

Mobile Code and Agents

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Mobility

- Mobility
 - Movement of bytes
 - Movement of typed data
 - `Int i = 1002; Send (s, i);` <--- you are sending a type defined in C/Java/C++/Smalltalk
 - Movement of member functions
 - Movement of processes
 - Movement of objects
 - Movement of objects with state
 - Movement of devices
 - Movement of agents

Agents

- What are agents?
 - Are objects agents?
 - Are mobile objects agents?
 - Are servers agents?
 - Should agents be always mobile?
 - Is broker an agent?

A definition of agent

- Persistent
 - Code runs continuously-- though it could be on demand
- Autonomous
 - No human intervention!
- Social
 - Communication and collaboration with other agents
- Proactive
 - It perceives/reads environments and acts on it, on its own

A Classification of Agents

- Autonomous Agents
 - Biological
 - Robotic
 - Computational
 - Software agents
 - Task specific
 - Entertainment
 - Viruses

Degree of agent-orientation

- Non agent
 - Does not show the characteristics defined earlier
- Moderately an agent
 - Spell-checker (persistent, autonomous, but reactive, non-social!)
- Strongly an agent
 - If the spellchecker can communicate with other spellcheckers and update its local dictionary

Shohm's Agents

- Agent has mental components such as beliefs, capabilities, commitments

What computations are rightly modeled as agents?

- Should light switch be modeled as an agent?
- Should Operating system be modeled as an agent?

Objects Vs. Agents

- Objects perform predefined tasks
- An agent can evolve another agent giving it a new capability

Some Mental Characteristics of Agents (e.g. Agent-0 language)

- Action
 - e.g. Agent robot raises arm at time t
- Belief
 - e.g.. At time t , an agent A believes that fact F is true
- Obligation
 - Agent a is obliged to have dinner with b at time t
- Decision
 - Agent a has taken decision to open door at time t
- Capability
 - Agent a is capable of opening the door at time t

Example: Plane agent

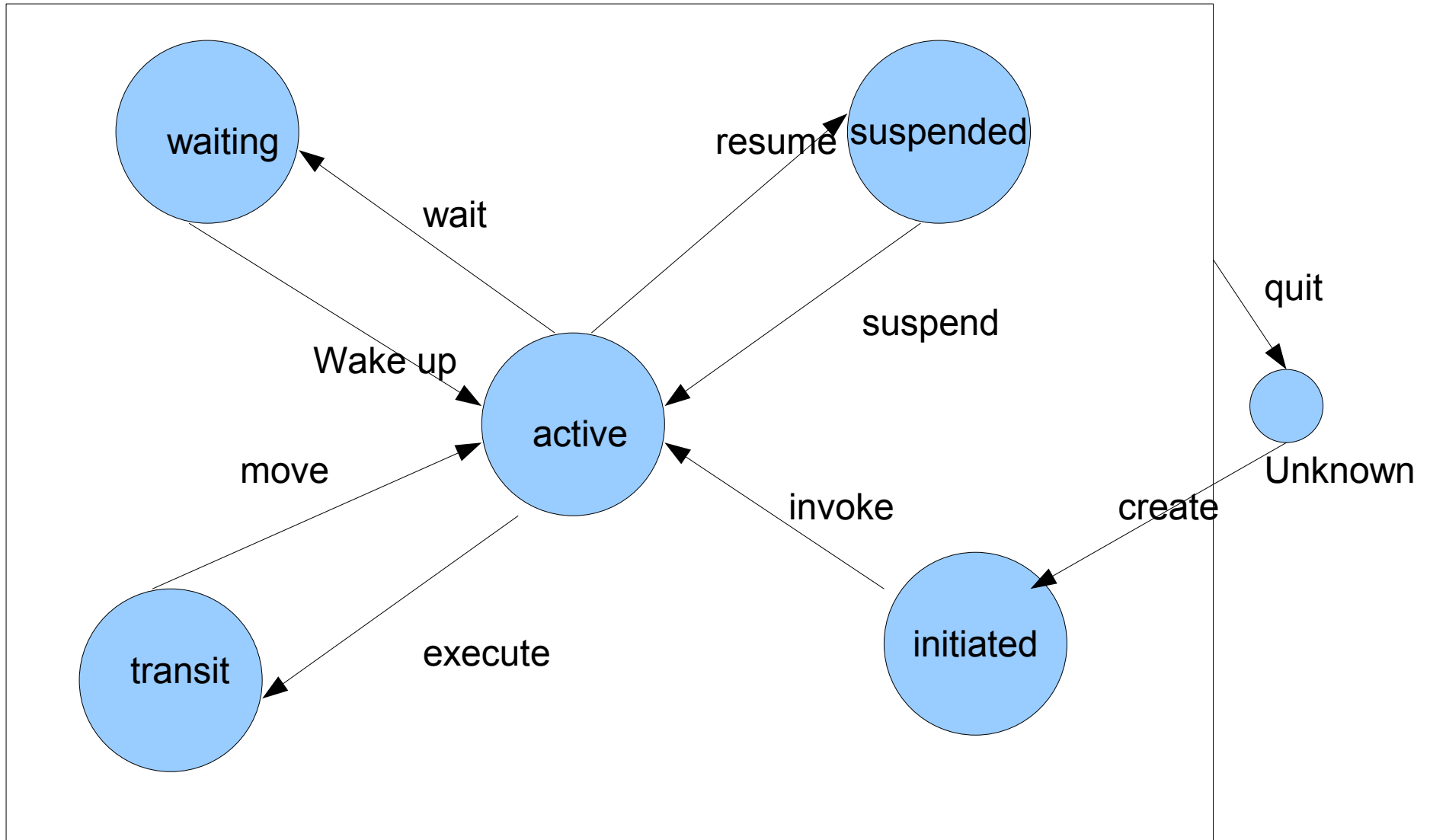
- Plane is controlled by ground control unit
 - Where to go and at what time

- Plane takes that action only when it is capable of doing so

Recent Developments

- FIPA (Foundation for Intelligent Physical Agents) standard
 - (now an IEEE standards committee)
- 1997-98 about 25 specs were released
 - Abstract agent architecture
 - Agent content language
 - Agent management
- JADE (Java Agent Development Environment)

A Typical Agent State Machine



Mobile Ambients

- Calculus of mobile agents

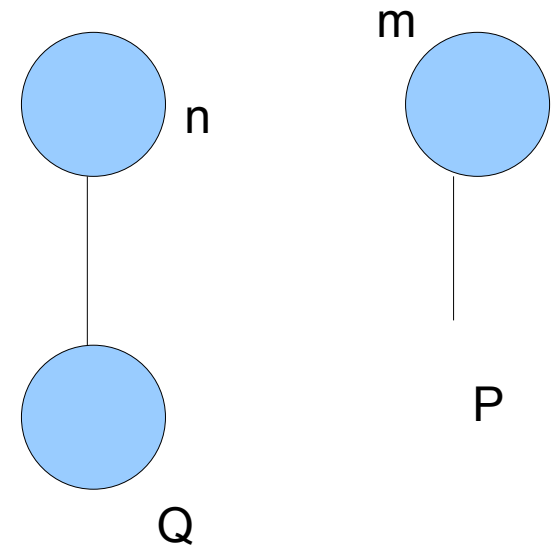
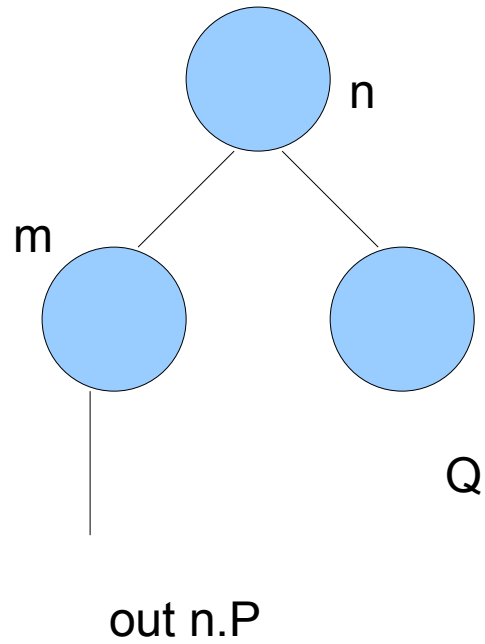
- Software

- Devices

n	names
M :=	capability
in n	can enter into n
out n	can exit out of n
open n	can open n

P, Q, R :=	processes
(new n)P	new name n in P
0	nil process
P Q	composition
!P	unbounded copies available of P (replication)
n[P]	ambient
M.P	action

An Example Ambient System



Another Example Ambient System

