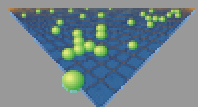




FIPA Ad Hoc Proposal Reviewed Draft for FIPA 25

Michael Berger
Michael Watzke

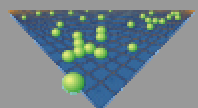
Siemens AG
Corporate Technology
Intelligent Autonomous Systems





Ad hoc agent communication

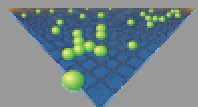
- Agent infrastructure for ad hoc communication hosted on a mobile device is characterized by need for autonomy
 - Must be able to act completely autonomously
 - Without need for communication with other additional parts of infrastructure that are existential
 - Such additional parts
 - Cannot be guaranteed to be in ad hoc communication range
 - If they were in ad communication range, it cannot be guaranteed that connection in between is reliable
 - In contrast, idea of ad hoc communication is to provide spontaneously, not permanently available communication connection





Agent platform architecture implications

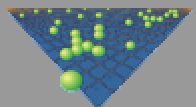
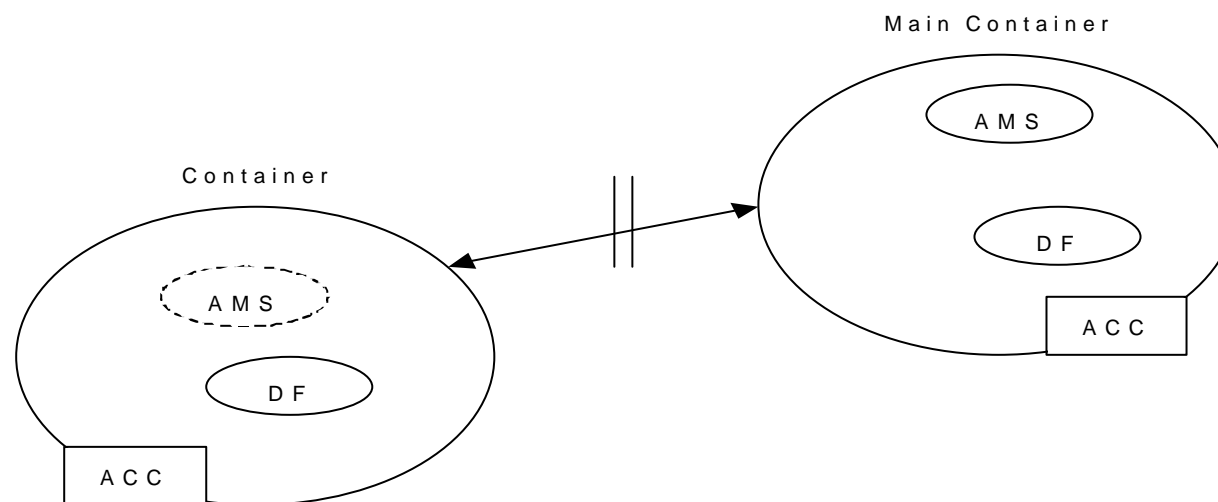
- Notion of Abstract Architecture of a FIPA-compliant agent platform
 - Is self-contained
 - Logically provides required autonomy
- FIPA does not specify any requirements of concrete agent platform architecture
 - Either stand-alone agent platform on a single host, or
 - Distributed over several hosts (e.g. JADE-LEAP)
 - Possible problem, that existential communication between platform hosts is not possible to be based on ad hoc communication





FIPA ad hoc proposal related to JADE/LEAP

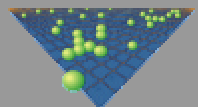
- In ad hoc scenario, JADE/LEAP main container may not be reachable all the time
 - Container on mobile device also has to be main container to be totally independent, thus complete agent platform on mobile device





Basic idea (1)

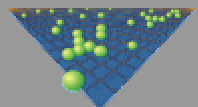
- Two alternative approaches:
 - Mobile device (network node or peer) carries independent FIPA-compliant agent platform
 - Including AMS and DF
 - or
 - In case of a distributed agent platform, mobile device carries only platform fragment
 - Possibly without AMS and/or DF





Basic idea (2)

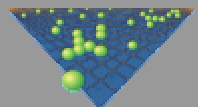
- First approach seems to be more promising with respect to existing FIPA specifications
 - Notion of FIPA Abstract Architecture of an agent platform is self-contained (thus ensuring required autonomy)
 - No introduction of the notion of an “agent platform fragment”
 - AMS (single instance) and DF (several instances) are mandatory elements of a FIPA-compliant agent platform, thus ensuring that each mobile device has its own AMS and DF
 - Resource restrictions expected to become less important in near future
- Platform fragments approach may lead to scalability problems





Outline of FIPA ad hoc proposal draft

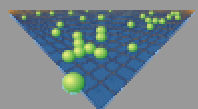
- Mobile independent FIPA compliant agent platforms
 - Including AMS and DF
- If in minimum two mobile devices are in scope for ad hoc communication, two independent agent platforms on it form **logical interconnection** (ad hoc agent platform federation)
 - Ad hoc federated agent platforms remain physically distinct
 - Obviously no AMS federation necessary, but DF federation
- **Needed: protocols/mechanisms for setup and dissolution of an ad hoc platform federation**





Ad hoc service component

- In order to enable ad hoc communication, a FIPA-compliant agent platform has an optional ad hoc service component
 - Discovery of other agent platforms in ad hoc communication range (broadcasting own platform announcement message)
 - Setup of an ad hoc agent platform federation
 - Only DF federation in already FIPA-specified manner
 - Dissolution of ad hoc agent platform federation
 - Lease mechanism to check whether ad hoc communication to another agent platform is still available or not
 - Realization as an agent or platform component is left open

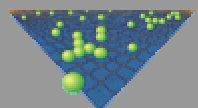


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Discovery of an agent platform

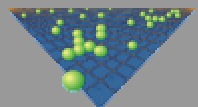
- Minimally, information necessarily to exchange:
 - Home platform address name (HAP)
 - Transport address of HAP
 - Assumes, that agent naming convention (GUID) conforms to *agentname@hap* scheme
 - E.g., to find remote AMS, use unique GUID *ams@hap*
- Broadcast of an agent platform announcement message
 - Similar to device and service discovery mechanisms provided by Jini or UPnP
 - Two possible approaches for exchange:
 - ACL message level
 - Agent platform level





Advantages of ACL message level approach

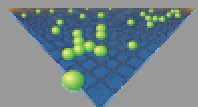
- Easily to specify content of announcement message
- Natural way for communication if ad hoc service component is an agent
- Transport protocol for delivering ACL messages is on OSI network layer 5 and above
 - Enforcing total independence of underlying ad hoc technology
 - Hard to find common standard
 - Bluetooth
 - Java API (JSR-82) at OSI network layer 4/3 (logical link control (L2CAP), link manager protocol (LMP))
 - Support for device and service discovery
 - WLAN interface on OSI network layer 2
 - Transparent use from above layered network protocols





Agent platform announcement message

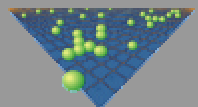
- Broadcast of an ACL-based agent platform announcement message
- Broadcast based on HTTPMU protocol (UDP Multicast of HTTP messages)
 - Specified by UPnP Forum Technical Committee
 - Message in a single UDP packet
- ACL message and envelope represented in XML (FIPA XC00071, FIPA XC00085 specifications)





Platform announcement message structure

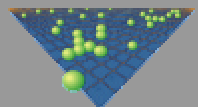
- Envelope:
 - AID in `:from` field contains transport address of HAP
 - `:to` field requires specification of a *particular AID* which matches the ad hoc service component in each agent platform in ad hoc communication range
- ACL message:
 - `inform` performative
 - Content:
 - FIPA agent platform description (agent platform name (HAP), and optionally MTS profile)
 - MTS profile can be further evaluated for agent communications after setup of ad hoc platform federation
 - List of root DF names





Ad hoc service component AID

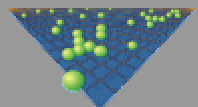
- Particular AID which matches the ad hoc service component in each agent platform in ad hoc communication range
 - Name: “ANY”
 - Transport addresses: HTTPMU:// (**TBD**)
 - Resolvers: none





Setup of an agent platform federation

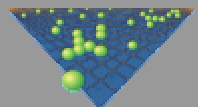
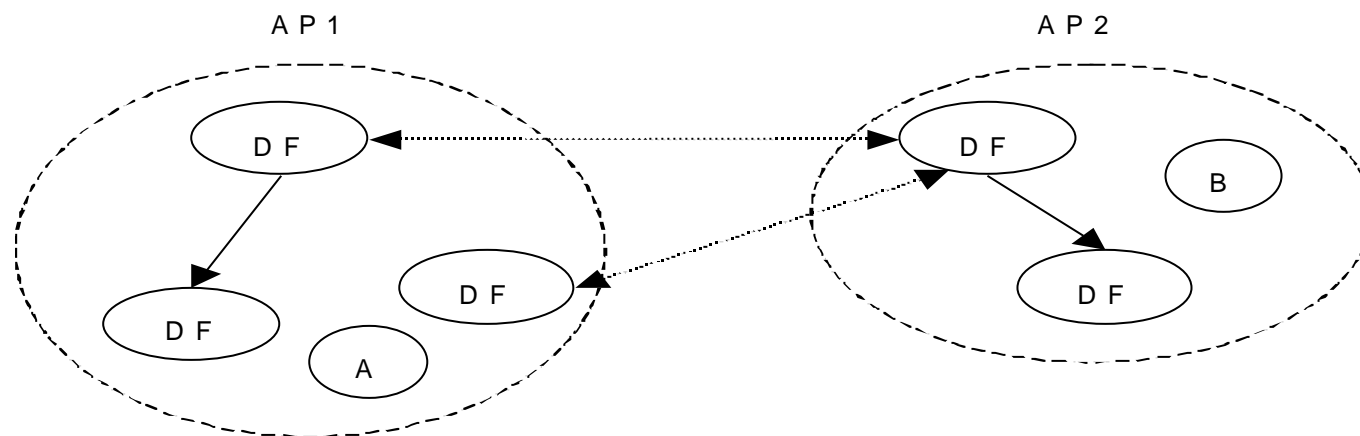
- Only DF federation, no AMS federation
 - DF federation:
 - Obviously, no large overhead to register the DFs with each other
 - Registration of transport address of other agent platform is absolutely necessary, either in DF (storage within AID of remote DF) or in ad hoc service component
 - Registration in ad hoc service component would require additional registration functionality
- ⇒Registration with DFs
- ⇒Additional advantage: transparent use of remote DFs, just ask local DF for available agent services





DF federation (1)

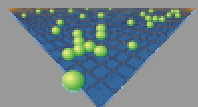
- FIPA Agent Management Specification already allows DFs to form federation (allows also single DFs and already federated DFs on the same platform)
- ⇒ Each root DF in AP1 is registered with each root DF in AP2 (and vice versa) only
- Limited DF search with respect to agent platforms to depth first traversal of agent platform nodes (i.e., no way back to already searched agent platform nodes)





DF federation (2)

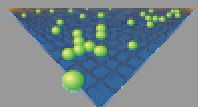
- When ad hoc service component receives agent platform announcement message, it immediately registers all remote root DFs with each local root DF
 - Agent platform announcement message carries transport address and HAP name of remote agent platform
 - Remote root DFs can be addressed by <root_df_name>@hap
 - Root DF names are provided by agent platform announcement message





Semantics of agent platform announcement

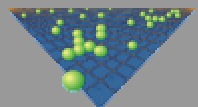
- Performative of agent platform announcement message is `inform`
- Announcing own agent platform means permission to use own DF
- On request not to use own DF, do not broadcast agent platform announcement message
- No explicit possibility to ask for remote DFs, only listening





Dissolution of agent platform federation (1)

- An agent detecting a no longer reachable remote DF informs ad hoc service component to locally remove remote DF registration
- Additionally, detection, whether ad hoc communication is no longer possible or not: lease mechanism
 - Agent platform announcement message is periodically sent
 - On receipt of agent platform announcement message, DF registration is refreshed
 - On timeout of receipt of agent platform announcement message, DF registration is removed





Dissolution of agent platform federation (2)

- Optionally, special message as polite way to a single platform or to all
 - Be aware of the problem with inform -> not a requirement that the other AP deletes the entry

