

FOUNDATION FOR INTELLIGENT PHYSICAL AGENTS

FIPA Personal Travel Assistance Specification

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19 **Foreword**

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21 industry of intelligent agents by openly developing specifications supporting interoperability among agents and agent-
22 based applications. This occurs through open collaboration among its member organizations, which are companies and
23 universities that are active in the field of agents. FIPA makes the results of its activities available to all interested parties
24 and intends to contribute its results to the appropriate formal standards bodies.

25 The members of FIPA are individually and collectively committed to open competition in the development of agent-
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27 partnership, governmental body or international organization without restriction. In particular, members are not bound to
28 implement or use specific agent-based standards, recommendations and FIPA specifications by virtue of their
29 participation in FIPA.

30 The FIPA specifications are developed through direct involvement of the FIPA membership. The status of a
31 specification can be either Preliminary, Experimental, Standard, Deprecated or Obsolete. More detail about the process
32 of specification may be found in the FIPA Procedures for Technical Work. A complete overview of the FIPA
33 specifications and their current status may be found in the FIPA List of Specifications. A list of terms and abbreviations
34 used in the FIPA specifications may be found in the FIPA Glossary.

35 FIPA is a non-profit association registered in Geneva, Switzerland. As of January 2000, the 56 members of FIPA
36 represented 17 countries worldwide. Further information about FIPA as an organization, membership information, FIPA
37 specifications and upcoming meetings may be found at <http://www.fipa.org/>.

38 Contents

39	1	Scope	1
40	2	General Analysis	2
41	2.1	Introduction	2
42	2.2	Problem Statements	3
43	2.3	Business Domain Analysis	4
44	2.4	Actors and Roles	5
45	2.4.1	Travel Service Agent	5
46	2.4.2	Travel Broker Agent	5
47	2.4.3	Personal Travel Assistant	6
48	2.4.4	Mini-Personal Travel Assistant	6
49	2.5	Scenario	6
50	2.6	External Software Integration	7
51	2.7	Internal Software Integration	7
52	2.8	Internal Capabilities	8
53	2.9	Human-Agent Interface	8
54	2.10	Agent Management	9
55	3	Architecture	10
56	3.1	Service Architectures and Protocols	10
57	3.2	Agent Definitions	10
58	3.2.1	Mini-Personal Travel Agent	10
59	3.2.2	Personal Travel Agent	11
60	3.2.3	Travel Broker	11
61	3.2.4	Tourist Office Broker	12
62	3.2.5	Flight Service Provider	12
63	3.3	Agent Platform Profiles	13
64	3.3.1	Small Company Agent Platform	13
65	3.3.2	Travel Broker Agent Platform	13
66	3.3.3	Agent Hotel Platform (On-Trip Execution)	13
67	3.3.4	Domain Structures	14
68	4	Personal Travel Assistant Ontology	15
69	4.1	Object Descriptions	15
70	4.1.1	Trip Summary	16
71	4.1.2	Location	16
72	4.1.3	Travel Time	17
73	4.1.4	Budget	17
74	4.1.5	General Preferences	17
75	4.1.6	Common Travel Preferences	19
76	4.1.7	Individual Travel Preferences	19
77	4.1.8	Trip Details	20
78	4.1.9	Common Travel Segment	20
79	4.1.10	Individual Travel Segment	20
80	4.1.11	Service Point	21
81	4.1.12	Service Link	21
82	4.1.13	Geographic Data File Node	21
83	4.1.14	Geographic Data File Link	22
84	4.1.15	Plan Evaluation	22
85	4.2	Function Descriptions	22
86	4.2.1	Reserve a Segment	23
87	4.2.2	Cancel a Segment	23
88	4.2.3	Purchase a Segment	23
89	4.2.4	Modify a Segment	23
90	4.2.5	Evaluate a Plan	24

91	4.3	Elaboration of the User Profile	24
92	4.4	Exceptions	25
93	4.4.1	Failure Exception Propositions	25
94	5	Study Cases.....	26
95	5.1	Pre-Trip Planning.....	26
96	5.2	Elaboration of Pre-Trip Planning.....	30
97	5.3	Last Minute Auction for Lower Fare.....	31
98	5.4	On-Trip Execution.....	33
99	5.5	Travel Plan Monitoring.....	35
100	6	Agent/Software Integration.....	37
101	6.1	Web-Based Fare Wrapper.....	37
102	6.1.1	Registration of a Wrapper Agent	37
103	6.1.2	Request for a Price.....	37
104	6.1.3	Notification of Price Change	38
105	6.2	BAYERNInfo Service Wrapper	38
106	6.2.1	Agent Request for a Route	38
107	7	Future PTA Developments.....	39
108	7.1	Travelling Users.....	39
109	7.1.1	Agent Mobility in a Network: Travel Planning	39
110	7.1.2	Traveller Mobility: Travel Monitoring.....	39
111	7.1.3	Traveller Mobility: Travel Monitoring Via UMTS	39
112	7.2	Inter-Operation Between Agents and Workflow.....	40
113	8	References.....	41
114			

114 **1 Scope**

115 This document extends the FIPA standard by providing an application specification for the travel industry. This
116 specification provides:

117
118 An overview of the current industry in regard to agents,

119
120 A reference architecture for a multi-agent system in this industry,

121
122 Examples of the agent management details such as domains and naming,

123
124 Examples of agent communication details such as content ontologies and communication protocols, and,

125
126 Examples of agent/software integration such as for accessing databases and mobile users

127
128 This specification is not complete, but the included examples help to illustrate the use of FIPA standard and thereby
129 quicken the development and deployment of real systems. Some points of this architecture have been selected as
130 normative in order to begin inter-operability tests of field trials. These requirements are noted throughout the
131 specification as they arise.

132
133 In summary, this specification servers three purposes:

134
135 1. To continue testing the FIPA technical specifications. The context of a real application serves to determine the
136 strengths and weaknesses of the specifications,

137
138 2. To demonstrate the real business value and requirement of a standard specification for such a large, distributed,
139 multi-vendor application, and,

140
141 3. To define initial application architecture, object design and use case analysis for actual development of field trials.

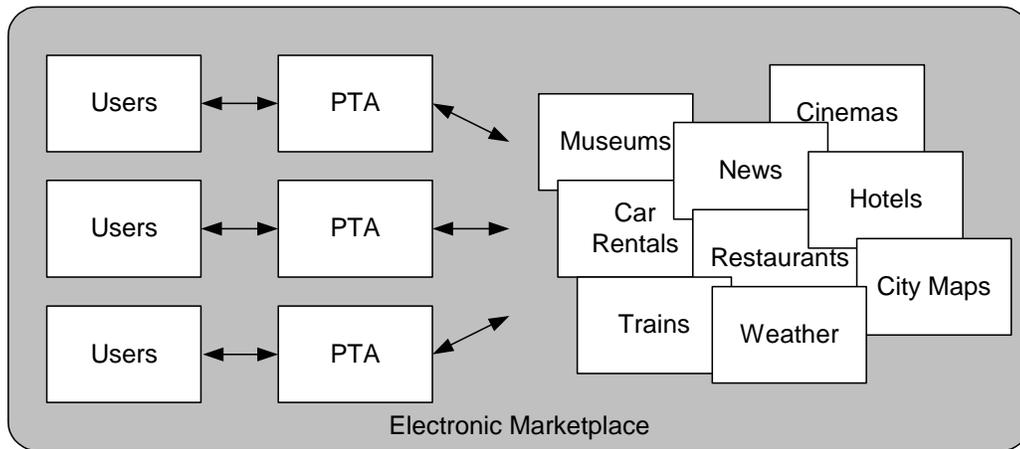
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143 **2 General Analysis**

144 **2.1 Introduction**

145 A wide variety of travel related services are becoming increasingly available through electronic means. There is a need
 146 for convenient and ready access to these services, in particular for travellers. This presents a prime example to
 147 showcase the benefits of agent technology. Agents operating on behalf of their users can provide assistance in the pre-
 148 trip planning phase, as well as during the on-trip execution phase of a trip. A system supporting these services is called
 149 a Personal Travel Assistant (PTA) system (see *Figure 1*).

150
 151 In order to accomplish this assistance, these agents will interact with the user and with other agents representing the
 152 available travel services. The agent system is responsible for the configuration and delivery, including the right time,
 153 cost, quality of service and appropriate security and privacy measures, of trip planning and guidance services (for
 154 example, multi-modal route planning, hotel and parking-lot reservations, individualised traffic guidance, cartography
 155 services, tourism information, plane reservation, metro guidance, weather conditions, public transportation, special
 156 events, etc.). Further, there is interaction with other supporting agents such as media agents, directory services (yellow
 157 and white pages) and information brokers that seek, evaluate and deliberate on information.
 158



159
 160
 161 **Figure 1: A Scene from FIPA Enabling Applications**

162 The PTA system should support the following core functionalities:

163 Different modes for request/response; the user does not need to be connected while a request completed,
 164

165 Composition of services; the system should provide an integrated experience even though the component services
 166 are disparate,
 167

168 Comparison of service offerings; the system should evaluate and provide the user with different service dimensions
 169 such as cost or other user's experience,
 170

171 Learning the user profile; the system should become more efficient toward the user's needs and habits with
 172 continued experience,
 173

174 Interoperability of communication means; the same underlying services should be available through many different
 175 media such as voice-phone, pager, e-mail and screen-phones,
 176

177 Administration of agents; the system and user will need the ability to follow-up agents or otherwise change their
 178 behaviour at any time,
 179

180 Alerts; the user should be notified of significant events, and,
 181
 182

183

184

Negotiation and transactions; the system should act on behalf of the user to make deals and commit to purchases, for example.

185

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187

This list of functions includes connectivity to basic services such as email as well as emerging services in e-commerce such as advertising and web casting. The PTA domain is rich with many basic and emerging possibilities, but for focus in this document, two test scenarios are developed, which represent the two basic phases of agent support:

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Pre-trip planning; the activities made in preparation for a trip, such as booking flights and hotels, and,

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193

On-trip execution; the activities required during a trip for successful execution, such as monitoring the schedule and making changes to bookings as required.

194

195

196

Focusing on these primary scenarios, this specification includes an overall outline of the agent types and roles and the software and devices required for both phases. For instance, on-trip execution introduces the potential use of PDAs and the agent's attachments to cellular or GSM-based phones and GPS services. Other secondary scenarios are included in this specification to demonstrate other aspects of the FIPA specifications; for instance, parts of an agent's lifecycle and special focus of mobility will be included.

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Travel is an excellent application to demonstrate because it includes so many external attachments that are of interest to many other applications. For instance, the Travel scenario will include:

203

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205

Information Retrieval

Travel services provide both database and Web-based access and search.

206

207

208

Scheduling

Travel not only includes scheduling within its own domain, travel schedules must also interact with personal calendars and schedules. Calendar tools, e-mail, and other general office applications are required.

209

210

211

212

End-user Mobility

Not to be confused with agent mobility, travel implies several mobile device modalities and problems of communication in connected/disconnected states.

213

214

215

216

Agent Mobility

Because of user mobility, agent mobility is often indicated for the transfer of binary or script code through the network.

217

218

219

220

Moreover, the travel scenario includes very strong testing of agent-to-agent attachment and the internal capacities to support different agent roles. For instance, the following agent-based technologies are also of very general interest:

221

222

223

Combined or Competitive Services

Compare attributes, negotiate cost and time .

224

225

226

User Profiling

Personal preferences and adaptive user modelling.

227

228

229

The latter issue is not directly addressed by the FIPA standard, but is critical to travel and several other end-user driven applications.

230

231

232

2.2 Problem Statements

233

The application of agents to the Travel industry exposes some very important problems now being faced by agent developers and applications in many other industries as well:

234

235

236

Web-based and Database-Based Publication

As the travel service providers move from database to web-based pricing, for instance, agent developers are faced with the problems of HTML parsing. While this method is workable, it is very sensitive to minor and peripheral format changes. All agents of all vendors must spend a great deal of effort to maintain the agents' proper attachment. Both the database-based and Web-based content can include "agentised" mediation. Aside from some re-publication issues, one or a few agent-based services can parse and otherwise "logicise" the raw data, offering this service to other agents. Other solutions, such as XML tags for ontology and content are very sympathetic to agent development, and future Web-based service providers might directly provide the agent-based service as well, but in any case, other agents from other vendors should rely on a well-founded communication standard at the level of agents.

Complexity of Market (De)Regulations

Travel policy (especially in world-wide travel) is complex and often un-known to human travel agents. These policies are highly distributed, from corporate policy to agency policy to national and international law. The representation and use of such policies is a fairly straight-forward knowledge engineering task. A distributed agent approach seems required to partition the problem and allow different vendors to provide different parts of the solution so that every agent in the system needs not carry all the responsibility.

Complexity of Real World Transactions

Travel planning is really a "super-transaction" of many negotiations. A service cannot merely find low fare, because lower fare is only one of many hard and soft constraints. A transaction cannot be based or concluded only for flight arrangements, because hotel, car, and many personal arrangements must also be established. To provide real value, a service should also be suggestive and beyond the direct travel needs and the PTA services should collectively provide the end user with a complete travel package, not just the minimal travel documents. It should contribute for market expansion into other segments.

This last problem suggests the need to co-ordinate the transactions using agent-based protocols such as Contract Net and internal technologies such as incremental scheduling. Because these are very specialised techniques, the FIPA design philosophies for agent software integration and agent interaction provide a solution by distributing the responsibilities; PTA is a very large and difficult problem, best solved by vendor specialists in internal agent technologies, external software domains, and agent-to-agent protocols that can work together.

To summarise, the PTA services should provide an effective test bed of the technology-oriented normative parts of the FIPA standard.

2.3 Business Domain Analysis

The viewpoint on business domain analysis of the Travel industry is based on a system focus; on the purpose, scope and policies for the system. It can be modelled in terms of objects representing user roles, business and management policies. This viewpoint is concerned with the overall environment in which a system is to operate. In the case of this specification, it spans co-operating organisations. In general, *Figure 2* represents the separate business domains.

This model can be used as a framework for:

Analysing the organisational environment

This mainly includes network operators, service providers and customers. Which actors are involved and how do they relate to each other, that is, their roles, their domains of activity, the inter-domain policies (security, billing) and what are the interactions between the system and the environment in which it is placed?

Defining the requirements of actors

For instance, what are the requirements between customers with respect to providers, that is, contractual relationships properties such as security aspects, payment and quality of service?

In each role, an actor performs different types of provisioning activities. Identifying these helps distinguish between different parts of an organisation and can indicate the types business and management support required.

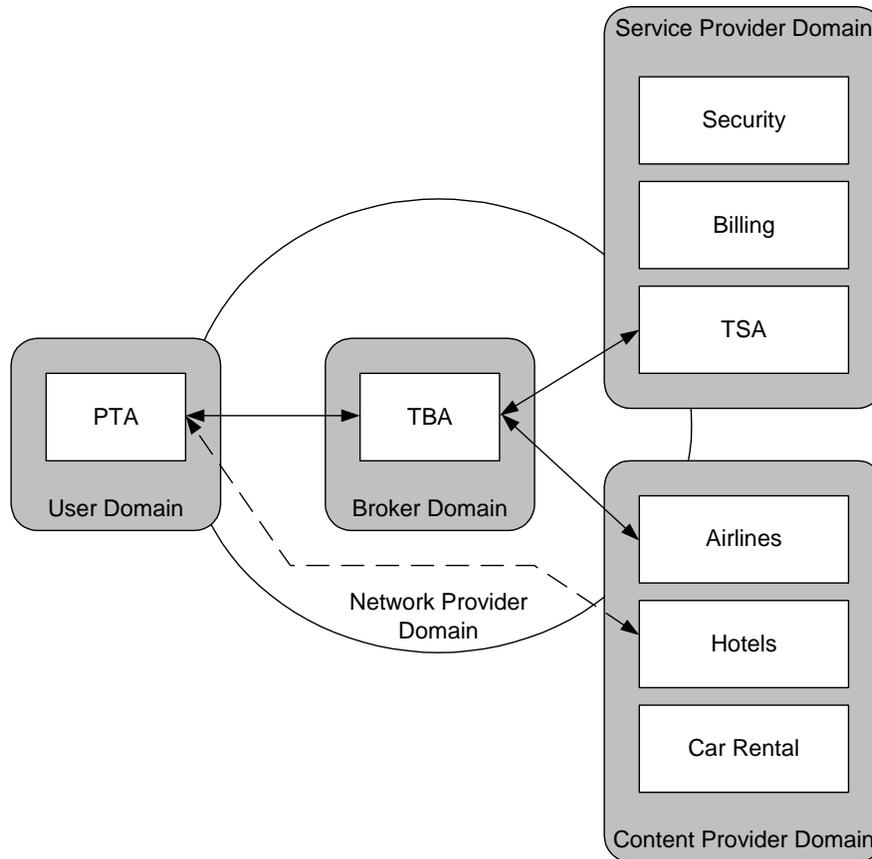


Figure 2: Relationships Between Business Domains

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295 **2.4 Actors and Roles**

296 **2.4.1 Travel Service Agent**

297 The Travel Service Agent (TSA) is responsible for attachment to the data of their domain. The scope of each domain is
298 arbitrary, but each such agent would tend to specialise in global flight plans and hotel arrangements or local hotel, car
299 and restaurant information, for example. Other services might specialise in tourism or restaurants, for example, but
300 globally. In either case, providing such "soft" added value about museums, theme parks and special events/offers
301 should be a strong part of agent co-operation to build a more complete travel plan for the user.

302
303 In all cases, this agent type is responsible for maintaining the data access, interpretation and delivery to other agents.
304 Such agents would typically use search services, too, in order to keep themselves up to date or to provide integrated
305 searches within the a travel domain to other agents. Any such agent service might be implemented as a "wrapper"
306 around legacy databases or WWW page content (see [FIPA00079]). New services can be directly wrapped by an
307 agent, but this distinction would be transparent to other agents.

309 **2.4.2 Travel Broker Agent**

310 The Travel Broker Agent (TBA) is responsible to locating and contracting with TSAs. It can obtain the travel options
311 from several services, filter and select from the alternatives, and legally bind a contract and travel documents based on
312 a final selection. It can schedule and incrementally reschedule the entire travel plan across several service types such
313 as flight, train, hotel and special events.

314

315 This agent type provides its service to any "anonymous" user. In other words, its service connection with the user is
 316 only for the life of the super transaction; it does not serve as the personal agent to any one user and does not keep any
 317 persistent information about particular users, aside from its own auditing/logging needs.
 318

319 **2.4.3 Personal Travel Assistant**

320 The PTA acts on behalf of a user and is legally authorised to do so, up to the level allowed by the user. While
 321 conceptually seen as one Personal Assistant (PA) for each user, the implementation should be assumed to use a multi-
 322 user, server-based design. This agent type has many similarities to a personal assistant and might simply be a cast in a
 323 similar role. This agent is responsible for remembering and following the user's instructions and learning the user's
 324 preferences based on choices or feedback after the trip.
 325

326 **2.4.4 Mini-Personal Travel Assistant**

327 The Mini-Personal Travel Assistant (MPTA) is a lightweight agent that is typically device-dependent, such as an agent
 328 operating on a PDA or laptop computer. For instance, bandwidth and modality become special issues. Although this
 329 tends to cause a restriction of functionality, many additional functions such as GPS and GSM can be provided in this
 330 context.
 331

332 Some assumptions about these responsibilities might be changed or elaborated. For instance, the TBA might maintain
 333 some of the personal information of users, such as simple travel preferences (airline seating, smoking or non-smoking).
 334 Also, value-added services can be provided by many different arrangements. For instance, the communication of the
 335 MPTA can be various. Does the user/MPTA contact the TBA directly on the road or always through the PTA? Can the
 336 user directly contact the TBA? Is the PTA really a sub-function of a PA (like a personal secretary)?
 337

338 Each project will determine the answers to these questions, but for initial field trials of FIPA standards, this specification
 339 will assume that TBA will interact with PAs (see [FIPA00083]) and that the PA will take the role of PTA. In either case,
 340 the following scenario is primary for such field trials.
 341

342 **2.5 Scenario**

343 The typical dialogue between real users and travel agencies will be used as a guiding metaphor:
 344

- 345 1. The user asks their secretary to make travel reservations for the next day. The user delegates the task to the agent.
 346 The agent is generally autonomous and bothers the user only for confirmation or in exception conditions. Time
 347 constraints for completion of this task might be explicitly stated or assumed according to the travel attributes or
 348 personal preferences (for example, past history).
 349
- 350 2. The secretary calls a travel agency. In the simplest case, the user's company might be pre-contracted with only one
 351 agency or the secretary might have some choice, but only within a list of approved and registered agencies. The
 352 assumption here is that there is some sort of accreditation or professional membership that ensures and suggests
 353 competency of the agency.
 354
- 355 3. The travel agency contacts several providers of services to build a complete plan. The travel agent maintains a
 356 dialogue with the secretary, who has a better sense of the user, validates how the travel documents should be
 357 delivered, etc.
 358
- 359 4. The secretary reports back to the user with a plan, options and additional information. The secretary places the
 360 schedule with some travel information on the user's calendar, perhaps also setting reminders for when the user
 361 should leave to catch the flight.
 362

363 **2.6 External Software Integration**

364 These different agent types have varying levels of integration to external software and/or other agents. For instance, the
 365 TSA's responsibilities are most for attachment to data sources, whereas a TBA's function is more abstract and more
 366 responsible to managing agent interactions. The *Table 1* lists external software attachments.
 367

Agent Type	Possible Software Attachments
Travel Service Agent	Existing Travel Database Services HTTP/HTML Broadcast Protocols (for example, RDS, DAB, ...) Search Service
Travel Broker Agent	Yellow Pages Directory (for example, LDAP) White Pages Directory (for example, LDAP)
Personal Travel Assistant	GSM Email Calendar/Scheduling Fax E-Commerce Video Server
Mini-Personal Travel Assistant	GSM GPS/Cartography Pager

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Table 1: External Software Attachments

Note that the TBA uses directory services but provides much more. More than a directory service alone, a TBA is itself an agent and can provide the negotiation and consolidation of services as an added-value. Also note how the PTA might provide travelogue video services; although a PA can also talk directly to a TBA, this is the kind of added value within a particular industry focus that a PTA can uniquely provide. This list is by no means exhaustive, but gives some idea of the integration components required and how these components might be reusable in other domains aside from travel.

378 **2.7 Internal Software Integration**

379 For instance, there are two approaches to integrating internal software. First, special internal engines such as for
 380 scheduling or learning can use this specification to attach such components to the agent. The internal reasoning of the
 381 agent can control other external and internal components equally. Applications can test whether or not the external
 382 wrapper interface can be used to attach internal capabilities of the agent to each other as well.
 383

384 Second, any special intelligence function can be made into a first class agent that provides such scheduling or
 385 translation of learning services. This approach too should be tested with different applications and compared with the
 386 first approach.
 387

388 In some regards, the two approaches are very internal components of intelligence to be viewed recursively and a large-
 389 grained agent's internal composition is a "society of minds" based on smaller, semantically simpler agents. Wrappers
 390 are much like very simple agents using a subset of communicative acts.
 391
 392

392 **2.8 Internal Capabilities**

393 Internal capabilities of agents are not the subject of FIPA standards but are important considerations for application
 394 design. *Table 2* lists the types of technology the agents are likely to require to serve each of their purposes.

Agent Type	Possible Internal Capability
Travel Service Agent	Rule-Based Inference Procedural Scripting
Travel Broker Agent	Rule-Based Policy and Planning Contract Net Protocol Rationality Acquaintance Modelling
Personal Travel Assistant	Rule Sets Preference Facts Based on User Instruction Adaptive User Model Learning
Mini-Personal Travel Assistant	Micro-Kernel capabilities Server-loadable Procedures

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Table 2: Internal Agent Capabilities

TSA's have simple requirements; they typically will respond to requests for information. Simple rule based or even scripting systems for the most basic services will be typical.

TBA's are probably the most complex agents; they must adhere to industry and owner policies. They should follow a number of co-operation and negotiation protocols. This is the most appropriate place for rational agents that can understand and respond very flexibly to any number of different situations. The TBA's should maintain an acquaintance model, such as for management of long-term associations with other agents.

As for the Personal Agents, basic inference is probably appropriate, but the addition of end-user modelling (learning) will be of increasing importance in such agents. The MPTA is more peculiar since it should act much like the PTA, but given the small size of the devices it must live on, the MPTA per se needs to be minimal and rely on networking with other agents to provide its intelligence as perceived by the user. Some core capabilities will need to be installed, but aside from communications with other agents, alternative architectures employing mobile code can dynamically load the MPTA as needed.

413 **2.9 Human-Agent Interface**

414 While the fundamentals of human-agent and agent-agent interaction should be based on the same underlying formal
 415 dialogue model, the FIPA standard does not seem to support full application development. Particularly, there are neither
 416 standard interfaces and component definitions for supporting the graphical/text and/or voice/speech interfaces directly
 417 at the end-user, nor are there translation tools from these "natural" representations to a formal model. To compensate,
 418 the above scenario assumes a highly restrictive end-user input form, which would have to be tightly coupled to a
 419 dialogue representation.

420
 421 A very important issue to consider is the "just necessary level" of user interaction. How is this established? By standard
 422 user interface controls and techniques? This problem requires specialised studies to define just necessary level: how
 423 are user preferences established and how do preferences interact with task complexity. Acceptability of the PTA and all
 424 other assistants will be based largely on matters of trust and control.

425
 426 Even though human-agent dialogue tools are not specified by FIPA, this specification includes a Dialogue Wrapper
 427 which translates any software user-interface events and media applications into FIPA-compliant communicative acts
 428 and content within the agent.

429

430 **2.10 Agent Management**

431 Life cycle management (see FIPA00023] is the first concern of the PTA system, even before the system is deployed.
432 The domain definitions, agent naming and registrations must be handled first.

433
434 PTA requirements for e-commerce and personal profiling give great need to addressing security. Basic services for
435 ensuring the financial transaction and certification of documents are required. Much of this can be assumed by
436 appropriate use of the underlying protocol, such as SSL.

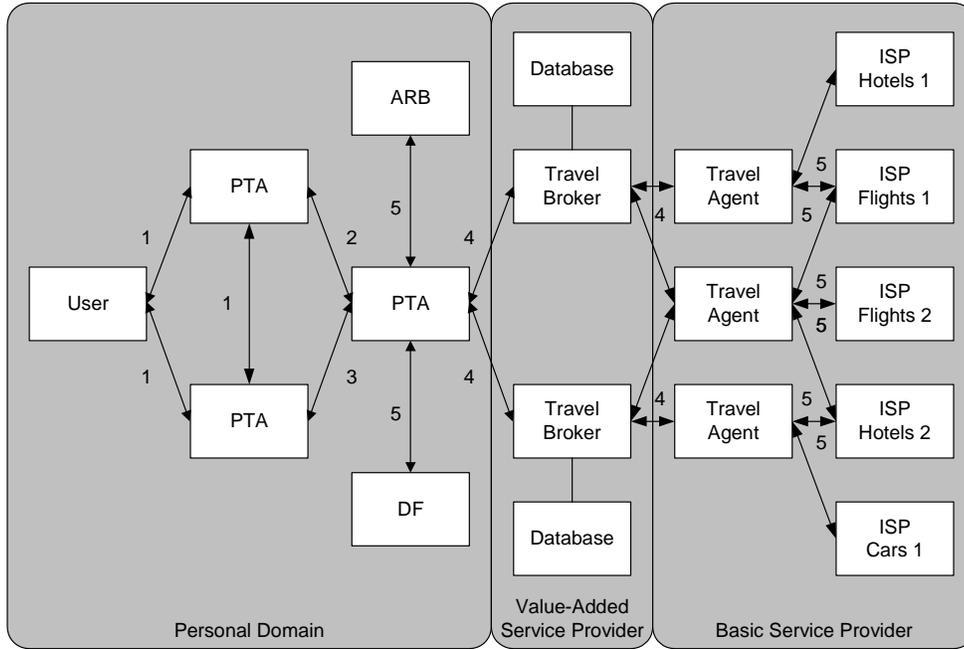
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438

438 **3 Architecture**

439 **3.1 Service Architectures and Protocols**

440 The PTA architecture (see *Figure 3*) should act as a reference model which identifies and characterises the
 441 components, interfaces and protocols.
 442



443
 444
 445 **Figure 3: Personal Travel Assistant Architecture**
 446

447 The diagram represents the various agent types and the communication types between them. This section provides a
 448 description of representative agents, some representative APs and then the protocols between them. Conventions such
 449 as for agent naming will be followed as they are developed by [FIPA00023], but note that much of what is given in this
 450 specification is deliberately inconsistent (when consistency is not required) to demonstrate the probable state of multi-
 451 vendor vagaries.
 452

453 **3.2 Agent Definitions**

454 Assume that a small company, *CompanyXYZ*, has installed an AP in which a multi-user implementation of a PTA is
 455 added. Each employee also is given a PDA with an MPTA. CompanyXYZ has agreements and policies to use World
 456 Travel Agency business travel and as an added value to its employees, CompanyXYZ has also developed its PTA to
 457 look-up value-added brokers to arrange for their personal interests, as well. These agencies are associated with various
 458 basic service providers.
 459

460 **3.2.1 Mini-Personal Travel Agent**

```

461 :name
462   (agent-identifier
463     :name MPTA.JoeSmith@companyxyz.com
464     :addresses (sequence gsm://011235551234/acc))
465 :type fipa-mpta
466 :services (set
467   (service-description
468     :properties (set
469       (property

```

```

470         :name Actions
471         :value (set notify available)))
472     :ontology (set User))
473 (service-description
474   :properties (set
475     (property
476       :name Location
477       :value self))
478   :ontology (set FIPA-PTA)))
479 :protocol (set FIPA-Request)
480 :ontology (set User FIPA-PTA)
481

```

482 Joe Smith is given an MPTA because he travels a lot for Company XYZ. Due to its limited capacity, it understands only
 483 the `request` protocol (see [FIPA00026]), but can provide a unique service to the entire PTA system of agents.
 484 Assuming an ontology called `User`, it can handle the operation of notifying the user, if he/she is available. For on-trip
 485 monitoring, it can provide location of itself, through its GPS attachment for example.
 486

487 3.2.2 Personal Travel Agent

```

488 :name
489   (agent-identifier
490     :name PTA@companyxyz.com
491     :addresses (sequence iiop://agents.companyxyz.com/acc))
492 :type fipa-pta
493 :services (set
494   (service-description
495     :properties (set
496       (property
497         :name Profile
498         :value PersonalInterests))
499     :ontology (set User))
500   (service-description
501     :ontology (set FIPA-PTA)))
502 :protocol (set FIPA-Contract-Net FIPA-Auction-Dutch FIPA-Request)
503 :ontology (set FIPA-PTA)
504

```

505 Assume that a small company such as CompanyXYZ would have only one personal travel agent as a multi-user system
 506 to service its entire staff. CompanyXYZ allows any flights with any carrier in order to get the cheapest fare and
 507 therefore, this PTA can follow Dutch auctions as well as contract net for conversation, either with brokers or with service
 508 providers directly. The company itself owns this PTA in order to control it in regard to corporate travel policies for
 509 example. Not only does the PTA handle the `FIPA-PTA` ontology for making regular travel arrangements, but it only
 510 understands user profiling. Residing on a server, the PTA is responsible for holding such personal profiling information
 511 (common travel preferences as well recreational interests, perhaps).
 512

513 3.2.3 Travel Broker

```

514 :name
515   (agent-identifier
516     :name TravelAgent76@worldtravel.com
517     :addresses (sequence iiop://broker.worldtravel.com/acc))
518 :type fipa-pta-broker
519 :services ...
520 :protocol (set FIPA-Contract-Net FIPA-Request-When)
521 :ontology (set FIPA-PTA)
522

```

523 As a large travel company, *WorldTravel* has a bank of several agents and this is number 76. As a TBA, this agent
 524 understands contract-net for negotiating basic travel arrangements, but also provides monitoring functions for its
 525 customers by using the `request-when` protocol (see [FIPA00028]) with its service providers. For instance, when a
 526 certain condition occurs concerning a reservation or the availability of a resource, the TBA is notified and can in turn
 527 notify other acquaintances.

528

529 3.2.4 Tourist Office Broker

```
530 :name
531   (agent-identifier
532     :name TourAgent@tokyotourism.com
533     :addresses (sequence iiop://broker.toyko.tourism/acc))
534 :type fipa-pta-broker
535 :services ...
536 :protocol (set FIPA-Request)
537 :ontology (set User-Personal-Interest)
```

538

539 A tourist office in Tokyo with a small budget wants to participate in the PTA system by registering its agent with several
540 brokers as a free value-added source of information. It is itself of broker of other agents in its geography, but it is
541 informational only. For instance, given a user's personal interests, it can connect a PTA to an appropriate soft-service
542 agent. It might also provide information about these soft services but does no transaction itself; it only needs the
543 request protocol (see [FIPA00026]).

544

545 3.2.5 Flight Service Provider

```
546 :name
547   (agent-identifier
548     :name Domestic389@foil.com
549     :addresses (sequence iiop://flightplanners.foil.com/acc))
550 :type fipa-pta-server
551 :services (set
552   (service-description
553     :ontology (set FIPA-PTA)
554     :properties (set
555       (property
556         :name Actions
557         :value (set reserve purchase))
558       (property
559         :name PTA-MeanType
560         :value plane))))))
561 :language (set FIPA-KIF))
562 :protocol (set FIPA-Contract-Net)
563 :ontology (set FIPA-PTA)
```

564

565 A very large flight reservation company maintains a number of agents, some for domestic travel and some for
566 international. It can make reservations or accept purchase for flights, but for flights only.

567

568 6.2.6 Web Service Provider

```
569 :name
570   (agent-identifier
571     :name GardenGuide@kewgardens.com
572     :addresses (sequence http://agents.kewgardens.com/acc))
573 :type fipa-pta-server
574 :services (set
575   (service-description
576     :ontology FIPA-PTA
577     :properties (set
578       (property
579         :name PointOfInterest
580         :value Gardening))))))
581 :protocol (set FIPA-Request)
582 :ontology (set Yahoo FIPA-PTA)
```

583

584 A public garden that has a Web site for itself and links to other points of similar interest could register with a broker to
585 provide information in this recreational domain. Although IOP was initially required to register with the brokers, it then

586 changes its preferred address to use HTTP, perhaps to use a future HTTP user profiling standard. Note also that the
 587 ontology assumes Yahoo-based classification as a de-facto standard for specifying a user's interests.
 588

589 3.3 Agent Platform Profiles

590 The following descriptions provide a list of examples using the AP description definition from [FIPA00023].

591 3.3.1 Small Company Agent Platform

```
592 (ap-description
593   :name companyxyz.com
594   :dynamic false
595   :mobility false
596   :properties (set
597     (property
598       :name Change-Environment
599       :value Administrator)
600     (property
601       :name Delegation-Allowed
602       :value (set (PTA.User) (PTA.Administrator)))
603     (property
604       :name Grant-Services
605       :value Within-Platform)
606     (property
607       :name Access-DF
608       :value within-platform)
609   :transport-profile ...)
```

610
 611 CompanyXYZ knows and provides all agents to its employees and so the agent system design is tightly con-trolled; the
 612 broker agents that the company has decided to use are known and static. Therefore, it does not allow dynamic
 613 registration nor support mobility. Authority is given to the administrator only and all permissions for accessing services
 614 and the DF are limited to agents within this AP. If any broker wants to contact the PTA, it must be based on its
 615 acquaintance model developed from the PTA's initial contact with it.
 616

617 3.3.2 Travel Broker Agent Platform

```
618 (ap-description
619   :name worldtravel.com
620   :dynamic true
621   :mobility false
622   :properties (set
623     (property
624       :name Change-Environment
625       :value Administrator)
626     (property
627       :name Delegation-Allowed
628       :value No)
629     (property
630       :name Grant-Services
631       :value (set (Within-Platform PTA.CompanyXYZ)))
632     (property
633       :name Access-DF
634       :value Within-Platform)
635   :transport-profile ...)
```

636
 637 The *Travel Service* company wants to allow outside agents to use its services, but no delegation is allowed.
 638

639 3.3.3 Agent Hotel Platform (On-Trip Execution)

```
640 (ap-description
641   :name travelservice.com
```

```

642 :dynamic true
643 :mobility true
644 :properties (set
645   (property
646     :name Change-Environment
647     :value Administrator)
648   (property
649     :name Delegation-Allowed
650     :value No)
651   (property
652     :name Grant-Services
653     :value (set (Within-Platform (ServiceProvider.Guest ContentProvider.Guest))))
654   (property
655     :name Access-DF
656     :value Yes)
657 :transport-profile ...)

```

659 Here, the metaphor of travelling agents as entourage to the human traveller is entertained by giving mobile agents a
660 temporary home. The requirement is obviously not to rest; indeed, the agent can be continuously very active, but such
661 an AP and the availability of a local DF provides a natural metaphor for many agent-based services.

663 The AP grants the agent access to all the services and content granted to guest authority. Many such services can be
664 provided by the hotel itself or by surrounding partner agents in the local area. For instance, the hotel can provide its
665 services to a human guest to the agent; the agent can request room service to deliver the user’s preferred breakfast at
666 the preferred time, for example. Note that such an AP can also be hosted by a company other than the hotel itself.

668 **3.3.4 Domain Structures**

669 *Table 3* provides the list of DFs and the agents registered to them (and DFs registered to other DFs) for the pre-trip
670 planning architecture and illustrates the agent-to-agent relationships that are most likely. For instance, a corporation is
671 usually responsible for software distribution to its employees, in this case providing the directory of PTAs, MPTAs within
672 its own domain, as well as contracted relationships to one or two travel brokers.

Directory Facilitator	Registered Agent
df@companyxyz.com	PTA@companyxyz.com MPTA.JoeSmith@companyxyz.com broker@worldtravel.com TravelGuideBroker@travelservice.com
df@worldtravel.com	Planner@foil.com TravelAgent76@worltravel.com
df@foil.com	international@foil.com us@foil.com Domestic389@foil.com
df@travelguide.com	GardenGuide@kewgardens.com TicketSeller@worldsoccerfederation.com

675
676 **Table 3:** Example Agent Registrations

677
678 The TBAs maintain a directory of TSAs which are usually associated with well known, large service providers in the
679 case of corporate travel agents, but generally, TBAs might also keep web-based TSAs in their directory.

680
681 Large service providers might keep their own directory of service agents and associate different agents to different
682 requests as a method of call handling. For instance, some service agents in a larger agency might handle international
683 travel, while others handle local arrangements. These sorts of service differences would be registered in the directory.

684
685

4 Personal Travel Assistant Ontology

Ontologies are needed to serve as a medium of common understanding among the collaborating agents. The FIPA-PTA ontology should be defined in a precise and consistent way to ensure an unambiguous interaction model between the disparate agents. More specifically, it is a significant part of the protocol that collaborating agents necessarily communicate the same terms or vocabularies to mean the same concepts or ideas for the same context. There are already several methods for building ontologies and languages to express them (Prolog, L-Lilog, Ontolingua, Loom, Back++, etc.). However, there is not a well-known ontology built for travel.

The FIPA-PTA ontology does not exist by itself, neither is it self-sufficient to represent the PTA. Separation and cross-references to other ontologies is necessary as indicated in *Figure 4*.

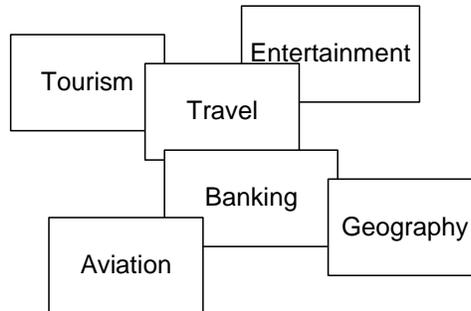


Figure 4: Potential Ontologies for Travel-Related Domains

As FIPA moves to support ontology definition and publication, these various ontologies will in fact become better separated. However, because the development and publication of ontologies per se is still evolving, the FIPA-PTA ontology will be defined here. For other possible relationships to travel, consider [FIPA00081], [FIPA00082] and [FIPA00083]. For instance, the entertainment domain is applicable for referencing video travelogues as a special case for video-on-demand.

Non-FIPA standards such as for Geographic Data Files (see [CENgdf]) will be referenced whenever they exist. ISO standards, such as for Language and Country codes, are also available (see [ISO639], [ISO4217] and [ISO3166]).

The FIPA-PTA ontology is a starting point to help the interoperability of early field trials of this application.

4.1 Object Descriptions

This section describes a set of frames, that represent the classes of objects in the domain of discourse within the framework of the FIPA-PTA ontology. The type definitions that are not specified here can be found in [FIPA00023].

The following terms are used to describe the objects of the domain:

Frame. This is the mandatory name of this entity, that must be used to represent each instance of this class.

Ontology. This is the name of the ontology, whose domain of discourse includes the parameters described in the table.

Parameter. This is the mandatory name of a parameter of this frame.

Description. This is a natural language description of the semantics of each parameter.

Presence. This indicates whether each parameter is mandatory or optional.

Type. This is the type of the values of the parameter: Integer, Word, String, URL, Term, Set or Sequence.

Reserved Values. This is a list of FIPA-defined constants that can assume values for this parameter.

4.1.1 Trip Summary

The sender will provide `trip-summary` object as part of a query for travel arrangements, passing its parameters as a set of constraints. The receiver will reply with `trip-details` object or an exception object.

Frame Ontology	trip-summary FIPA-PTA	Parameter	Description	Presence	Type	Reserved Values
origin	The original location of the trip.	Mandatory	location			
via	A list of via locations of the trip.		Sequence of location			
destination	The destination location of the trip.	Mandatory	Sequence of location			
time	A list of start dates and times of the trip	Mandatory	Sequence of travel-time			
return-travel-time	A list of return dates and times of the trip.		Sequence of travel-time			
budget	The budget for the trip.	Optional	budget			
g-prefs	The general preferences of the trip.	Optional	g-prefs			
ct-prefs	The common travel preferences of the trip.	Optional	ct-prefs			
it-prefs	The individual travel preferences of the trip.	Optional	it-prefs			

4.1.2 Location

Frame Ontology	location FIPA-PTA	Parameter	Description	Presence	Type	Reserved Values
type	The type of the location	Optional	String	Address ParkAndRide PointOfInterest TextLocation ServicePoint TaxiStand GDFNode ResolvedCity		
address	The street of the location.	Optional	String			
city	The city of the location.	Optional	String			
zip-code	The zip code of the location.	Optional	String			
country	The country of the location.	Optional	String	See [ISO3166]		
text	The description of the location.	Optional	String			
service-point	The service point of the location.	Optional	service-point			
gdf-node	The GDF node of the location.	Optional	gdf-node			

739 **4.1.3 Travel Time**

Frame Ontology	travel-time FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
type	The type of the travel time point.	Mandatory	String	Departure Arrival
at	The date and time of travel.	Mandatory	DateTime	See [FIPA00070]
before	The time required before travelling.	Optional	DateTime	
after	The time required after travelling.	Optional	DateTime	

740

741 **4.1.4 Budget**

742 The sender can establish a budget range by specifying an upper spending limit for example. The receiver can reply with
 743 the exact amount using the :at parameter. Such a budget can also be used in other scenarios, such as for a Dutch
 744 auction. The budget can be used to trigger the automatic purchase by an agent when the price meets the constraints.
 745

Frame Ontology	budget FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
currency	The currency in which the currency is expressed.	Mandatory	String	See [ISO4217]
at	The exact value of the budget.	Mandatory	Integer	
upper	The upper limit of the budget.	Optional	Integer	
lower	The lower limit of the budget.	Optional	Integer	

746

747 **4.1.5 General Preferences**

748 This object indicates the preferred means of travel such as train versus car. The :selection parameter allows quality
 749 of service requirements to be expressed. The receiver should be expected to use this parameter to both clip and to
 750 order the results.
 751

Frame Ontology	g-prefs FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
selection	The selection preference.	Mandatory	String	ByCost ByTime ByComfort
preferred	The transport mechanisms preferred in this preference.	Mandatory	Set of String	CollectiveTransport IndividualCar IndividualTransport InterCityCollectiveTransport Taxi UrbanPublicTransport ...
exclude	The transport mechanisms excluded in this preference.	Mandatory	Set of String	CollectiveTransport IndividualCar IndividualTransport InterCityCollectiveTransport Taxi UrbanPublicTransport ...
language	A list of languages associated with this preference.	Mandatory	Set of String	See [ISO3166]
map	The map type preference.	Mandatory	String	ForRoute ForOrigin

				ForDestination
--	--	--	--	----------------

752
753

753 **4.1.6 Common Travel Preferences**

754 This object represents common travel requirements that a user might wish to express to influence the type of
 755 transportation selected.
 756

Frame Ontology	ct-prefs FIPA-PTA	Parameter	Description	Presence	Type	Reserved Values
class	The class of travel for this preference.	Mandatory	String	First Second Business Economy LastMinute ...		
fare	The fare type for this preference.	Mandatory	String	Child Adult Senior WeeklyPass MonthlyPass ...		
other	A list of other preferences.	Mandatory	Set of String	FootPathKnow EscalatorRequested HandicapForEntry HeavyLuggage ...		

757

758 **4.1.7 Individual Travel Preferences**

759 This object represents individual travel preferences to allow the user to include transport services, such as buses, but
 760 which allow the user an anonymous and individual means of transport.
 761

Frame Ontology	it-prefs FIPA-PTA	Parameter	Description	Presence	Type	Reserved Values
preferred-speed	The preferred speed of transport.	Optional	String	Bus CarHurried CarRelaxed Lorry ...		
other	A list of other preferences.	Optional	Set of String	ParkingAtDestination WeatherInformation ...		

762

763

763 **4.1.8 Trip Details**

764 Given a `trip-summary` object as a query, the receiver will reply with a `trip-details` object. This object will include
 765 the original `trip-summary`. The constraints passed by the sender are replaced by the specific values or the `trip-plan`.
 766 For instance, the exact time and budget of the trip are provided. Additional information relating to the trip is appended,
 767 typically of travel documents for providing contact numbers and emergency procedures. Most importantly, the details of
 768 the trip are provided as `ct-segments` or `it-segments`.
 769

Frame Ontology	trip-details FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
trip-summary	The original trip summary query.	Mandatory	trip-summary	
ct-segments	A list of common travel segments.	Optional	Sequence of ct-segment	
it-segments	A list of individual travel segments.	Optional	Sequence of it-segment	
information	Additional information about the trip.	Optional	String	

770

771 **4.1.9 Common Travel Segment**

772 A `ct-segment` is composed of `service-links`. This level of detail might not always be presented to the user except in
 773 summary form, but formally, a common travel segment often includes plane hops or train stops. These links are
 774 important to construct and monitor a trip.
 775

Frame Ontology	ct-segment FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
service-point	The service point of the segment.	Mandatory	service-point	
trip-summary	A summary of the segment.	Mandatory	trip-summary	
service-links	A list of links relating to the segment.	Optional	Sequence of service-links	

776

777 **4.1.10 Individual Travel Segment**

778 A `it-segment` has a similar structure to a `ct-segment`. Both include a `trip-summary` to provide location, time,
 779 budget and preference information for each segment and both indicate service points. However, an `it-segment` might
 780 include an unresolved service point, as well. For instance, car transportation might require a rental car (from a
 781 resolved service point) or simple a personal car (an unresolved service point).
 782

Frame Ontology	it-segment FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
service-point	The service point of the segment.	Mandatory	service-point	
trip-summary	A summary of the segment.	Mandatory	trip-summary	
gdf-links	A list of GDF links relating to the segment.	Optional	Sequence of gdf-links	

783

784

784 **4.1.11 Service Point**

785 Resolved and unresolved service points distinguish between well known locations of service providers versus general
 786 locations that are less well defined.

787

Frame Ontology	service-point FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
type	The type of the service point.	Mandatory	String	Resolved Unresolved
identifier	The identifier of the service point.	Optional	String	
name	The name of the service point.	Mandatory	String	
mean	The type of the service point.	Optional	String	Bus CableRailway ChainTrain CommuterTrain Foot LowFloorBus MagneticTrain Plane Ship SuspensionRailway Train Tram Underground
city	The city of the service point.	Mandatory	String	
country	The country of the service point.	Mandatory	String	See [ISO3166]
co-ordinates	The co-ordinates of the service point.	Optional	Double Double	

788

789 **4.1.12 Service Link**

790 This object forms a travel connection within a ct-segment.

791

Frame Ontology	service-link FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
identifier	The identifier of the transport.	Mandatory	String	
origin	The start point of the link.	Mandatory	service-point	
departure-time	The departure date and time of the link.	Mandatory	Date	
destination	The destination of the link.	Mandatory	service-point	
arrival-time	The arrival date and time of the link.	Mandatory	Date	
delay	The delay associated with the link.	Optional	Integer	

792

793 **4.1.13 Geographic Data File Node**

794 This object forms a particular geographical point.

795

Frame Ontology	gdf-node FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
identifier	The identifier of the node.	Mandatory	Integer	
name	The name of the node.	Mandatory	String	

796

797 **4.1.14 Geographic Data File Link**

798 This object forms a travel connection which is based upon geographical points for navigation.

799

Frame Ontology	gdf-link FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
identifier	The identifier of the link.	Mandatory	Integer	
name	The name of the link	Mandatory	String	
location-start	The start co-ordinates of the link.	Mandatory	Double Double	
location-end	The end co-ordinates of the link.	Mandatory	Double Double	
turn-instruction	The instruction associated with the link.	Mandatory	String	GoStraight TurnLeft TurnRight
length	The length of the link.	Mandatory	Integer	
information	Travel information associated with the link.	Optional	String	

800

801 **4.1.15 Plan Evaluation**

802 This object forms a pair of references for evaluating new plans based on existing relevant plans or trash plans.

803

Frame Ontology	plan-evaluation FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
relevant	A list of identifiers of relevant plans.	Optional	Integer Integer	
trash	A list of identifier of irrelevant plans.	Optional	Integer Integer	

804

805 **4.2 Function Descriptions**

806 The following tables define usage and semantics of the functions that are part of the FIPA-PTA ontology.

807

808 The following terms are used to describe the functions of the FIPA-PTA domain:

809

810 **Function.** This is the symbol that identifies the function in the ontology.

811

812 **Ontology.** This is the name of the ontology, whose domain of discourse includes the function described in the table.

813

814 **Supported by.** This is the type of agent that supports this function.

815

816 **Description.** This is a natural language description of the semantics of the function.

817

818 **Domain.** This indicates the domain over which the function is defined. The arguments passed to the function must belong to the set identified by the domain.

819

820 **Range.** This indicates the range to which the function maps the symbols of the domain. The result of the function is a symbol belonging to the set identified by the range.

821

822

823

824

825 **Arity.** This indicates the number of arguments that a function takes. If a function can take an arbitrary number of
 826 arguments, then its arity is undefined.
 827

828 4.2.1 Reserve a Segment

Function	reserve
Ontology	FIPA-PTA
Supported by	TBA/Service Provider
Description	The execution of this function has the effect of reserving a segment or group of segments.
Domain	Sequence of <i>ct-segment</i> / Sequence of <i>it-segment</i>
Range	The execution of this function results in a change of the state, but it has no explicit result. Therefore there is no range set.
Arity	1

829

830 4.2.2 Cancel a Segment

Function	cancel
Ontology	FIPA-PTA
Supported by	TBA/Service Provider
Description	The execution of this function has the effect of cancelling a segment.
Domain	<i>ct-segment</i> / <i>it-segment</i>
Range	The execution of this function results in a change of the state, but it has no explicit result. Therefore there is no range set.
Arity	1

831

832 4.2.3 Purchase a Segment

Function	purchase
Ontology	FIPA-PTA
Supported by	TBA/Service Provider
Description	The execution of this function has the effect of purchasing a segment or group of segments.
Domain	Sequence of <i>ct-segment</i> / Sequence of <i>it-segment</i>
Range	The execution of this function results in a change of the state, but it has no explicit result. Therefore there is no range set.
Arity	1

833

834 4.2.4 Modify a Segment

Function	modify
Ontology	FIPA-PTA
Supported by	TBA/Service Provider
Description	An agent may make a modification in order to change the details of a segment. The argument of a <i>modify</i> function will replace the existing object description stored within the executing agent.
Domain	<i>ct-segment</i> / <i>it-segment</i>
Range	The execution of this function results in a change of the state, but it has no explicit result. Therefore there is no range set.
Arity	1

835

836

836 **4.2.5 Evaluate a Plan**

Function	evaluate
Ontology	FIPA-PTA
Supported by	TBA/Service Provider
Description	An agent may ask a for future plans based upon the evaluation of given plans as either relevant or trash.
Domain	plan-evaluation
Range	The execution of this function results in a change of the state, but it has no explicit result. Therefore there is no range set.
Arity	1

837

838 **4.3 Elaboration of the User Profile**

839 The purpose of the user profile is to improve the PTA service to the user as well as to the broker or service/content
 840 providers. Personalisation means ease of filling the request since many personal data items are constant and also
 841 means service modifications and propositions according to the accuracy of the user profile. From the user's point of
 842 view, personalisation affects the search process, assistance and the presentation of results and from the
 843 service/content provider's perspective it helps in better matching user needs.

844
 845 Some items of preference were included in the FIPA-PTA ontology, but much more is possible in this special domain.
 846 Even most simply, the requirements for e-commerce should include the user's preferred method of payment in an
 847 object such as:

848

Frame Ontology	payment FIPA-PTA			
Parameter	Description	Presence	Type	Reserved Values
method	The payment method.	Mandatory	String	Visa MasterCard AmericanExpress ...
balance	The balance on the payment method.	Optional	Integer	
limit	The limit on the payment method.	Optional	Integer	

849

850 A hotel might also like to know whether a smoking or non-smoking room is preferred in a booking and this is a property
 851 of the user that might be granted to the hotel for this need, but in the FIPA-PTA ontology, explicit reference to this type
 852 of information is not made.

853

854 There are also many other complexities to what is generally called a user profile. Aside from the more static and clear
 855 parameters of the user such as name, telephone and email addresses, we need to differentiate such a user profile into
 856 three separate structures:

857

- 858 1. The ontology of domains such as travel, recreation, sports, entertainment and music,
- 859 2. An explicit preference structure mapped onto this ontology (:preference-carrier AirFrance), and,
- 860 3. An implicit preference structure, also mapped onto this ontology, such as learned patterns of the user's behaviour
 861 within a given ontology.

862

863 In other words, the ontology description of virtually all items should first exist separately from the user profile as al-ready
 864 emphasised in the previous section. Moreover, the functions "preference" and "interest" can be applied. If it is of value,
 865 a distinction between these two might be:

866

867 Preferences that are reserved for the user's probable selection from a short, well defined list (forced choice
 868 situations), and,

869

871
872
873
874
875
876
877
878
879
880

Interests which describe personal strength of like-dislike on a single item (rating situations).

In summary, the FIPA-PTA ontology is a beginning towards the definitions of trip segments, especially in multi-modal travel. It highlights some inclusion of soft services and the important application of position and way finding technologies. It is still inadequate for the definition of node-based resources such as hotels and attractions and its reference to electronic commerce standards such as SET still need development for real business transactions to take place. Towards integration with other standards, issues of user profiling and privacy, such as the Open Profiling Standard [OPS], much more can be done to make such an application available.

881 4.4 Exceptions

882 The exceptions for the FIPA-PTA ontology follow the same form and rules as specified in [FIPA00023].

883 4.4.1 Failure Exception Propositions

Communicative Act Ontology	failure FIPA-PTA	
Predicate symbol	Arguments	Description
location-ambiguous	String	The location cannot be determined precisely; the string identifies the location.
location-not-found	String	The specified location cannot be found; the string identifies the location.
no-ct-connection	String String	A common traveller connection cannot be establish from a specified start location to a specified end location; the first string identifies the start location and the second string identifies the end location.
service-not-available	String	A service is not available; the string identifies the service name.
no-city-info	String	No information is available for the specified city; the string identifies the city.

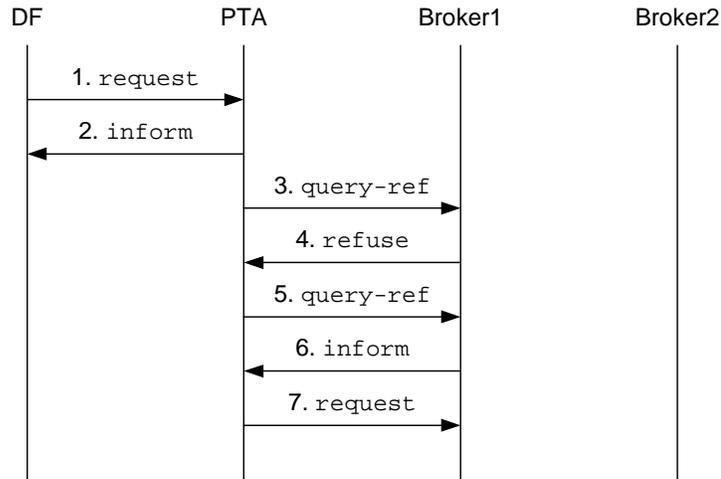
884
885
886
887

887 5 Study Cases

888 5.1 Pre-Trip Planning

889 This scenario is focused exclusively on the details of agent interaction. As such, the interaction diagram in *Figure 5*
890 shows the four agents involved and the communicative acts exchanged between them.

891



892

893

894

895

Figure 5: Agent Interaction for Pre-trip Planning

896

A formal description of intentions and some of the important content description is described as follows¹:

897

- 898 1. Request the DF to find more than one broker. Message content requires some rough description of service
899 offerings/capabilities.

900

```

901 (request
902   :sender
903     (agent-identifier
904       :name PTA@foo.com
905       :addresses (sequence iiop://foo.com/acc))
906   :receiver (set
907     (agent-identifier
908       :name DF@bar.com
909       :addresses (sequence iiop://bar.com/acc)))
910   :language FIPA-SL0
911   :protocol FIPA-Request
912   :ontology FIPA-Agent-Management
913   :content
914     (action
915       (agent-identifier
916         :name DF@bar.com
917         :addresses (sequence iiop://bar.com/acc))
918       (search
919         (df-agent-description
920           :services (set
921             (service-description
922               :type fipa-tba))))))
923   :reply-with KarlsTrip)
924 
```

924

¹ The intermediate messages of the FIPA-Request and FIPA-Query-Ref interaction protocol have been omitted for clarity.

- 925 2. The DF searches through its own directory and possible that of other DFs. It informs the PTA with list of two TBAs
 926 meeting the specified service requirements. Note that the DF has not been required to open communication to the
 927 brokers or to ensure their current existence after registration.

```

928 (inform
929   :sender
930     (agent-identifier
931       :name DF@foobarcom
932       :addresses (sequence iiop://bar.com/acc))
933   :receiver (set
934     (agent-identifier
935       :name PTA@foo.com
936       :addresses (sequence iiop://foo.com/acc)))
937   :language FIPA-SL0
938   :protocol FIPA-Request
939   :ontology FIPA-Agent-Management
940   :content
941     (result
942       (action
943         (agent-identifier
944           :name DF@bar.com
945           :addresses (sequence iiop://bar.com/acc))
946         (search
947           (df-agent-description
948             :services (set
949               (service-description
950                 :type fipa-tba))))))
951       (set
952         (df-agent-description
953           :name
954             (agent-identifier
955               :name Broker1@foo.com
956               :addresses (sequence iiop://foo.com/acc))
957           :services (set
958             (service-description
959               :type fipa-tba)))
960         (df-agent-description
961           :name
962             (agent-identifier
963               :name Broker2@bar.com
964               :addresses (sequence iiop://bar.com/acc))
965           :services (set
966             (service-description
967               :type fipa-tba))))))
968   :in-reply-to KarlsTrip)
969
970
```

- 971 3. The PTA ask one of the brokers for information (no contractual obligation) for a possible trip. Note that the PTA
 972 uses the *iota* operator when communicating with the broker, which requires the FIPA-SL2 language rather than
 973 FIPA-SL0. This does not imply that SL is required for field trials; this content language in this scenario is provided
 974 only as an example.

```

975 (query-ref
976   :sender
977     (agent-identifier
978       :name PTA@foo.com
979       :addresses (sequence iiop://foo.com/acc))
980   :receiver (set
981     (agent-identifier
982       :name Broker1@bar.com
983       :addresses (sequence iiop://bar.com/acc)))
984   :language FIPA-SL2
985   :protocol FIPA-Query-Ref
986   :ontology FIPA-PTA
987
```

```

988      :content (iota ?trip-details
989      (available Broker1@bar.com ?trip-details
990      (trip-summary
991      :origin (location
992      :country GE
993      :city Frankfurt)
994      :destination (location
995      :country FR
996      :city Dublin)
997      :time (sequence
998      (travel-time
999      :type Departure
1000      :after 19971010T170000Z
1001      :before 19971919T240000Z))))))
1002

```

4. Broker1@bar.com refuses because it knows about two cities with similar names (Frankfurt am Main and Frankfurt a.d. Oder).

```

1005 (refuse
1006   :sender
1007     (agent-identifier
1008     :name Broker1@bar.com
1009     :addresses (sequence iiop://bar.com/acc))
1010   :receiver (set
1011     (agent-identifier
1012     :name PTA@foo.com
1013     :addresses (sequence iiop://foo.com/acc)))
1014   :language FIPA-SL0
1015   :ontology FIPA-PTA
1016   :content ((iota ?trip-details
1017   (available Broker1@bar.com ?trip-details
1018   (trip-summary
1019   :origin (location
1020   :country GE
1021   :city Frankfurt)
1022   :destination (location
1023   :country FR
1024   :city Dublin)
1025   :time (sequence
1026   (travel-time
1027   :type Departure
1028   :after 19971010T170000Z
1029   :before 19971919T240000Z))))))
1030   (location-ambiguous Frankfurt)))
1031
1032

```

5. The PTA corrects this problem using the full name of the city.

```

1033 (query-ref
1034   :sender
1035     (agent-identifier
1036     :name PTA@foo.com
1037     :addresses (sequence iiop://foo.com/acc))
1038   :receiver (set
1039     (agent-identifier
1040     :name Broker1@bar.com
1041     :addresses (sequence iiop://bar.com/acc)))
1042   :language FIPA-SL2
1043   :protocol FIPA-Query-Ref
1044   :ontology FIPA-PTA
1045   :content (iota ?trip-details
1046   (available Broker1@bar.com ?trip-details
1047   (trip-summary
1048   :origin (location

```

```

1051         :country GE
1052         :city "Frankfurt am Main")
1053     :destination (location
1054         :country FR
1055         :city Dublin)
1056     :time (sequence
1057         (travel-time
1058         :type Departure
1059         :after 19971010T170000Z
1060         :before 19971919T240000Z))))))

```

6. Broker1@bar.com can now reply with the details of the trip.

```

1063 (inform
1064     :sender
1065         (agent-identifier
1066         :name Broker1@bar.com
1067         :addresses (sequence iiop://bar.com/acc))
1068     :receiver (set
1069         (agent-identifier
1070         :name PTA@foo.com
1071         :addresses (sequence iiop://foo.com/acc)))
1072     :ontology FIPA-PTA
1073     :content
1074         (tripDetails
1075         :summary
1076             (trip-summary
1077             :origin (location
1078                 :country GE
1079                 :city "Frankfurt am Main")
1080             :destination (location
1081                 :country FR
1082                 :city Dublin)
1083             :time (sequence
1084                 (travel-time
1085                 :type Departure
1086                 :after 19971010T170000Z
1087                 :before 19971919T240000Z)))
1088     :ct-segments (sequence
1089         (ct-segment
1090         :service-point (service-point
1091         :type Resolved
1092         :identifier LH
1093         :name "Lufthansa Airlines"
1094         :country DE
1095         :city "Frankfurt am Main")
1096         :trip-summary ...
1097         :service-links ...))
1098     :information ...))

```

7. The PTA is satisfied with this plan and proceeds to reserve the suggested common travel segment.

```

1103 (request
1104     :sender
1105         (agent-identifier
1106         :name PTA@foo.com
1107         :addresses (sequence iiop://foo.com/acc))
1108     :receiver (set
1109         (agent-identifier
1110         :name Broker1@bar.com
1111         :addresses (sequence iiop://bar.com/acc)))
1112     :language FIPA-SL0
1113     :protocol FIPA-Request

```

```

1114 :ontology FIPA-PTA
1115 :content
1116   (action
1117     (agent-identifier
1118       :name Broker1@bar.com
1119       :addresses (sequence iiop://bar.com/acc))
1120     (reserve
1121       (ct-segment
1122         :service-point (service-point
1123           :type Resolved
1124           :identifier LH
1125           :name "Lufthansa Airlines"
1126           :country DE
1127           :city "Frankfurt am Main")
1128         :trip-summary ...
1129         :service-links ...)
1130       :information ...))
1131

```

5.2 Elaboration of Pre-Trip Planning

While pre-trip planning is mostly a matter of reserving or purchasing hard travel documents, the full PTA system is intended to include the added value of soft services. This scenario demonstrates such an elaboration of pre-trip planning. As per the FIPA-PTA ontology, the profiling ontology is not ready for field trial usage. However, this elaboration assumes such an ontology will at least include an object named `PersonalInterest`, which is used in this scenario which continues where the last scenario ended.

1. `Broker1@bar.com` asks the PTA whether it can access to the user's preference profile in order to add additional entertainment items to the travel plans.

```

1141
1142 (query-ref
1143   :sender
1144     (agent-identifier
1145       :name Broker1@bar.com
1146       :addresses (sequence iiop://bar.com/acc))
1147   :receiver (set
1148     (agent-identifier
1149       :name PTA@foo.com
1150       :addresses (sequence iiop://foo.com/acc)))
1151   :language FIPA-SL2
1152   :protocol FIPA-Query-Ref
1153   :ontology FIPA-Profile
1154   :content (iota ?profile
1155     (access PTA@foo.com ?profile)))
1156

```

2. The PTA decides to provide `Broker1@bar.com` with a subset of the user's profile. It provides three interest items, defined by the item itself and the item's ontology.

```

1160 (inform
1161   :sender
1162     (agent-identifier
1163       :name PTA@foo.com
1164       :addresses (sequence iiop://foo.com/acc))
1165   :receiver (set
1166     (agent-identifier
1167       :name Broker1@bar.com
1168       :addresses (sequence iiop://bar.com/acc)))
1169   :ontology FIPA-Profile
1170   :content (profile
1171     :personal-interests
1172       (interests (sequence
1173         (:interest football

```

```

1174         :ontology (set sport))
1175         (:interest ballet
1176         :ontology (set culture))
1177         (:interest gardening
1178         :ontology (set hobby))))))
1179

```

3. Broker1@bar.com replies with a Botanic Garden in Dublin as a potential point of interest for the user.

```

1180
1181 (inform
1182   :sender
1183     (agent-identifier
1184       :name Broker1@bar.com
1185       :addresses (sequence iiop://bar.com/acc))
1186   :receiver (set
1187     (agent-identifier
1188       :name PTA@foo.com
1189       :addresses (sequence iiop://foo.com/acc)))
1190   :ontology FIPA-Profile
1191   :content (location
1192     :country IR
1193     :city Dublin
1194     :name "Botanic Gardens"))
1195
1196

```

The PTA ontology does not yet extend to node items such as hotels, much less to soft travel items such as entertainment events. However, with such extensions a similar conversation could also provide a means for the broker to suggest ballet or football tickets and the PTA to reserve or purchase them in which case they would become part of the complete travel package.

1201

1202 5.3 Last Minute Auction for Lower Fare

1203 Another airline provider notices a large number of open seats on one of its flights (which happens to satisfy the flight
 1204 plans in the above scenario). The airline provider agent contacts several brokers, one of which is the broker in the
 1205 above scenario.

1206

- 1207 1. The broker contacts the PTA that owns the travel documents to see if it (or the PTA's user) would be interested in a
 1208 possibly cheaper fare.

```

1209
1210 (inform
1211   :sender
1212     (agent-identifier
1213       :name Flights@bar.com
1214       :addresses (sequence iiop://bar.com/acc))
1215   :receiver (set list-of-acquaintances)
1216   :ontology FIPA-PTA
1217   :protocol FIPA-Auction-Dutch
1218   :content ((sell seats 100)
1219     (trip-summary
1220       :origin (location
1221         :country GE
1222         :city "Frankfurt am Main")
1223       :destination (location
1224         :country FR
1225         :city Dublin)
1226       :time (sequence
1227         (travel-time
1228           :type Departure
1229           :after 19971010T170000Z
1230           :before 19971919T240000Z)))
1231

```

- 1232 2. The auctioneer agent opens the auction at some starting price and invites takers for that price from the audience.
 1233 The auctioneer in this case is assumed to be the `Flights@bar.com` but this is not necessary. Additionally,
 1234 assume that the PTA has registered itself with the auctioneer and is one of the agents participating in the audience.

```
1235
1236 (cfp
1237   :sender
1238     (agent-identifier
1239       :name Auctioneer@bar.com
1240       :addresses (sequence iiop://bar.com/acc))
1241   :receiver (set audience)
1242   :content ((buy ticket) ((max-no 20) (cost 100)))
1243   :reply-with cfp0
1244   :context FIPA-Auction-Dutch)
1245
```

- 1246 3. If no audience takes bid, the auctioneer counter-proposes with a lower price.

```
1247
1248 (cfp
1249   :sender
1250     (agent-identifier
1251       :name Auctioneer@bar.com
1252       :addresses (sequence iiop://bar.com/acc))
1253   :receiver (set audience)
1254   :content ((buy ticket) ((max-no 20) (cost 90)))
1255   :reply-with cfp1
1256   :context FIPA-Auction-Dutch)
1257
```

- 1258 4. `Audiencel@foo.com` takes a bid.

```
1259
1260 (bid
1261   :sender
1262     (agent-identifier
1263       :name Audiencel@foo.com
1264       :addresses (sequence iiop://foo.com/acc))
1265   :receiver (set
1266     (agent-identifier
1267       :name Auctioneer@bar.com
1268       :addresses (sequence iiop://bar.com/acc)))
1269   :content ((buy ticket) ((no 20) (cost 90)))
1270   :in-reply-to cfp1)
1271
```

- 1272 5. The auctioneer accepts this bid.

```
1273
1274 (accept-offer
1275   :sender
1276     (agent-identifier
1277       :name Auctioneer@bar.com
1278       :addresses (sequence iiop://bar.com/acc))
1279   :receiver (set
1280     (agent-identifier
1281       :name Audiencel@foo.com
1282       :addresses (sequence iiop://foo.com/acc)))
1283   :content ((buy ticket) ((no 20) (cost 90)))
1284   :in-reply-to cfp1)
1285
```

- 1286 6. The auctioneer continues to invite takers with a lower price.

```
1287
1288 (cfp
1289   :sender
1290     (agent-identifier
1291       :name Auctioneer@bar.com
1292       :addresses (sequence iiop://bar.com/acc))
1293   :receiver (set audience)
```

```

1294     :content ((buy ticket) ((max-no 15) (cost 85)))
1295     :reply-with cfp2
1296     :context FIPA-Auction-Dutch)

```

1297

7. This propose, bid and accept-offer cycle continues until the number of seats becomes zero or it arrives at minimum price. If the number of goods offered is insufficient, the auctioneer may reject a bid as follows.

```

1300 (reject-offer
1301   :sender
1302     (agent-identifier
1303      :name Auctioneer@bar.com
1304      :addresses (sequence iiop://bar.com/acc))
1305   :receiver (set
1306     (agent-identifier
1307      :name Audience2@foo.com
1308      :addresses (sequence iiop://foo.com/acc)))
1309   :content ((buy ticket) ((no 20) (cost 85)))
1310   :in-reply-to cfp2)

```

1312

8. At last the auctioneer tells the audience that the auction is finished.

```

1313 (inform
1314   :sender
1315     (agent-identifier
1316      :name Auctioneer@bar.com
1317      :addresses (sequence iiop://bar.com/acc))
1318   :receiver (set audience)
1319   :content (done auction))

```

1322

1323 5.4 On-Trip Execution

1324 This scenario focuses more on the required software attachments rather than agent interaction. This scenario
 1325 description is still incomplete, but the following diagram shows the Inform-Request performative within the simple
 1326 client/server protocol between an agent core and its wrappers.

1327

- 1328 1. DialogWrapper@foo.com asks MPTA@foo.com "Where am I?" This is not a performative between user and
 1329 agent; it is simply an event from a piece of software. DialogWrapper@foo.com informs the agent core of this
 1330 event, but it is now in terms of dialogue semantics and content.

```

1331 (inform
1332   :sender
1333     (agent-identifier
1334      :name DialogWrapper@foo.com
1335      :addresses (sequence iiop://foo.com/acc))
1336   :receiver (set
1337     (agent-identifier
1338      :name MPTA@foo.com
1339      :addresses (sequence iiop://foo.com/acc)))
1340   :ontology UserDialog
1341   :content (gui-event
1342     :event WhereAmI))

```

1344

- 1345 2. MPTA@foo.com queries its GPS co-ordinates.

```

1346 (query-ref
1347   :sender
1348     (agent-identifier
1349      :name MPTA@foo.com
1350      :addresses (sequence iiop://foo.com/acc))
1351   :receiver (set
1352     (agent-identifier

```

1353

```

1354         :name MapAgent@foo.com
1355         :addresses (sequence iiop://foo.com/acc))
1356 :ontology GPS
1357 :content (iota ?x (city-list ?x
1358   (gps-position
1359     :x 135
1360     :y 35))))

```

3. MapAgent@foo.com returns the list of nearby cities.

```

1363 (inform
1364   :sender
1365     (agent-identifier
1366       :name MapAgent@foo.com
1367       :addresses (sequence iiop://foo.com/acc))
1368   :receiver (set
1369     (agent-identifier
1370       :name MPTA@foo.com
1371       :addresses (sequence iiop://foo.com/acc)))
1372   :ontology GPS
1373   :content (Akashi))

```

4. MPTA@foo.com requests DialogWrapper@foo.com to display the some information about the city at the current position.

```

1378 (request
1379   :sender
1380     (agent-identifier
1381       :name MPTA@foo.com
1382       :addresses (sequence iiop://foo.com/acc))
1383   :receiver (set
1384     (agent-identifier
1385       :name DialogWrapper@foo.com
1386       :addresses (sequence iiop://foo.com/acc)))
1387   :ontology UserDialog
1388   :content (gui-action
1389     :display "The city at the current position is Akashi"))

```

The following is another scenario where the MiniPTA migrates on the network.

1. MPTA@foo.com migrates bar.com and requests GPSWrapper@bar.com to notify it when the GPS co-ordinates of the user change.

```

1396 (subscribe
1397   :sender
1398     (agent-identifier
1399       :name MPTA@bar.com
1400       :addresses (sequence iiop://bar.com/acc))
1401   :receiver (set
1402     (agent-identifier
1403       :name GPSWrapper@bar.com
1404       :addresses (sequence iiop://bar.com/acc)))
1405   :ontology GPS
1406   :content (iota ?x (gps-position ?x)))

```

2. GPSWrapper@bar.com informs MPTA@foo.com of its CPS co-ordinates when they change.

```

1410 (inform
1411   :sender
1412     (agent-identifier
1413       :name GPSWrapper@bar.com
1414       :addresses (sequence iiop://bar.com/acc))

```

```

1416     :receiver (set
1417       (agent-identifier
1418         :name MPTA@bar.com
1419         :addresses (sequence iiop://bar.com/acc)))
1420     :ontology GPS
1421     :content (gps-position
1422       :x 135
1423       :y 35))
1424

```

3. MPTA@foo.com requests a translation of the GPS co-ordinates into a list of nearby cities.

```

1426 (query-ref
1427   :sender
1428     (agent-identifier
1429       :name MPTA@bar.com
1430       :addresses (sequence iiop://bar.com/acc))
1431   :receiver (set
1432     (agent-identifier
1433       :name MapAgent@foo.com
1434       :addresses (sequence iiop://foo.com/acc)))
1435   :ontology GPS
1436   :content (iota ?x (city-list ?x
1437     (gps-position
1438       :x 135
1439       :y 35))))))
1440

```

4. MapAgent@foo.com returns the list of nearby cities.

```

1441 (inform
1442   :sender
1443     (agent-identifier
1444       :name MapAgent@foo.com
1445       :addresses (sequence iiop://foo.com/acc))
1446   :receiver (set
1447     (agent-identifier
1448       :name MPTA@bar.com
1449       :addresses (sequence iiop://bar.com/acc)))
1450   :ontology GPS
1451   :content (Akashi))
1452

```

5.5 Travel Plan Monitoring

The following notations provide some initial definition of agent planning, plan decomposition and communication in the context of plan monitoring. These steps are assumed to tie pre-trip planning with on-trip execution. For instance, pre-trip planning should include the distribution of the plan to multiple agents, such as between a PTA and an MPTA.

A plan is composed of plan items such as:

$$P = P_1 \cdot P_2 \cdot P_3 \cdot \dots \cdot P_N$$

which can be decomposed for the purposes of parallel execution of the monitoring as:

$$\text{monitor}(P) = \text{monitor}(P_1) \mid \text{monitor}(P_2) \mid \dots \mid \text{monitor}(P_n)$$

Given this parallel execution, the task of monitor can be distributed to many agents at many places (at the GPS input point, at the flight database, etc.).

A PTA owns the entire composite plan at the pre-trip phase. Given the registered capabilities of other agents to accept the monitor performative, the PTA can request other agents to monitor parts of the plan. For instance, the PTA can

1474 distribute some elements to the MPTA or to the service provider agents. In the latter case, the PTA can request a TSA
1475 to notify it if schedule or other conditions change.
1476
1477

1477 6 Agent/Software Integration

1478 6.1 Web-Based Fare Wrapper

1479 This example (which uses definitions from [FIPA00079]) shows how a wrapper to web-based content hosting can be
 1480 provided by a third-party vendor. Parsing HTML is never a clean solution, but is the only recourse available for an agent
 1481 if it needs to access web-based content. To assist in this parsing, wrapper agents can be used to provide a mapping
 1482 between the raw content and its representation to the level of an ontology and an agent-based representation.
 1483

1484 This example shows how such a third-party vendor can provide added-value to the PTA community of agents, so that
 1485 every agent in the system does not have to re-implement such lower level attachments. The content structure is likely to
 1486 change, but this wrapper provider can monitor and moderate such changes for several agents.
 1487

1488 This example also assumes that the web-based content provider offers a Dutch auction to human participants from time
 1489 to time. The Great Deal Web site publishes this event on its site such that the `GreatDealParser` can determine this
 1490 event automatically.
 1491

1492 6.1.1 Registration of a Wrapper Agent

```

1493 (request
1494   :sender
1495     (agent-identifier
1496       :name GreatDealWrapper@foo.com
1497       :addresses (sequence iiop://foo.com/acc))
1498   :receiver (set
1499     (agent-identifier
1500       :name ARB@bar.com
1501       :addresses (sequence iiop://bar.com/acc)))
1502   :ontology FIPA-ARB)
1503 :content (action
1504   (agent-identifier
1505     :name ARB@bar.com
1506     :addresses (sequence iiop://bar.com/acc))
1507   (register
1508     (service-description
1509       :name GreatDealParser
1510       :type fipa-wrapper
1511       :ontology (set Market)
1512       :properties (set
1513         (property
1514           :name events
1515           :value (set price-change great-deal-auction))
1516         (property
1517           :name sensors
1518           :value (set current-price carrier flight-number)))
1519       :communication (set
1520         (:protocol HTTP
1521           :address http://www.greatdeal.com/pricetable
1522           :body-format FIPA-String-ACL
1523           :body-encoding XDR))))))
1524
```

1525 6.1.2 Request for a Price

```

1526 (query-ref
1527   :sender
1528     (agent-identifier
1529       :name FlightServiceAgent@bar.com
1530       :addresses (sequence iiop://bar.com/acc))
1531   :receiver (set
```

```

1532     (agent-identifier
1533       :name GreatDealWrapper@foo.com
1534       :addresses (sequence iiop://foo.com/acc)))
1535     :content (current-price
1536       :carrier AA
1537       :flight 712))
1538
1539 (inform
1540   :sender
1541     (agent-identifier
1542       :name GreatDealWrapper@foo.com
1543       :addresses (sequence iiop://foo.com/acc))
1544   :receiver (set
1545     (agent-identifier
1546       :name FlightServiceAgent@bar.com
1547       :addresses (sequence iiop://bar.com/acc)))
1548   :content (price
1549     :currency USD
1550     :value 400))
1551

```

1552 6.1.3 Notification of Price Change

1553 The wrapper might support a subscription method to receiving such notification, but in the simplest case, consider that
 1554 the wrapper will trigger the following message when any published price changes on the price table page.

```

1556 (inform
1557   :sender
1558     (agent-identifier
1559       :name GreatDealWrapper@foo.com
1560       :addresses (sequence iiop://foo.com/acc))
1561   :receiver (set
1562     (agent-identifier
1563       :name FlightServiceAgent@bar.com
1564       :addresses (sequence iiop://bar.com/acc)))
1565   :content (price-change
1566     :carrier AA
1567     :flight 712
1568     :price (price
1569       :currency USD
1570       :value 250)))
1571

```

1572 6.2 BAYERNInfo Service Wrapper

1573 This is an example of a specific existing service for very high level inter-modal route planning which is restricted to
 1574 Bavaria.

1576 6.2.1 Agent Request for a Route

```

1577 (query-ref
1578   :sender
1579     (agent-identifier
1580       :name MPTA.JoeSmith@companyxyz.com
1581       :addresses (sequence gsm://011235551234/acc))
1582   :receiver (set
1583     (agent-identifier
1584       :name BAYERNInfoWrapper@bar.com
1585       :addresses (sequence iiop://bar.com/acc)))
1586   :content (street-route
1587     :start-location ...
1588     :end-location ...
1589     :start-time ...))

```

1590

1590 7 Future PTA Developments

1591 7.1 Travelling Users

1592 Mobile end-users are a major driver toward mobile agent technology. The applications of mobile agent technology to
 1593 personal travel assistance as a natural abstraction design seems clear.
 1594

1595 7.1.1 Agent Mobility in a Network: Travel Planning

1596 The traveller is based in Germany and organises a business trip to Korea and Japan. The costs of communications and
 1597 bandwidth have to be minimised and long distance calls should be avoided. While in Germany, the PTA checks for flight
 1598 facilities. Then, it moves into the Korean domain which contains information on local arrangements as well as
 1599 entertainment facilities. The organisation of meetings with partners requests the use of negotiations to find the best
 1600 schedules for all parties. In case of drastic time constraints, such negotiations require a lot of effort and the hotel
 1601 reservations may be performed by auction to find the best conditions. Due to its autonomy, the PTA successfully makes
 1602 the bookings and collects only the required information according to the flight schedule possibilities. For example, it will
 1603 provide a list of concerts and other events the traveller may wish to attend during their stay. It moves to Japan to carry
 1604 the same work out and to finalise the trip possibilities. Finally, the PTA returns to Germany with the schedules of the
 1605 meetings, entertainment, hotel and car reservations, etc.
 1606

1607 This scenario shows benefits for the traveller in terms of the quality of planning and the lower travelling costs. In
 1608 particular, the mobility of the agents provides shorter response times, minimises the cost of the transmissions and
 1609 lowers the bandwidth required by the application.
 1610

1611 7.1.2 Traveller Mobility: Travel Monitoring

1612 The traveller packs an MPTA in their luggage so they are able to connect to their virtual office environment in a
 1613 transparent manner, for example, email, ongoing work, Internet access, etc. Agent migration reduces the connection
 1614 costs by moving some agents in fixed network to gain efficiency and lower bandwidth requirements.
 1615

1616 Another function of the mobile MPTA is to monitor the progress of the traveller. For instance, while staying in Korea, a
 1617 typhoon hits the country and the flight out of the country is cancelled. As such, the traveller will spend one extra day in
 1618 Korea, but has to reschedule their meetings in Japan. The MPTA will provide access to the requested data, propose to
 1619 reschedule the journey and the meetings and contact the Japanese partners involved. Finally, the MPTA will also
 1620 inquire for entertainment possibilities in Korea for the extra day and inform German colleagues and family of the
 1621 traveller's new arrangements.
 1622

1623 In this case, the MPTA has to access the local entertainment resources in Korea, but needs some agent mobility to
 1624 minimise the connection costs to Japan and Germany.
 1625

1626 7.1.3 Traveller Mobility: Travel Monitoring Via UMTS

1627 The mobile telecommunication world permits access to everyone anywhere at any time. As such, the service offered by
 1628 the UMTS (Universal Mobile Telecommunications System) MPTA is greatly enhanced. Using the earlier example, the
 1629 traveller gets the weather forecast as soon as it is published and the MPTA may reschedule the trip in time to finish
 1630 business in Korea before the arrival to the typhoon. In such a case, the traveller benefits from the pro-activity of the
 1631 agent approach and anticipates and avoids a potential problem.
 1632

1633 Additionally, the UMTS MPTA may need to move their agents into the fixed infrastructures to reach computer resources
 1634 that cannot be integrated into the UMTS MPTA.
 1635

7.2 Inter-Operation Between Agents and Workflow

1636
1637 The agent design model was born from a blending of roots from artificial intelligence and transaction systems. In regard
1638 to the latter, other models such as workflow have come to mature and are closely related to agent applications.
1639 Relationships between workflow and agent models is becoming very important to several application domains. In the
1640 case of personal travel assistance, the relationship between travel agents and corporate approval procedures should be
1641 considered On one hand, the practical matter of agent application (as in this PTA example) indicates a need to
1642 understand and inter-operate with other such technologies that are already established. One the other hand,
1643 understanding and comparing both underlying models can be explored and tested within the context of FIPA directions
1644 and its relationships to other evolving standards.
1645

1646

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