Crew and Aircraft Recovery Through a Multi-Agent Airline Electronic Market

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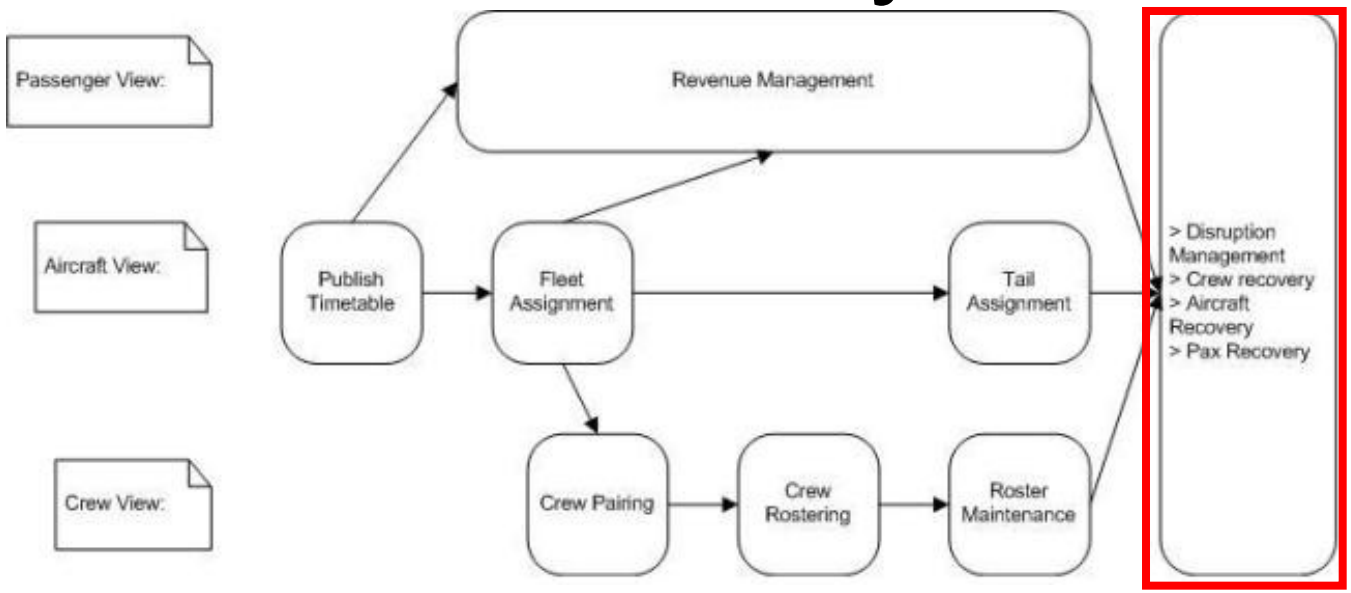
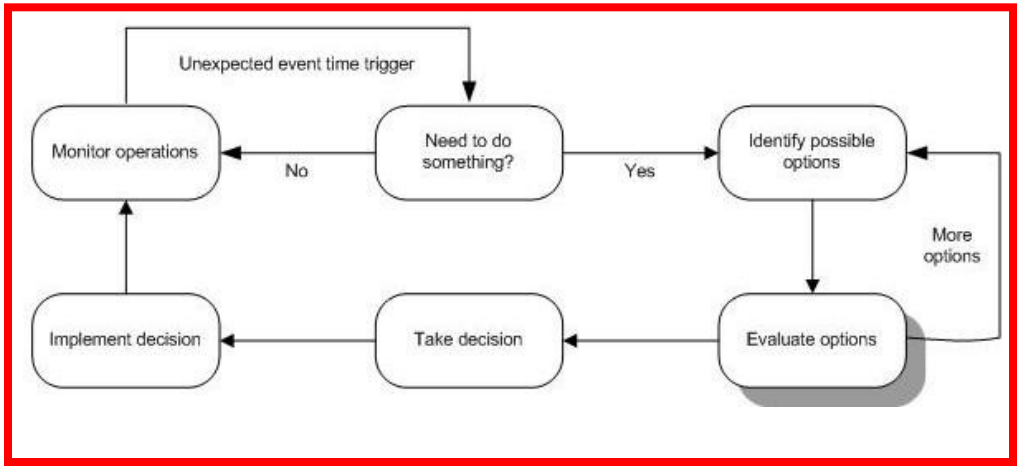
Outline

- The operations recovery problem
- Our MAS for operations recovery
- Our Proposal
- Advantages
- Airline EM Architecture
- Ontology-based services
- A Simple Example
- Conclusions

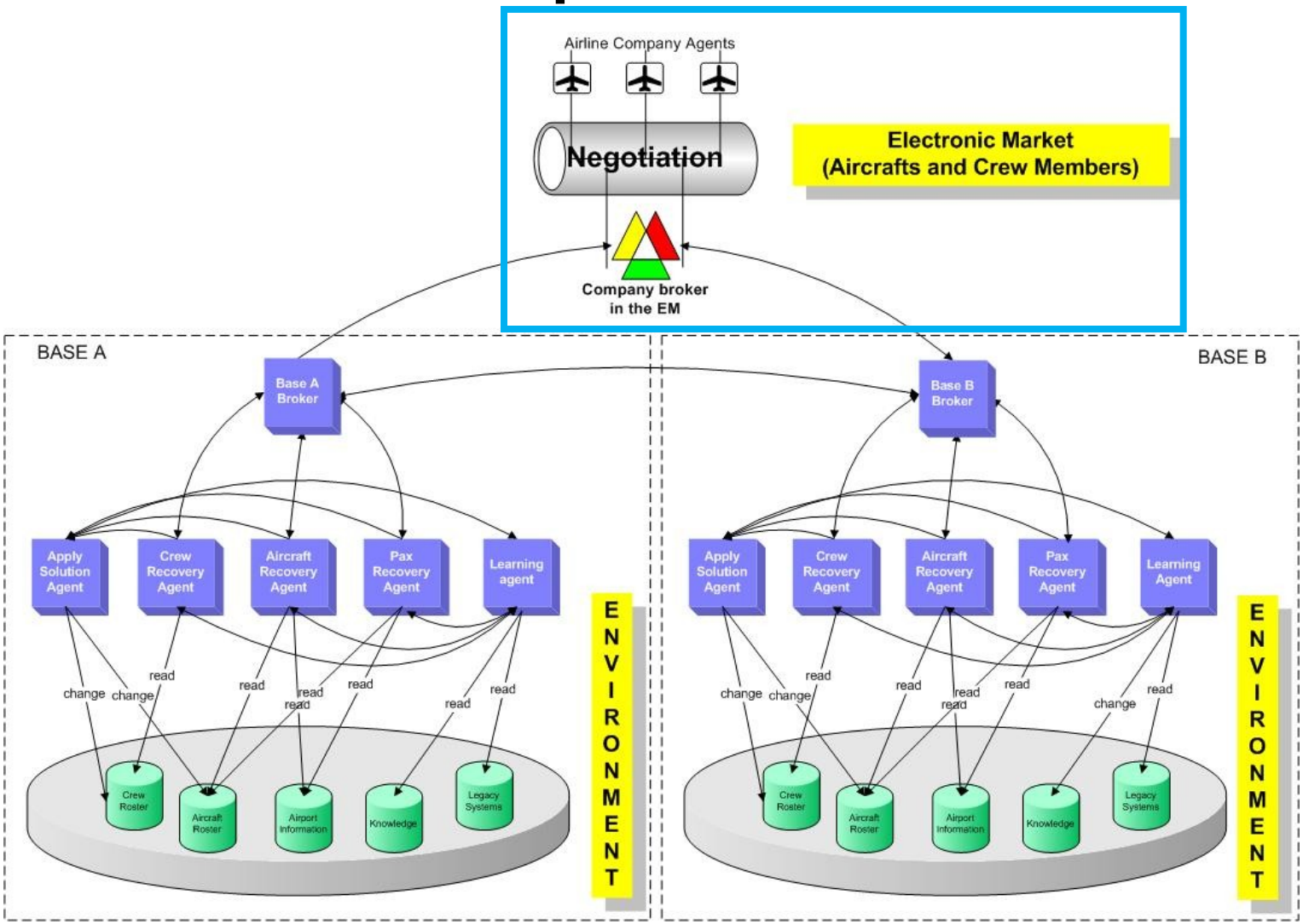
Operations Recovery Problem





- Traditionally approach with OR techniques
- Focuses on recovering a particular resource
- No cooperation between airlines

Our MAS for Operations Recovery



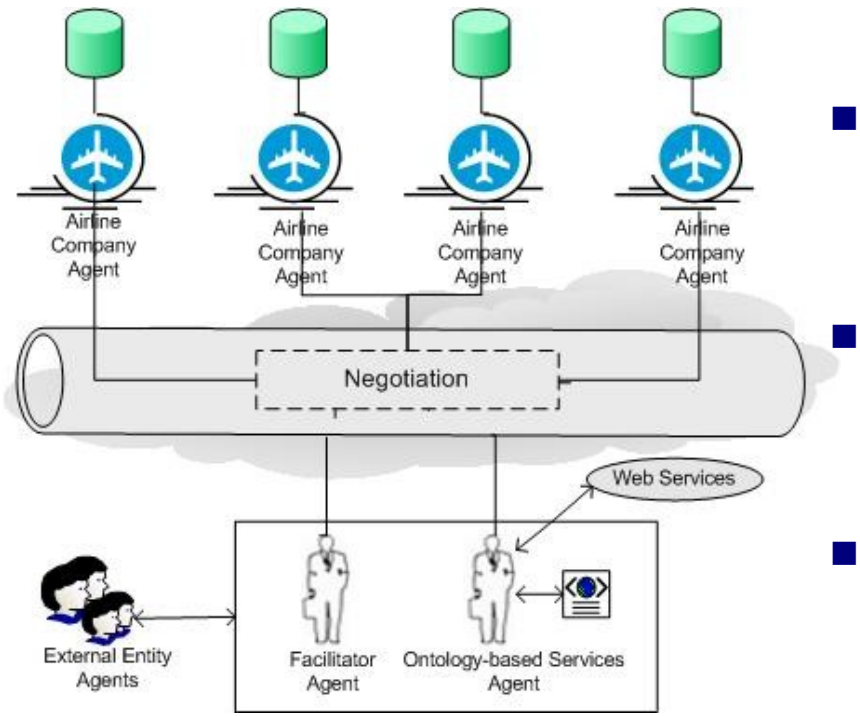
Our Proposal

- The EM proposed here is a permanently open virtual market place where registered airlines (represented by agents) can meet each other through the web to purchase services according to established norms and rules.
- Each airline has its own ontology about the structure of the organisation.
- Ontology-based services to help in communication interoperability problems.

Advantages of the Proposed Market

- More resources available to solve airline companies problems.
- Take advantage of exceeding resources in specific dates and times and sell services performed by these resources (crew members and aircrafts) to other companies.
- Use this market to supply themselves in high seasons of passenger demand.

Airline EM Architecture



- Facilitator Agent(FA) entity that matches the right agents and supports negotiation process.
- Customer Airline Company Agent (CAA) represents airline companies interested in the crew members or aircrafts services.
- Supplier Airline Company Agent (SAA) represents airline companies interested in providing crew members or aircrafts renting services.
- External Entity Agent (EEA) represents entities that are responsible for the validation of the providers' proposal.
- Ontology-based Services Agent (OSA) provides currency conversion or matching terms services when required.

Ontology-based services

- A possible solution to solve the problem of lack of understanding that may arise during agents interaction, due to structural as well as semantic representation heterogeneity.
- Includes the following services:
  - Matching Terms Service (MTS), used when agents do not understand the content of a message.
  - Currency Conversion Service (CCS), used for currency conversion.
  - Measurement Conversion Service (MCS), used for measures conversion.

Example

Flight Number: TP5555,
From: LIS (Lisbon) **to** REC (Recife),
Number of Passengers: 200,
Date/Hour of Departure: 2005-10-18 10:00 (UTC),
Date/Hour of Arrival: 2005-10-18 18:00 (UTC),
Aircraft Type: A340 (airbus A340) with **License Number**: CS-TIH.

Flight Number: TP6666,
From: REC **to** LIS,
Number of Passengers: 240,
Date/Hour of Departure: 2005-10-19 11:00 (UTC),
Date/Hour of Arrival: 2005-10-19 19:00 (UTC),
Aircraft Type: A340 (airbus A340) with **License Number**: CS-TIH.

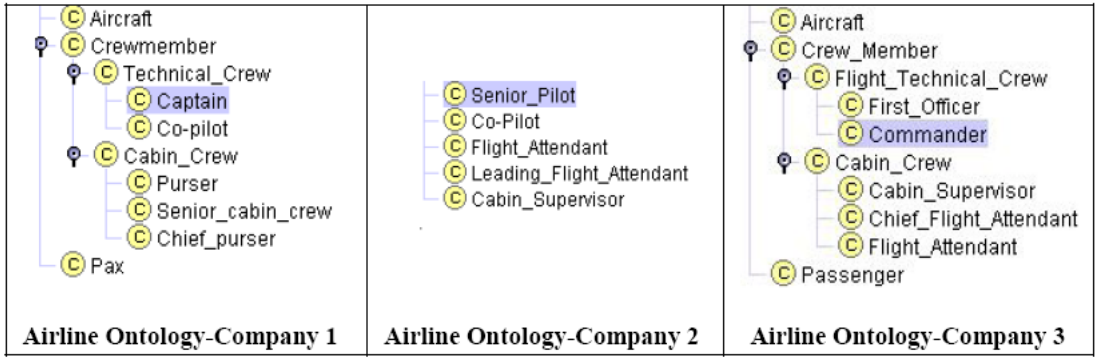
An example of a duty period composed by two flights. The crew members and aircraft (resources) have to do both flights.

Other airlines will have to understand this message and its meaning without having to disclosure their own ontology.

Problem: the commander of this flight did not report for duty.
First, the airline company tries to solve the problem with their own resources.
Second, if not possible, uses the EM. The request would be similar to the following:

Number of crew required: 1,
Crew Rank: Commander,
Aircraft Model: A340 Series,
Aircraft Type Rating: A340,
Instrument Rating: IFR,
Operation Category: CAT III,
Crew Fleet Qualification: NA,
Route: LIS-REC-LIS,
Route Aerodrome Competence: NA,
Flight Numbers: TP5555/TP6666,
Date Time Check-in: 2005-10-18 09:00 (UTC),
Date Time Check-out: 2005-10-19 20:00 (UTC),
Long Range Qualification: ETOPS,
RNAV Qualification: yes.

Example (cont.)



Three different airline methodologies which may cause the interoperability problem during the negotiation process. The concept “Commander” has correspondent terms/concepts in other ontologies which are written in a different way. However, they are in the same domain and have the same meaning. The concept “Commander” for company 1 is “Captain” and for company 2 is “Senior Pilot”.

The Match Term Services from the Ontology-based services will be used to help some of the registered agents to understood the concepts.

Example of a message sent from a customer airline company agent interested in renting a crew member, to all know supplier airline companies that may provide the requested crew member. The term “Commander” originates from its own, private, ontology.

```
(CFP
   :sender
        (agent-identifier
         :name customer@sutton:1099/JADE
         :addresses (sequence http://sutton:7778/acc))
   :receiver
        (set
         (agent-identifier
           :name cust1@sutton:1099/JADE
           :addresses (sequence http://sutton:7778/acc)))
   :content (IsPurchasable (
         item: Commander
         quantity: 1
         currency: EUR))
   :reply-with  R20364762_0
   :language  fipa-sl
   :ontology  eCommerce
   :reply-by  20041112T102012611Z
   :protocol  fipa-contract-net
   :conversation-id  1100254802611
)
```

Conclusions

- The EM we propose aims to achieve cooperation between airlines in solving aircraft and crew recovery problems.
- Ontology-based services facilitates the negotiation process when different ontologies are used.
- Airline rules, labor and country specific rules, European rules and crew qualifications are issues that need to be taken into account regarding the adoption of a EM for this domain.
- Communications between different systems, security, privacy and authorizations as well as contracts, also needs to be addressed by the EM.
- Still some important open issues before this EM turns out to be a reality!

THANKS FOR YOUR ATTENTION!

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