Knowledge Brokering in AKT

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Introduction

- AKT vision of problem-solving within a distributed environment of service providers.
- Basic need to match customer service requirements with the appropriate providers.
- Some sort of brokering agent is required:
  - providers advertise their services;
  - customers post their service requests;
  - broker has ability to match requests with services.

AKT Brokering Services

- Two complementary brokering algorithms, operating at different levels of abstraction:
- 'Functional' brokering:
  - Services described at low level of abstraction.
  - Returns precise results to precise queries.
  - Results in the form of alternative executable 'plans'.
- 'Transformational' brokering:
  - Services described at a more general level.
  - Returns less specific plans in response to less specific queries.
- *No single 'brokering algorithm'?*

‘Functional’ Brokering

- Services described through:
  - Agent-Name and URI;
  - Ontology;
  - List of competences:
    - Competence name;
    - Preconditions;
    - Input/output ‘roles’;
    - Required external competences.
- (Environment also contains ontology ‘servers’ and ‘bridges’…)
- A query is in form of a request for a particular named competence.

Describing Services

```
service(
    agent-name,
    agent-uri,
    agent-ontology,
    [
    competence((name ← preconditions),
                input-roles,
                output-roles,
                external-competences),
    competence(…),
    …
    ]).
```

Agent *ticket-office*

```
service(
   ticket-office,
   http://oronsay.aiai.ed.ac.uk:12100,
   travel-ontology,
   [
   competence((issue_ticket(Person,italy,Ticket) ← has_money(Person,1000,gb_pound)),
       [person(Person)],
       [valid_ticket(Ticket)],
       [pay(Person,ticket_office,1000,gb_pound)]),

    competence((issue_ticket(Person,spain,Ticket) ← has_money(Person,1500,euro)),
       [person(Person)],
       [valid_ticket(Ticket)],
       [pay(Person,ticket_office,1500,euro)]),

    competence((issue_ticket(Person,egypt,Ticket) ← has_visa(Person,egypt),
                                          has_money(Person,1200,egyptian_pound),
                                          has_passport(Person)),
       [person(Person)],
       [valid_ticket(Ticket)],
       [pay(Person,ticket_office,1200,egyptian_pound)])],
    ]).
```

Plan Synthesis

- Plan synthesis is a recursive procedure.
- Starting with an empty plan, the broker:
  - Looks for an agent described as offering the desired competence;
  - Are all preconditions & external requirements met?
    - If so, stop, and add this agent to the current plan;
    - If not, search for other agents offering these as competences.
- With backtracking, can generate alternative plans.

Synthesised Plan

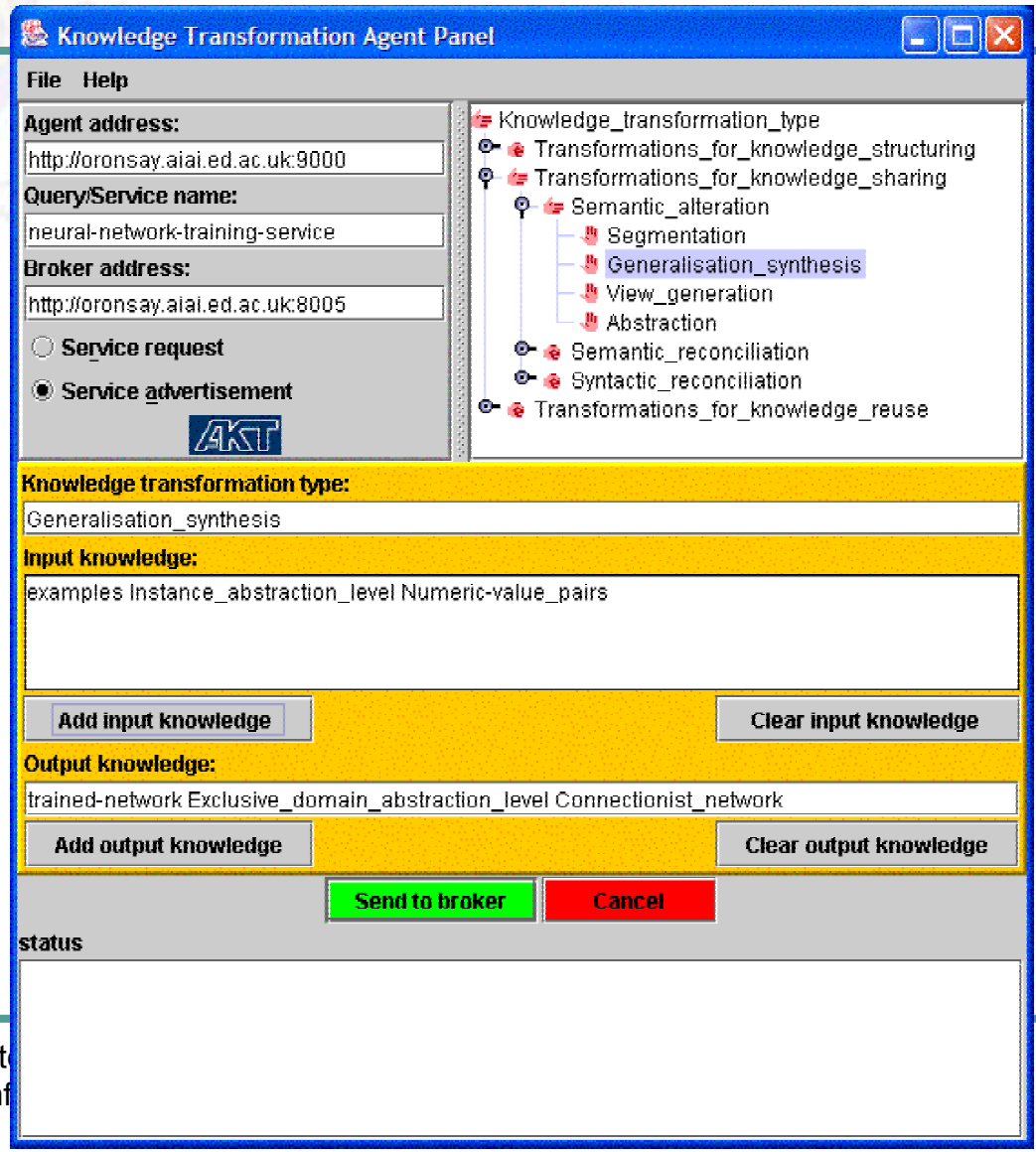
```
ask(traveller,has_money(joe,1000,gb_pound),
                        http://foula.aiai.ed.ac.uk:9000),
test([person(joe)]),
ask(ticket_office,(issue_ticket(joe,italy,_Ticket):-
                        has_money(joe,1000,gb_pound)),
                        http://oronsay.aiai.ed.ac.uk:12100,
    using(traveller,pay(joe,ticket_office,1000,gb_pound),
                          http://foula.aiai.ed.ac.uk:9000)),

test([valid_ticket(_Ticket)])
```

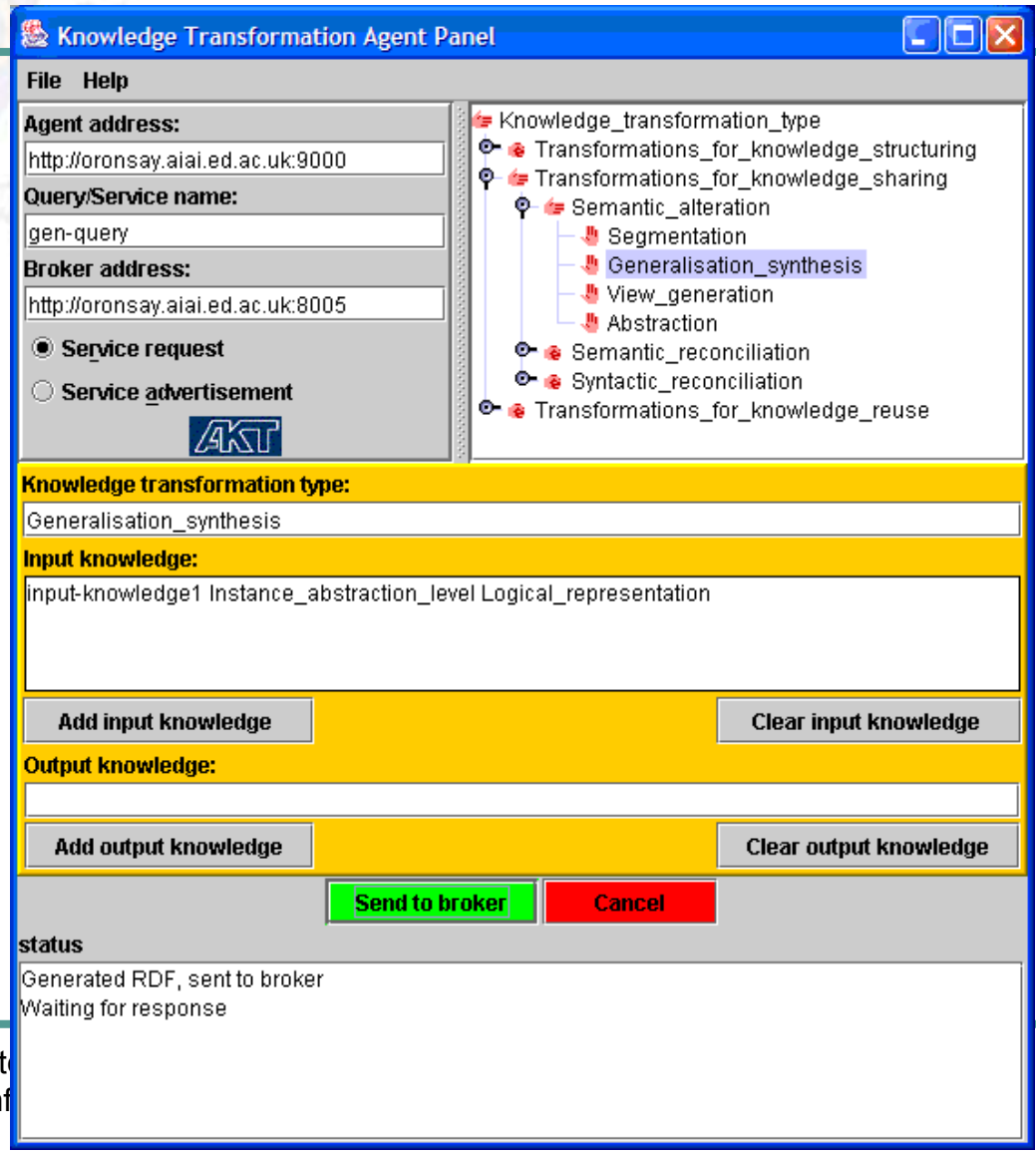
Transformational Brokering

- An attempt to operate at a more abstract service level.
- A service is described as a transformation from one or more input ‘bodies of knowledge’ to an output body of knowledge:
  - A transformation is described according to a given classification.
  - A body of knowledge is described in terms of its representation format and abstraction level.
- A query takes the form of the description of a (possibly partial, possibly more general) desired transformation.

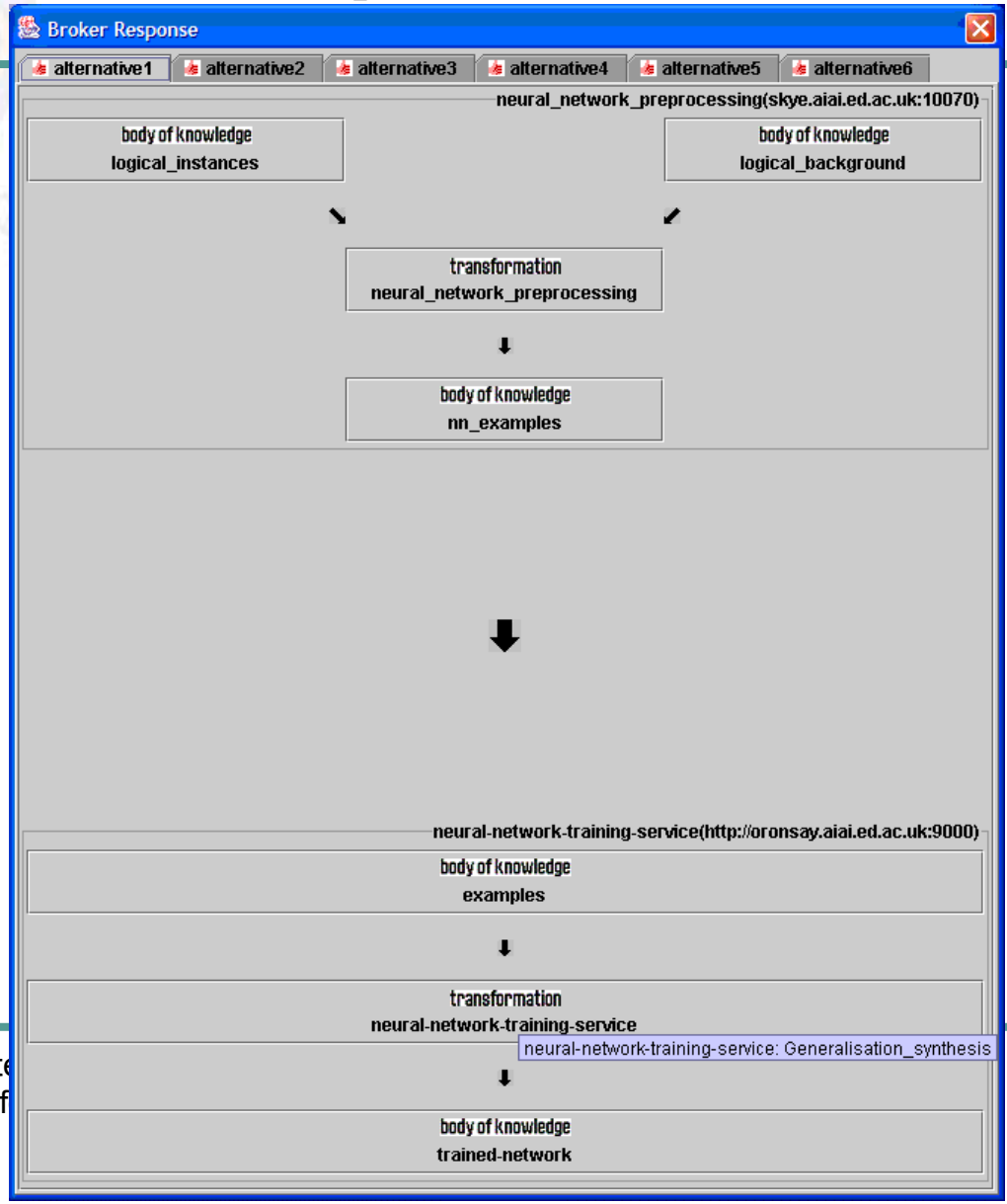
Service Advertisement



Service Request



Sample Solution



Issues

- What sort of broker is appropriate?
  - Depends on the problem…and the assumptions that can be made about the environment and its agents….
- Broker mechanisms in Prolog:
  - Will this scale to more agents doing more complicated things?
- Interoperability:
  - Broker communications described using FIPA with content expressed in RDF(S).
  - How feasible is the use of shared ontologies for service/query content?
- Security? Trust? Reliability? etc…
  - Of services? Of broker?