FIPA

The Foundation for Intelligent, Physical Agents

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- FIPA Mission -

"The promotion of technologies and *interoperability specifications* that facilitate the end-to-end interworking of intelligent agent systems in modern commercial and industrial settings."

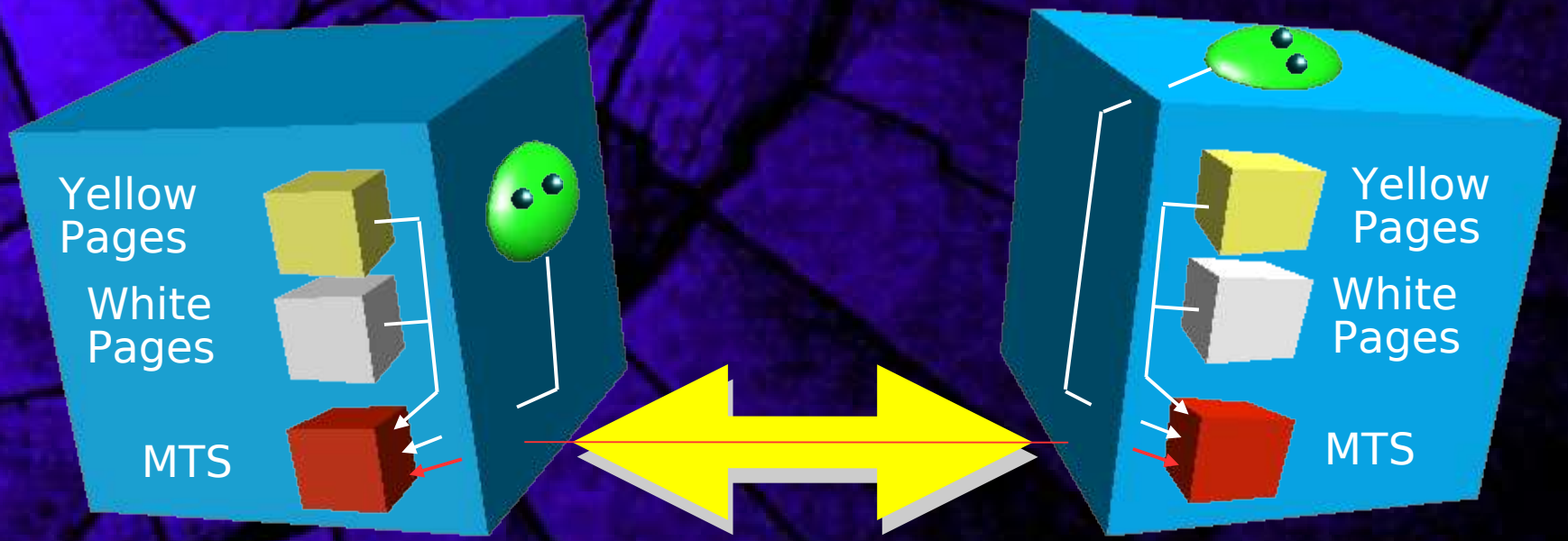
- FIPA History -

- Started work in 1997
- At peak comprised 60 members
- Primary specifications became standard in 2002
- Work ongoing in Modeling, Methodology, Semantics & Services

- Within the Scope of FIPA -

Agent Lifecycle Management
Message Transport
Message Structure
Inter-agent Interaction Protocols
Ontologies
Security

Within the Scope of FIPA



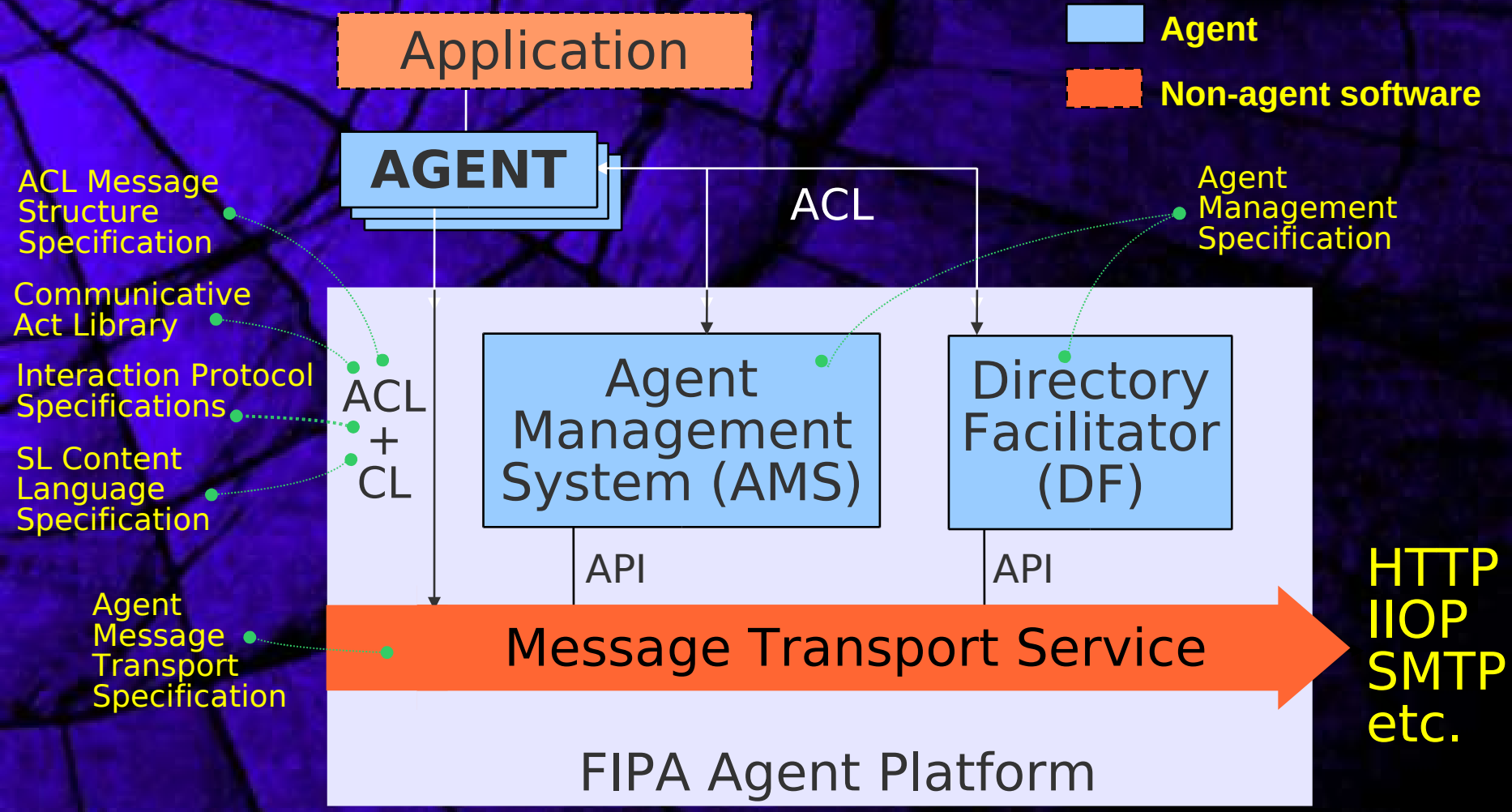
- Outside the Scope of FIPA -

The Agent

- Agent Characteristics -

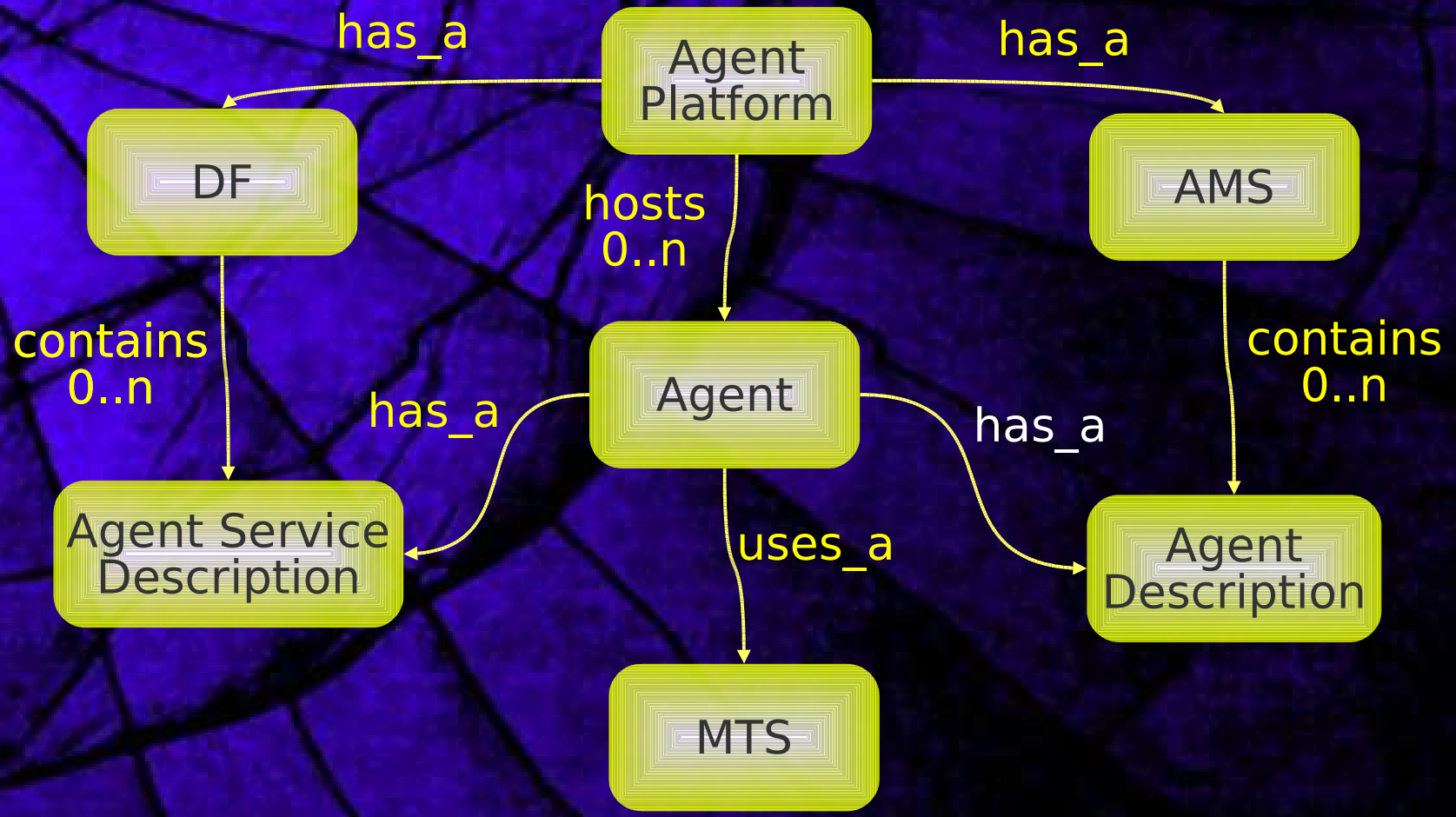
Autonomous
Reactive
Proactive
Goal-driven
Social
Adaptive
Cognitive

- The FIPA Agent Platform -



The Core Specifications (standard)

- Agent Management -



- Agent Management -

Common Operations

REGISTER
DEREGISTER
MODIFY
SEARCH

Name
Location
Services
Protocols

Ontologies
Lease-time
Scope

Different
Agent
Descriptions

Name
Owner
State

- Sample DF Description -

```
(df-agent-description
 :name (agent-identifier
            :name dummy@foo.com
            :addresses (sequence iiop://foo.com/acc))
 :protocols fipa-request
 :ontologies (set fipa-agent-management)
 :languages (set fipa-sl0)
 :lease-time +00000000T600000000T
)
```

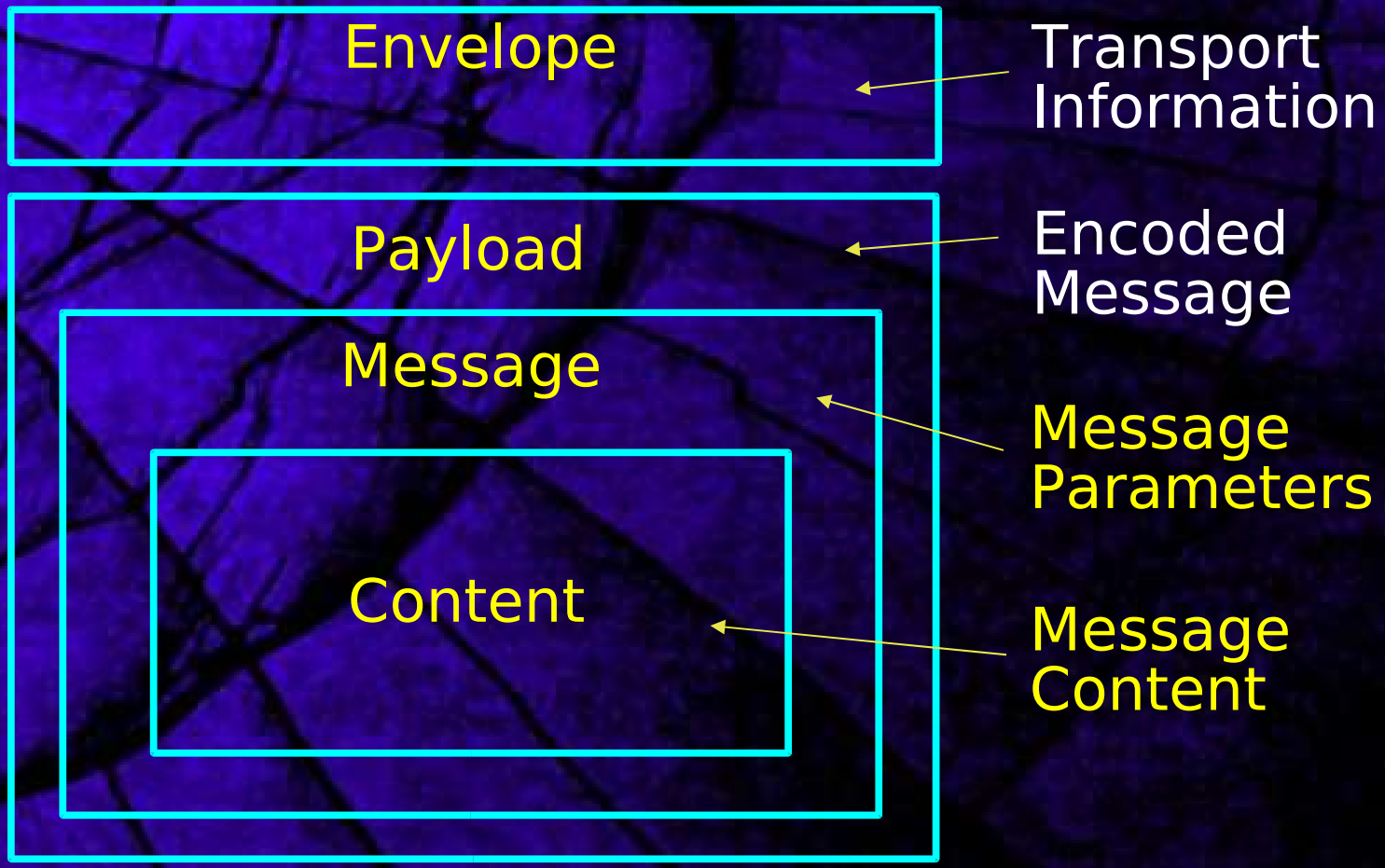
- Message Transport -

Agent message transport comprises two levels:

(1) The Message Transport Protocol (MTP) carries out the physical transferof messages between two ACCs.

(2) The Message Transport Service (MTS) is provided by the AP to which an agent is attached. The MTS supports the transport of FIPA ACL messages between agents on any given AP and between agents on different APs.

- FIPA Message Structure -



- FIPA Envelope Parameters -

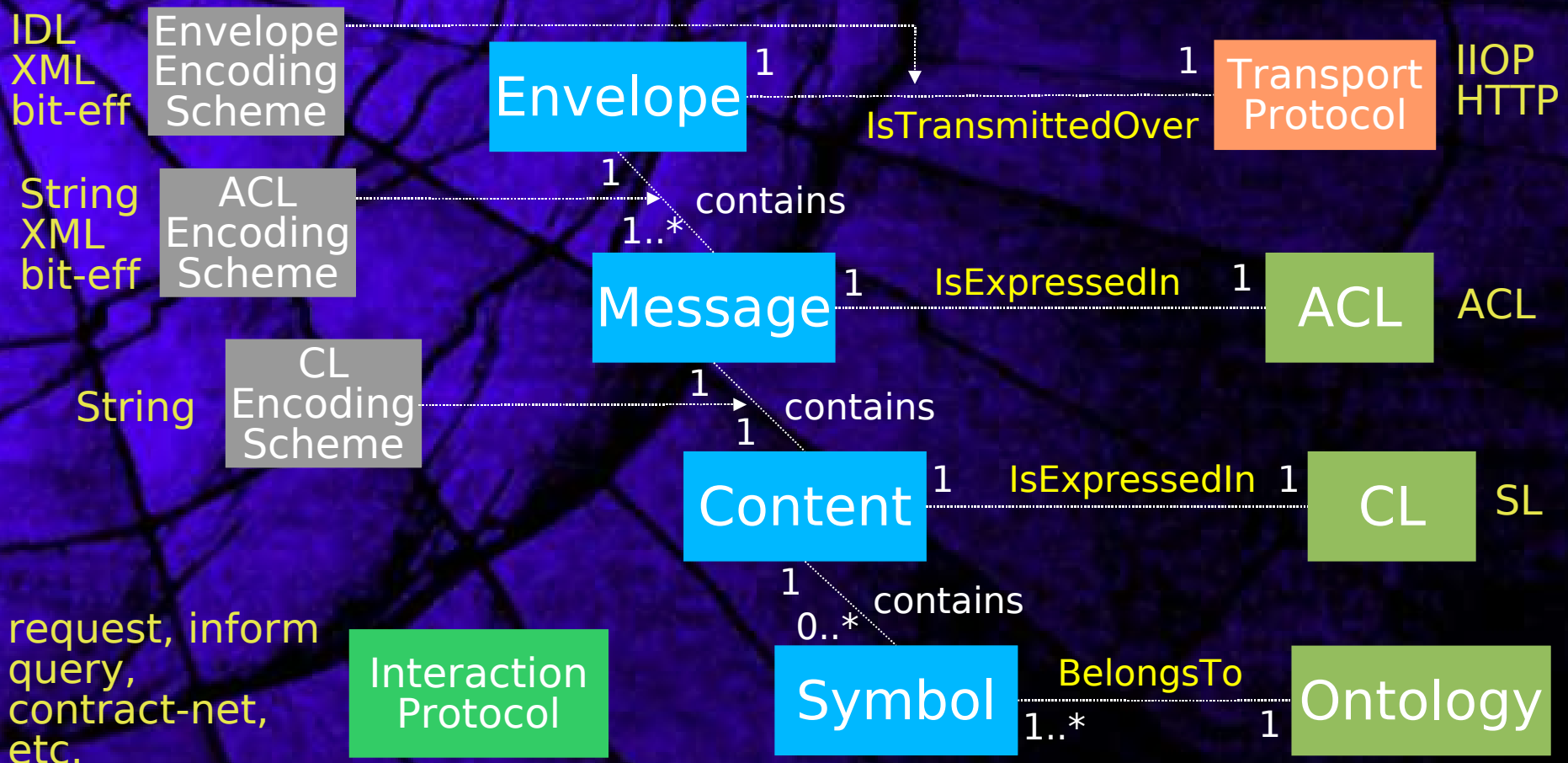
Mandatory

to	The intended receiver.
from	The sender
acl-representation	ACL presentation (e.g. String, XML, Bit-efficient)
date	Creation date of the envelope

Optional

payload-length	Byte length of the payload
payload-encoding	ACL language encoding (e.g. US-ASCII, UTF-8)
received	Stamp evidencing receipt of the message
security-object	Encryption and certification information

- FIPA Message Structure -



- ACL Message Structure -

FIPA ACL Message Elements

Element	Description
performative	What action the message performs
sender	Initiator of the message
receiver	Recipient of the message
reply-to	Recipient of the message reply
content	Content of the message
language	Language used to express content
encoding	Encoding used for content
ontology	Ontology context for content
protocol	Protocol message belongs to
conversation-id	Conversation message belongs to
reply-with	Reply with this expression
in-reply-to	Action to which this is a reply
reply-by	Time to receive reply by

- ACL Message Example -

```
(request
    :sender (:name dominic-agent@whitestein.com:8080)
    :receiver (:name rex-hotel@tcp://hotelrex.com:6600)
    :ontology personal-travel-assistant
    :language FIPA-SL
    :protocol fipa-request
    :content
       (action movenpick-hotel@tcp://movenpick.com:6600
         (book-hotel (:arrival 25/11/2000)  (:departure 05/12/2000) ...
       ))
)
```

- Communicative Acts -

- Drawn from Speech Act theory
- A speaker „utters“ *speech acts, which are also known as performatives or communicative acts*
- *ACL messages are modeled after speech acts*
- Speech acts may be understood in terms of an intentional level description of an agent
- An intentional description makes references to beliefs, desires, intentions & other modalities

Communicative Act Library (1)

accept-proposal: accept a previously submitted proposal
agree: agree to perform some action, possibly in the future
cancel: cancel some previously requested action
cfp: make a cal for proposals to perform a given action
confirm: inform a receiver that a given proposition is true
disconfirm: inform a receiver that a given poposition is false
failure: inform another agent that an action was attempted but failed
inform: inform a receiver that a given proposition is true
not-understood: informs a receiver that sender did not understand
query-if: ask another agent whether a given proposition is true
request: **r**equests a receiver to perform some action

Communicative Act Library (2)

propose: submit a proposal to perform a certain action

query-ref: ask another agent for the object referred to by a referential expression

refuse: refuse to perform a given action

reject-proposal: reject a proposal during a negotiation

request-when: request a receiver to perform some action when some given proposition becomes true

request-whenever: request a receiver to perform some action as soon as some proposition is true and thereafter each time the proposition becomes true again

subscribe: a persistent intention to notify the sender of a value, and to notify again whenever the value changes

Communicative Act Library (3)

propagate: the receiver treats the embedded message as sent directly to it, and must identify the agents denoted by the given descriptor and send the received propagate message to them

proxy: the receiver must select target agents denoted by a given description and to send an embedded message to them

subscribe: a persistent intention to notify the sender of a value, and to notify again whenever the value changes

- Content Languages -

Any language can be used as a Content Language, e.g.:

- KIF
- Prolog
- SQL
- Serialized Objects
- Binary Large Objects
- FIPA-SL, FIPA-CCL, FIPA-RDF, FIPA-KIF

- FIPA SL Content Language -

FIPA SL content expression has 3 types:

(1) Proposition

- A Wff (well-formed formulae) that can be assigned a truth value in a specific context, e.g., c*onfirm.*
- *Agent i confirms to agent j that it is, in fact, true that a platypus is a mammal.*

```
(confirm
        :sender (agent-identifier :name i)
        :receiver (set (agent-identifier :name j))
        :content ((is mammal platypus))
        :language fipa-sl )
```

- FIPA SL Content Language -

FIPA SL content expression has 3 types:

(2) Action

- Something to be performed, e.g. *request.*
- *Agent i requests agent j (robot) to deliver a box.*

```
(request
   :sender (agent-identifier :name i)
   :receiver (set (agent-identifier :name j))
   :content ((action (agent-identifier :name j) (deliver box017 (loc 12)))
   :protocol fipa-request
   :language fipa-sl
   :reply-with order567 )
```

- FIPA SL Content Language -

FIPA SL content expression has 3 types:

(3) IRE (Identifying Reference Expression)

- References an object in the domain, e.g. *inform-ref*.
- *Agent i requests agent j to tell it the 'capital of Wales'.*

```
(request
  :sender (agent-identifier :name i)
  :receiver (set(agent-identifier :name j))
  :content
   ((action (agent-identifier :name j)
     (inform-ref
      :sender (agent-identifier :name j)
      :receiver (set (agent-identifier :name i))
      :content ((iota ?x (CapitalWales ?x)))
      :ontology world-politics
      :language fipa-sl ) ))
  :reply-with query0
  :language fipa-sl )
```

- Ontology -

A common vocabulary of agreed upon definitions and relationships between those definitions, to describe a particular subject domain.

E.g.:

Agent-management ontology

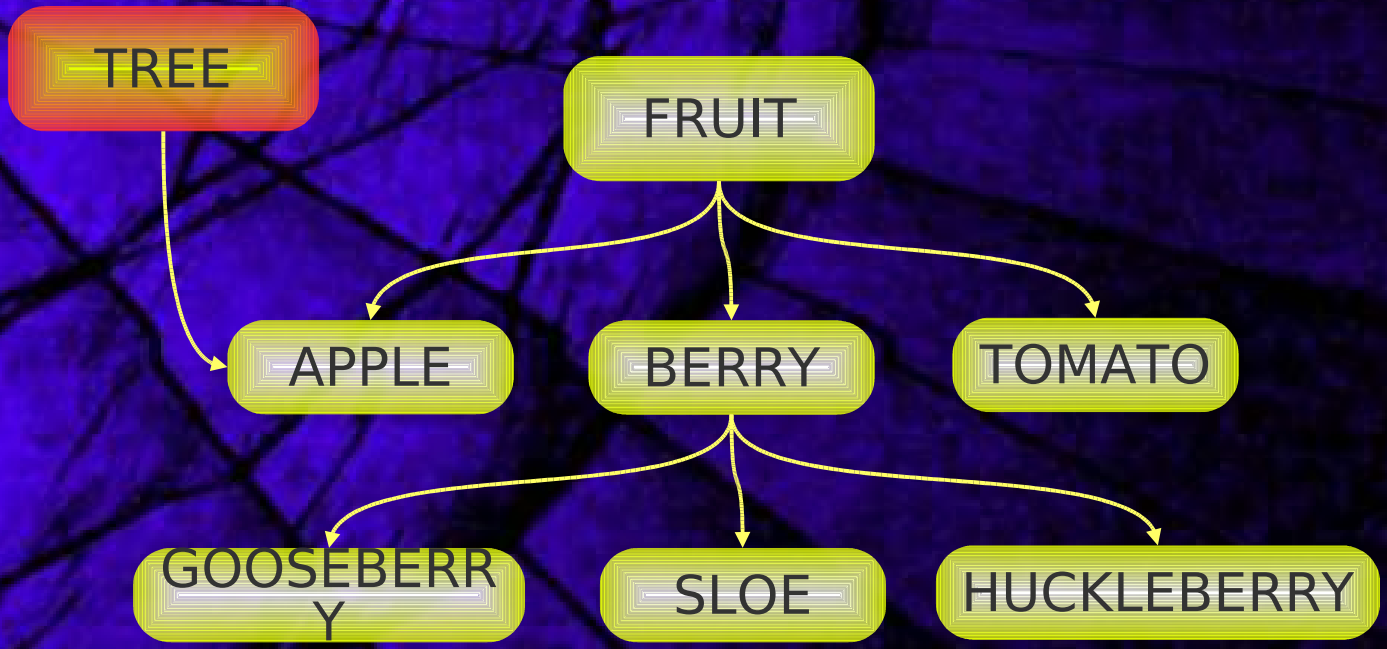
UMTS wireless technology ontology

Cinema ontology

Weather ontology

IEEE Standard Upper Ontology

- Ontology Example -



- Ontology -

In the previous example the Ontology was *world-politics*

This ontology refers to *ALL* terms in the content expression

Future work would allow definitions from different ontologies to be associated with different terms in a content expression

E.g.: :ontology (set (world-politics, geography))
:content ((iota ?x (world-politics:CapitalWales ?x)),
iota ?y (geography:LandAreaWales ?y)))

- Interaction Protocols -

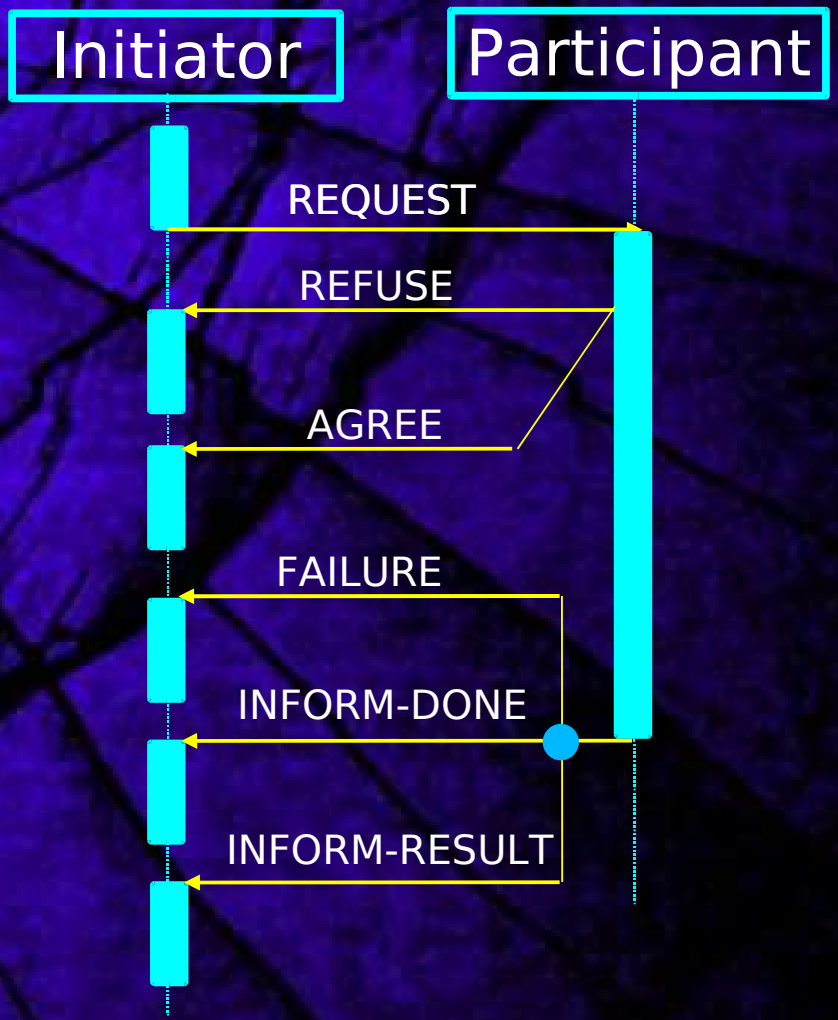
- Patterns of message exchange between agents
- Concurrent IPs are called conversations
- Based on communicative acts
- There is a basic set of pre-defined standard IPs
- Ad hoc IPs can be defined
- Communication semantics can be defined at IP level rather than individuals CAs

- Interaction Protocols -

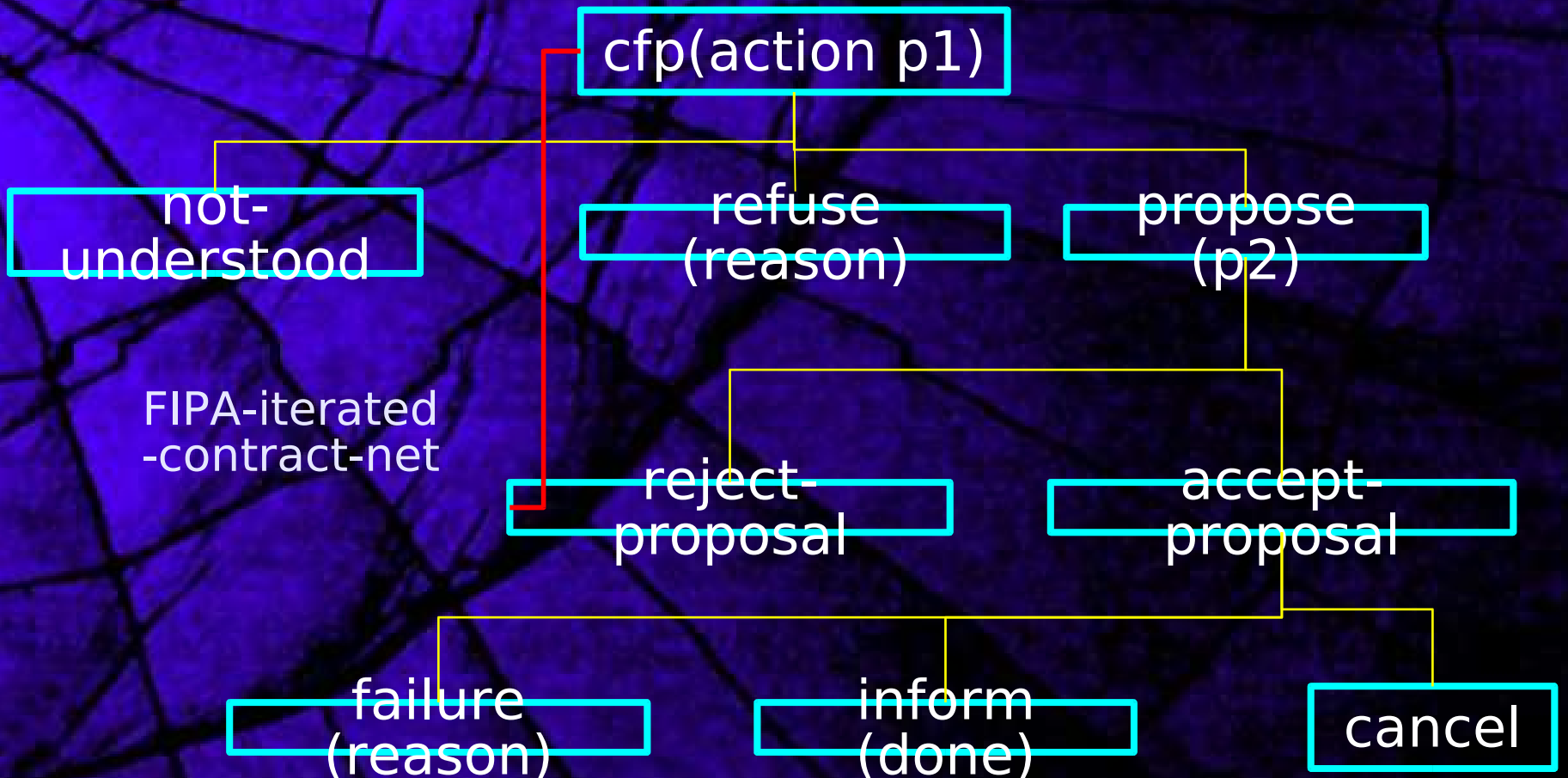
FIPA defined IPs are:

- FIPA-Request
- FIPA-Query
- FIPA-Request-When
- FIPA-Contract-Net
- FIPA-Iterated-Contract-Net
- FIPA-Auction-English
- FIPA-Auction-Dutch
- FIPA-Brokering
- FIPA-Recruiting
- FIPA-Subscribe
- FIPA-Propose

- The FIPA-Request Protocol -



- The FIPA-Contract-Net IP -



- Other FIPA Specifications -

- The Abstract Architecture
- Quality of Service
- CCL/KIF/RDF Content Languages
- Agent MTP for WAP
- Network Management and Provisioning
- Ontology service
- Message Buffering Service
- Domains and Policies
- JXTA Discovery Middleware

- Ongoing Work -

- Agent Modelling
- Agent Methodology
- Semantic Framework
- Service Framework
- Security

- Resources -

- FIPA
  - http://www.fipa.org
- Agentcities
  - http://www.agentcities.org/
  - http://www.agentcities.net/
- Agent in General
  - http://www.agentlink.org/