Bidding language and sample bid for the FAA problem

Bidding Language

We propose the XOR- (AND, OR) – XOR bidding language where the first XOR is at the business plan level, the (AND, OR) is at the flight level and the XOR on the right is at the slot level. The AND in the (AND, OR) allows us to express dependencies, such as sets of flights/slots that must be acquired together. The OR in the (AND, OR) allows us to express combinations of flights/slots that the airline would like to acquire. It also keeps the size of the bid from blowing up exponentially because we do not have to enumerate the possible combinations. The final XOR is over the possible slots for a particular flight.

Example

Consider the following (simple) hypothetical case:

- airline with 5 planes available at Atlanta (ATL) airport
- airline only bids for departure slots
- airline wants to offer on-the-hour morning commuter service to La Guardia (LGA)
- the “ideal” scheduled departure times are 7:00, 8:00, 9:00 for the commuter service to LGA
- maximum tolerable deviation from ideal departure time is +/- 15 minutes for the commuter service flights
- it is critical for the airline to acquire the appropriate slots for all the commuter service flights (in other words, unless they can offer the 3 hourly flights, their “morning commuter service” business is not viable)
- the airline also wants to offer some service to the West Coast (either to San Francisco or Los Angeles, or both), but the airline can tolerate not acquiring the necessary slots
- the airline has more tolerance for deviations from the “ideal” departure times for the flights to the West Coast

<table>
<thead>
<tr>
<th>Slot ID</th>
<th>Slot Window</th>
<th>Flight 1 ATL-LGA</th>
<th>Flight 2 ATL-LGA</th>
<th>Flight 3 ATL-LGA</th>
<th>Flight 4 ATL-SFO</th>
<th>Flight 5 ATL-LAX</th>
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<td>6:30-6:45</td>
<td>100</td>
<td>100</td>
<td>30</td>
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<tr>
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<tr>
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</table>

In terms of this bidding language, the three flights for the commuter service are AND’ed because the airline must acquire slots for each of the flight. The West Coast flights are OR’ed because these are flights/slots that the airline would like to acquire independent of other flights and the failure to acquire slots is not critical to the business plan.
The structure of the bid (and the associated values) will look like the following:

**Business Plan 1** ("Morning Commuter Plan")

Flight 1: \{(0645,100) \textbf{XOR} (0700,100)\} \\
(ATL-LGA) \\
AND \\

Flight 2: \{(0645,100) \textbf{XOR} (0700,100)\} \\
(ATL-LGA) \\
AND \\

Flight 3: \{(0645,100) \textbf{XOR} (0700,100)\} \\
(ATL-LGA) \\
OR \\

Flight 4: \{(0645,100) \textbf{XOR} (0700,100)\} \\
(ATL-SFO) \\
OR \\

Flight 5: \{(0645,100) \textbf{XOR} (0700,100)\} \\
(ATL-LAX) \\

XOR

**Business Plan 2** ("Mid-day Economy Plan" or whatever)

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XOR

**Business Plan 3** ("Evening Commuter Plan" or whatever)

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