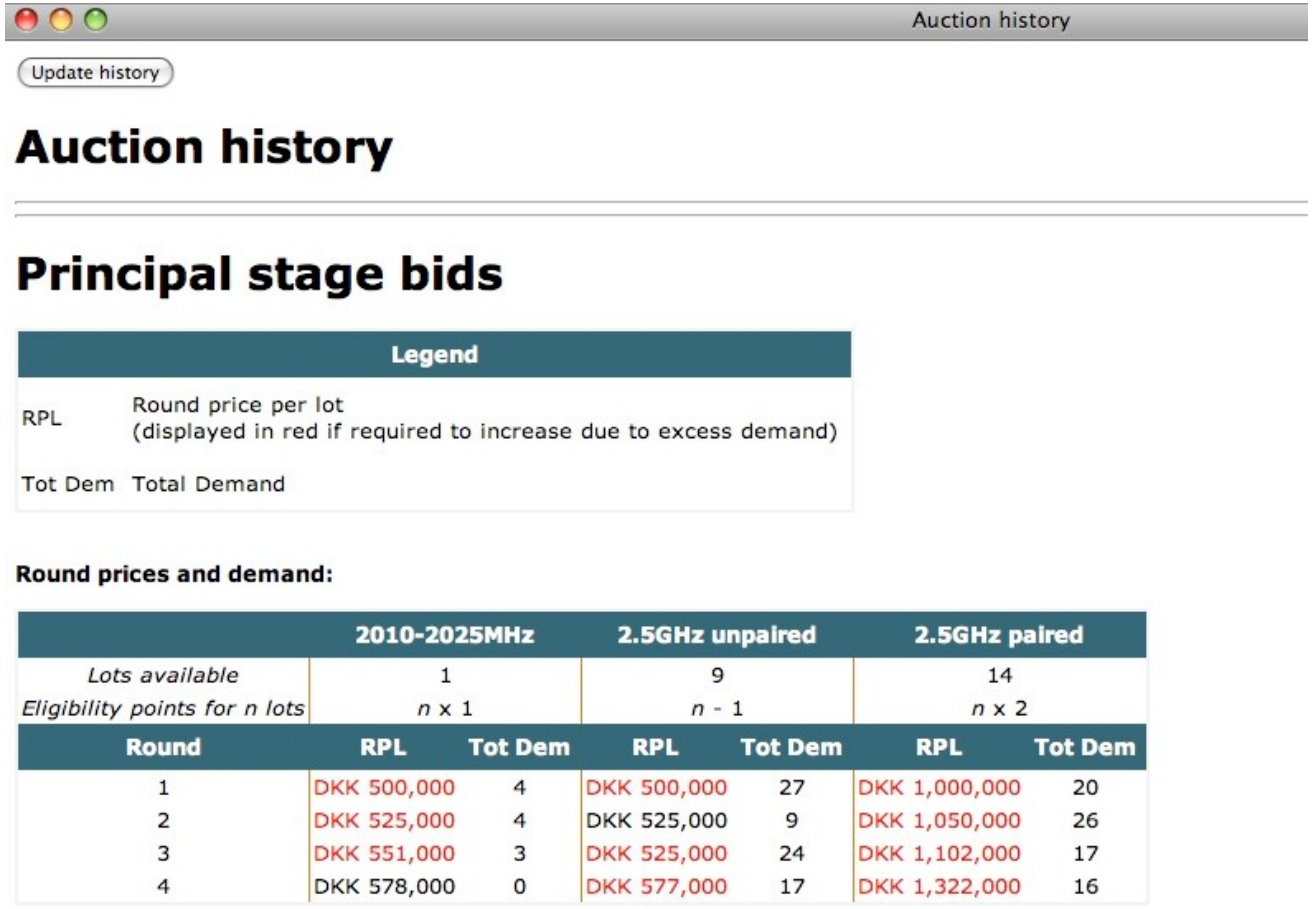


Information available to bidders during the auction



- Auction clock and auction stage
- Historic information:
  - own bids round by round
  - round prices and excess demand round by round
  - downloadable information in .csv and .txt format
- Messaging system for announcements from NITA

Information available – auction history



Auction history

Update history

Auction history

Principal stage bids

Legend	
RPL	Round price per lot (displayed in red if required to increase due to excess demand)
Tot Dem	Total Demand

Round prices and demand:

	2010-2025MHz		2.5GHz unpaired		2.5GHz paired	
Lots available	1		9		14	
Eligibility points for n lots	*n* x 1		*n* - 1		*n* x 2	
Round	**RPL**	**Tot Dem**	**RPL**	**Tot Dem**	**RPL**	**Tot Dem**
1	DKK 500,000	4	DKK 500,000	27	DKK 1,000,000	20
2	DKK 525,000	4	DKK 525,000	9	DKK 1,050,000	26
3	DKK 551,000	3	DKK 525,000	24	DKK 1,102,000	17
4	DKK 578,000	0	DKK 577,000	17	DKK 1,322,000	16

Back up

- Bidders are responsible for their own software, hardware and Internet connections
- Extension rights to help protect against system failure:
  - 2×30 minutes in the primary rounds
  - 1×30 minutes in the supplementary round
  - 1×30 minutes in the assignment round
- A manual back-up process will be in place in case of widespread system failure

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