

## Basic concepts of evolution in agents calculating and agents system

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*Abstract.* The basics concepts of evolution in agents calculating are discovered in this work and are showed their directions and applications. Before explaining what is agent and its description, there were given a bit of its history and the difference between agents and programs. Were given basic types of agents on examples and figures.

The main task of agents is to require a large number of interactions for which most mathematical modeling methods are unsuitable. Were analyzed agent systems architecture and a description of their main parts. Principles of work with mobile and intelligent agents are considered. Furthermore, were exemplify the reasons and situations of use either intelligent agents or mobile agents. Also, their examples were showed on different examples and figures. Technology and application tools which uses in the process are represented.

Analysis of JADE-technology are carried out. On the market today there are analogues of JADE, but most of the systems are relatively new and require many improvements, some are under development prototypes. Also, were given description of main tools and features of JADE. It will help a lot in elaboration of agents.

Advantages and disadvantages of using agent approach are showed for creating system of data processing and they show their versatility compared with other systems.

*Key words:* system, technology, agents, agents computing, mobile agents, method, web-application, processing, analysis.

### INTRODUCTION

Today there is a significant development of computer technology, including the Internet "cloud" computing and GRID-technologies. We often work in open systems, systems that have the ability to update the software (software).

However, most of the web-technologies that provide access to many sources of information described in natural language and therefore is not structured. Working with such systems is interactive and simulation tasks require a large number of interactions for which most mathematical modeling methods are unsuitable [1, 5].

To overcome these problems recently, using agents technology. While the use of agent paradigm allows the use of artificial intelligence methodology and theory of distributed computing.

This paradigm is based on the abstraction "agent" - a component of software that has the properties of reactivity, autonomy, pro-activity and social ability.

### TOPICALITY OF PROBLEM

To better understand the agents calculation, you must first understand what the agent is. Agent - a computer program that enters into relation with the mediation of the user or another program. The word "agent" (from Lat. Agere - do) - the agreement on implementation of the actions of someone's name. Such action is meant by the right to decide what is appropriate. The idea is that agents are activated independently and not launched specifically for the task.

The main agent attributes include [3]:

- independent activation itself,
- ability to be suspended on the host and perceive context,
- able to obtain the status of implementation on the host for the initial conditions,
- optional user experience,
- to refer to other problems, including communication.

The work of researchers are analyzed by the authors and are proposed some concepts that characterize the properties of the definition "agent" [2]:

- vitality (the code is never-ceasing and self-organized),
- autonomy (the agent has the option for choosing the tasks prioritization, focus on the behavior and decisions without human intervention),
- social behavior (using defined relationships and actions, agents may involve additional components for common tasks to work on),
- reactivity (agents respond appropriately to the context with which work).

Agents are not tied to one user or to a computer, they have the ability to migrate and maintain a user interface and execution context. They may terminate their own employment and replenished with new components and maintain its internal state during migration. They make effective use of easy to use powerful software for better data and software of the system. This type of software program called migration (migratory applications) or mobile agents. Their use is effective and reasonable mechanism for the quality of the information space. Therefore, the study of the properties and organization of mobile agents and defines the purpose of our study [10].

DIFFERENCE BETWEEN AGENTS AND PROGRAMS

The works of Franklin and Gausser are researched by the authors, which discusses four key concepts on which

agents are different from voluntary programs: reaction to environment, autonomy, target orientation and vitality (Fig.1).

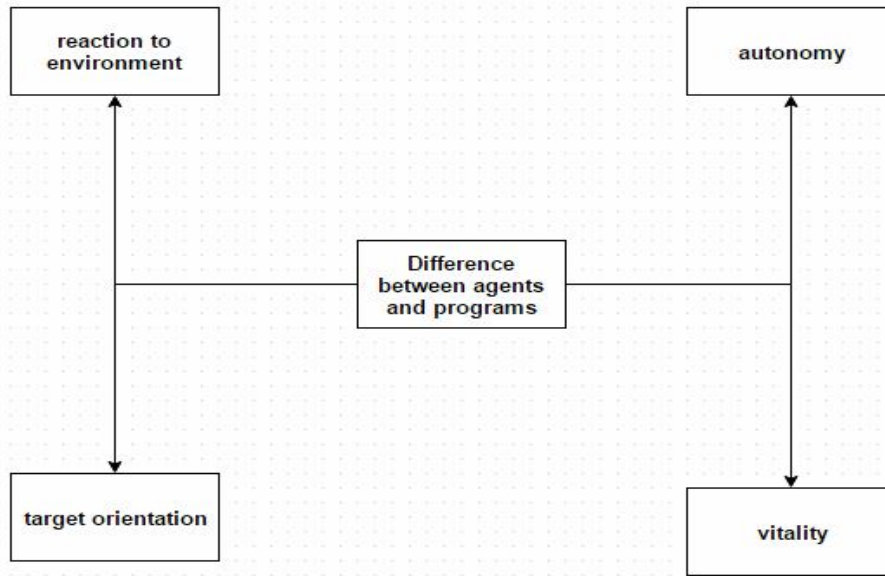


Fig.1. Difference between agents and programs

Also, similar and derivative agent concepts are exemplified by the authors(Fig.2):

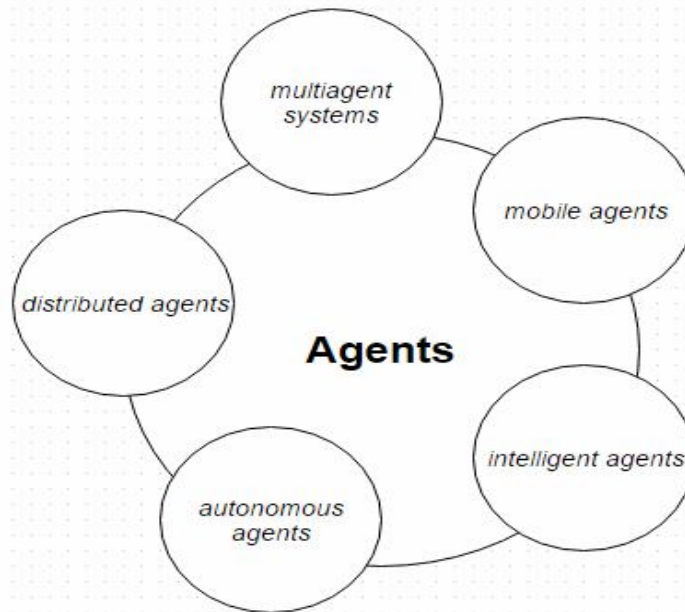


Fig.2. Related and derivative agent concepts

Example of agents concepts listed in Figure 2, allow the isolate their one common trait. They work to achieve a common goal - an efficient, organized, cooperative operation of the system as a whole. Because intelligent agents have partial artificial intelligence, such as learning and reasoning. Autonomous agents - agents that can change the ways of achieving their goals. Distributed agents - agents that perform tasks running on different computers. Multi-system - a distributed agents which can not work and achieve their goals on their own, but only in

cooperation with other agents. Mobile agents - are agents that can move their work to other processors.

Property agents and objects are discovered by authors, which mistakenly considered to the same concept. The differences in these definitions are directed by the authors [8]:

- agents are more autonomous than objects,
- agent behavior is more flexible,
- agents have reactivity, proactivity and social behavior,

- agents are both single-threaded and multi-threaded.

Also there is a difference between the agents from expert programs [10]:

- expert systems have no connection with the environment,
- expert systems have not reactive and proactive behavior,
- expert systems do not have the social behavior.

Among the variety of types of agents, the authors paid interest to the intelligent and mobile agents because of the pace of research and development on this subject is growing every day.

EXAMPLES OF INTELLIGENT AGENTS

Researches that are carried out by the authors, allow to distinguish four types of intelligent agents, which results in his writings Stephen Haag (Fig. 3):

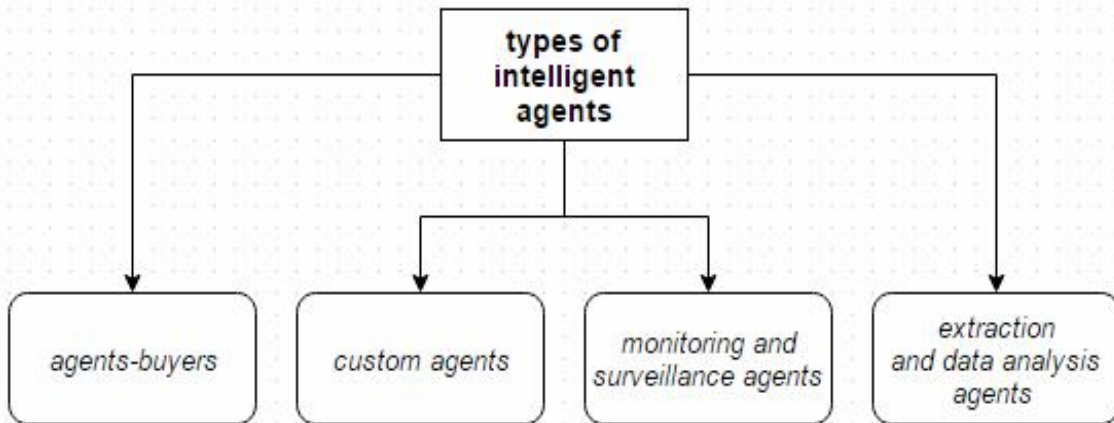


Fig.3. Examples of intelligent agents( by Stephen Haag)

On Fig.3 agents-buyers (or trading bots) analyze network resources (Internet) to obtain various kinds of information about products and services. They effectively works with products like CDs, books, various electronic components or consumer goods.

Unlike previous custom agents (personal boats or personal agents) - is intelligent agents that act directly on

the user. These include intelligent agents at a time perform or will perform in the future necessary task. The challenge of this type of agents are shown in Fig.4. Task list user agents can facilitate maintenance of various programs and consumer information services to facilitate their using software.

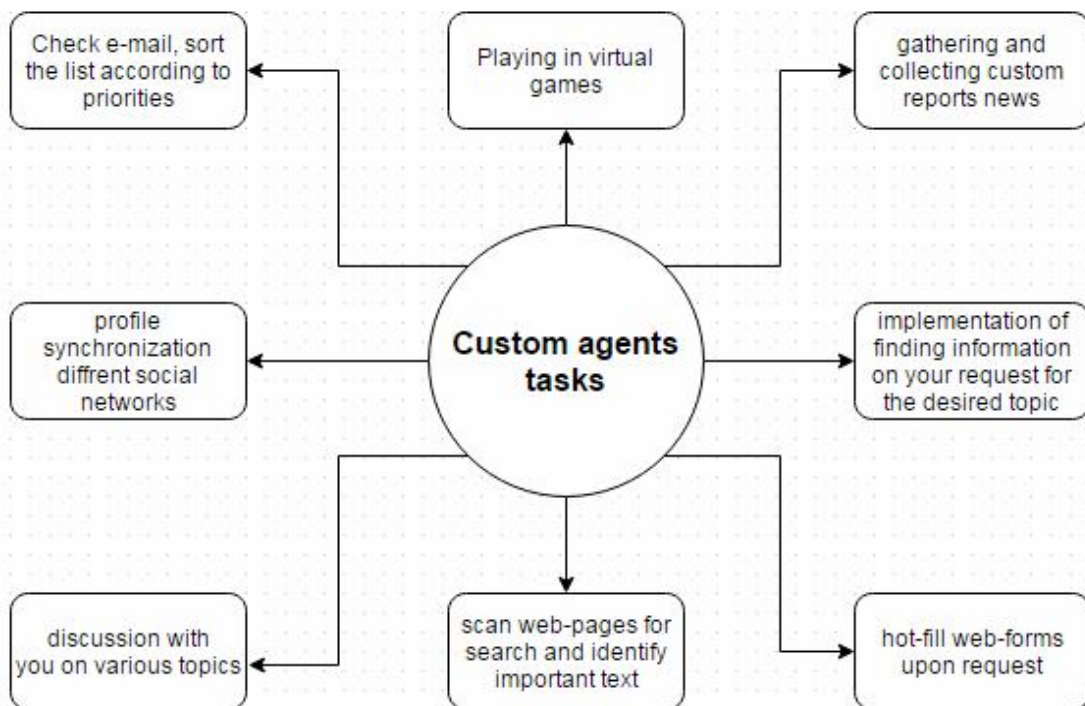


Fig.4. Custom agents tasks

Another type of agents (Fig. 4) are agents for monitoring and surveillance. They are priority for their use in monitoring the objects and data on equipment, usually in computer systems. This type of agents can track inventory levels of resources any corporation, monitor competitors' prices, analyze and synthesize stock manipulation by inside information and rumors etc.

For example Microsoft Monitoring Agent. Microsoft Monitoring Agent is a new agent that replaces the Operations Manager agent and integrates APM .NET features in System Center with full-featured IntelliTrace collector of the development environment Microsoft Visual Studio. This allows complete collection of trace profiling applications. Microsoft Monitoring Agent is able to collect trace on request, or you can leave it running for application monitoring and collecting trace. There is provided an opportunity to limit the disk space that the agent uses to store collected data. When the amount of data reaches the limit, the agent overwrites old data in the right places replacing new [6, 12].

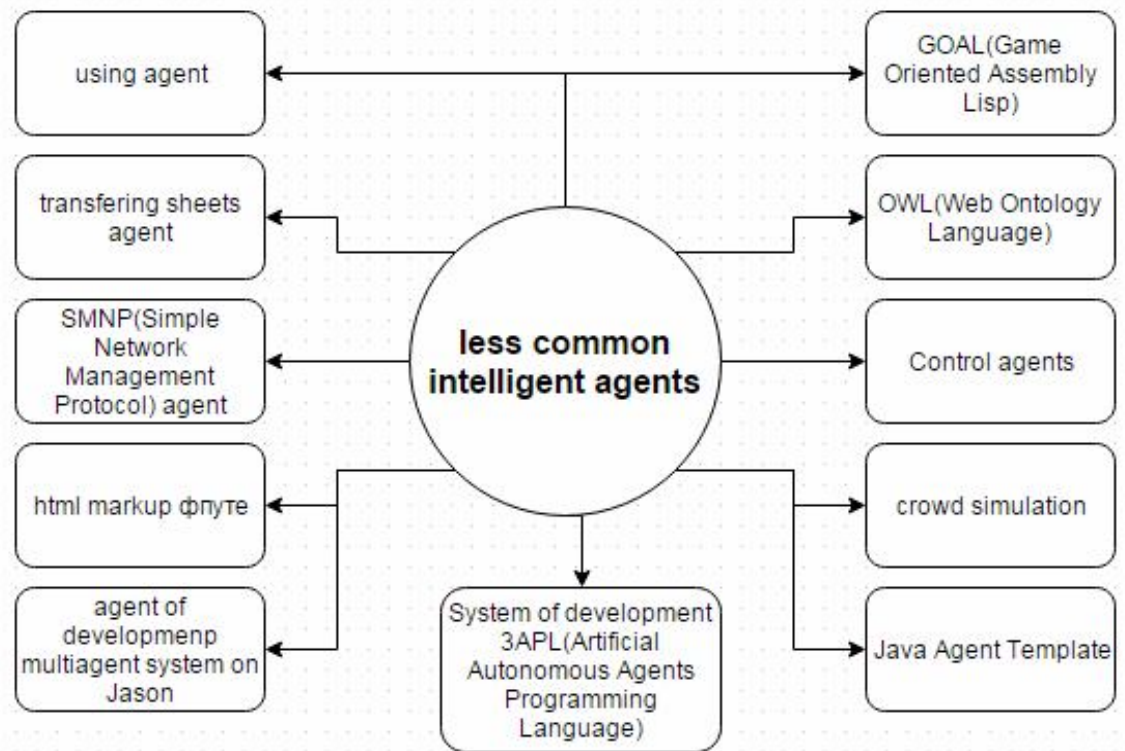
Last in Fig. 3 shows the agent monitoring and surveillance. This structure agents used for decision support systems during tactical operations. These agents carry out an analysis of assets (ammunition, weapons, personnel, vehicles, etc.) and get a job (order) of the top-level agents. This type of agent reaches the goal with their assets, costs are minimized. They operate information

technology to monitor and search for trends or patterns for a wide range of information flow. You can sort the existing information in accordance with the submitted search criteria.

Extraction and analysis data agents operating with data store accumulated information. This storage combines a huge range of information flows for subsequent analysis. This review process is a data repository for the purpose of isolating the necessary information [4].

Classification is the most widely used data mining, without which there are keywords in information flows. Agents for the extraction and analysis allow for changes in trends in key indicators, track the updated information to fill her store. For example, the agent finds decline in cybersport team or player of the same team. Bookmaker companies involved in calculating the coefficients for cybersport matches, based on information received on time, can change their data rates or peer review, which will replace the previous best rates so that revenue was maximized [7].

Researchers show other modern intelligent agents that are less common and can realize the task spam filters, game bots of monitoring servers and bots indexing searching systems. Their variety is provided by the authors in Fig. 5.



**Fig.5.** Uncommon intelligent agents

Fig. 5 given the use of an agent (Using agent), which is used for browsers WWW. Another singled out transfer agent to mail that serves electronic mail, for example, MailRu.Agent. This program supports IP-telephony, video calls, sending SMS, and also provides notifications of new messages submitted to the server Mail.Ru. For their use requires an account with domain @ mail.ru, @

inbox.ru, @ list.ru, @ bk.ru, @ mail.ua. Also this program makes it possible to connect to the email account that is tied to the service «Mail.Ru business." The official client supports the ICQ. This agent referred to a collection of settings and rules that do not allow the user to perform their own mail filtering.

SNMP agent (Fig. 5) continuously monitors the network and work of any corporate network, allowing you to keep it in working order.

Next agent, which give off researchers is an agent markup in HTML-format. This intelligent agents in virtual environments are under the authority of the agency DARPA. There are also agents of development multiagents system on Jason platform (Fig. 5). This platform established to develop multiagents systems, advanced by programming language AgentSpeak and uses to program the behavior of individual agents. The system design of artificial autonomous agents include 3 APL abstract programming language for developing, implementing and testing several synthetic autonomous agents using the BDI approach.

The programming language for the development of rational agents GOAL is a high level programming language. Description language for semantic web ontologies OWL. This language allows to describe the classes and relations between them inherent web-documents and applications. OWL is based on earlier languages OIL and DAML + OIL and now recommended by the World Wide Web Consortium.

Management Agents, which are presented in Fig. 5, used in knots of telecommunications networks. The basis of the existing network management scheme is "manager-agent". The agent is the intermediary between the managed resource and the main control program manager. Interacting with a property agent delivers formalized information manager which decides on management.

Crowd simulation is used for providing safety and for three-dimensional graphics. Java Agent Template - template that is designed to create software agents in the system Java (JAT).

### MOBILE AGENTS

Recently, mobile agents often discussed in the scientific world and became an interesting topic in the circle of researchers. This trend is growing, contributing authors to revive interest in the subject. After all, mobile

agents is a promising area of research that affects development of this area.

The concept of mobile agent was identified in 1994. Then it was a description of the computing environment (Telescript). In this environment, these programs could actually stop the execution and were able to move from one computer to another computer within the same network. Also they could restore your runtime after the "arrival" to the point of destination [6].

Mobile agents have to operate on various platforms and operating systems to realize their full potential. This need arises from the fact that mobile agents that were created in such systems, allowing use scripts and application code represented as bytecode. The interpretation for different operating systems (OS) eliminates the need to recompile agent after the transition to a new computer, provided they stay in the same environment of different machines. These servers are called environmental agents.

The advantages of mobile agents include: simplicity while installing the server database, the flexibility of the service, and the opportunity for local agents interact in real time. Because system of mobile agents can implement process support of cloning processes ensure their permanent memory and do their exchange group in the system.

According to some researchers the only reason for the rejection of mobility is that in the near future will have enough Internet bandwidth to support all traffic. Client-server interaction through the web will be carried out as quickly as interactions within a single machine. So one could argue advantage interaction, which is accessible through mobile agents. Although this is only a theory and assumptions made by separate groups of scientists [5].

On fig. 6 agent movement among multiple platforms are given by the authors. The platform, which is derived agent called home (Home platform), and is usually reliable environment for him. One or more hosts can contain the agent platform that supports several places of agents.

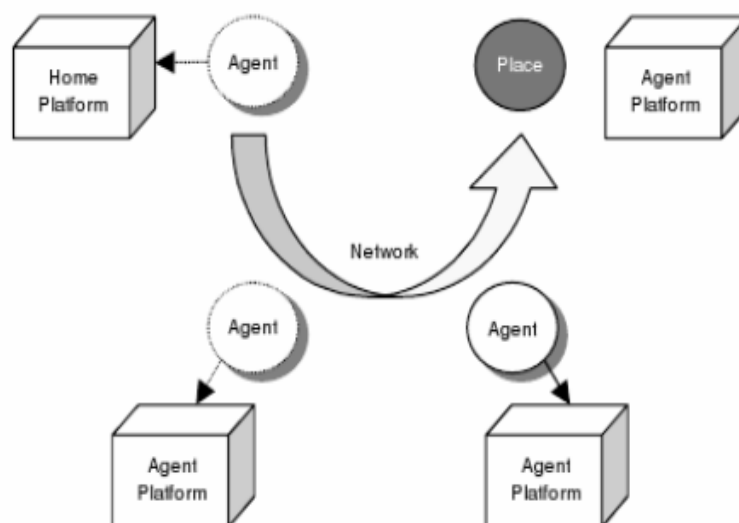
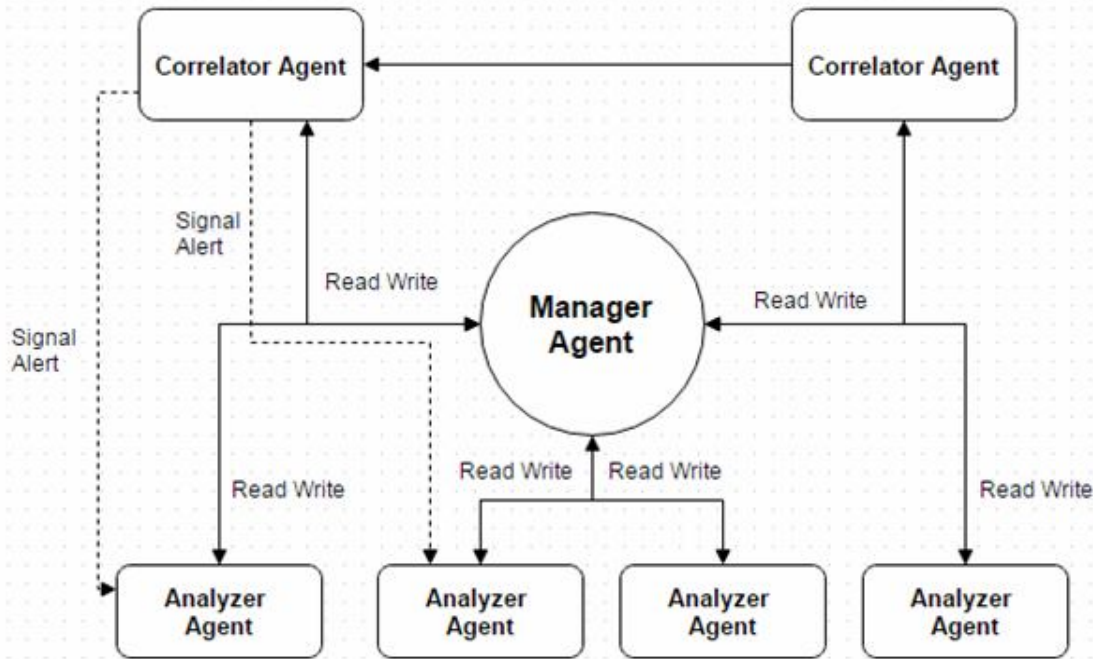


Fig.6. Movement of agent between few platforms

The typical architecture of agent system can consist of following parts (Fig. 7): agent-collector, agent-correlator, the agent analyzer, the agent manager.



**Fig.7.** The typical architecture of agent system

Fig. 7 shows the agent-collector that is cloned and distributed throughout the network. Its task is to monitor the network and gather information that takes place on the host to which it relates.

Agent correlator send certain information that call critical to an appropriate agent analyzer, bypassing the agent manager. Default communication protocol is centralized. This means that the agent-collector must send a report to the manager, who will decide whether to send data to the analyzer. This communication model is not suitable for online use, because some important events should be handled by analyzer in the process of entering the system. That's why each correlator uses a set of rules that clearly define the required events, conditions and agents analyzers that includes to them.

Agent analyzer analyzes. There is also a behavioral analyzer that uses a statistical model to determine the "normal" behavior of the system.

Agent Manager receives the information and distributes it among agents analyzers. This process does not allow online communication analysis. For this reason, agents correlators can decide whether they communicate directly with agents analyzers.

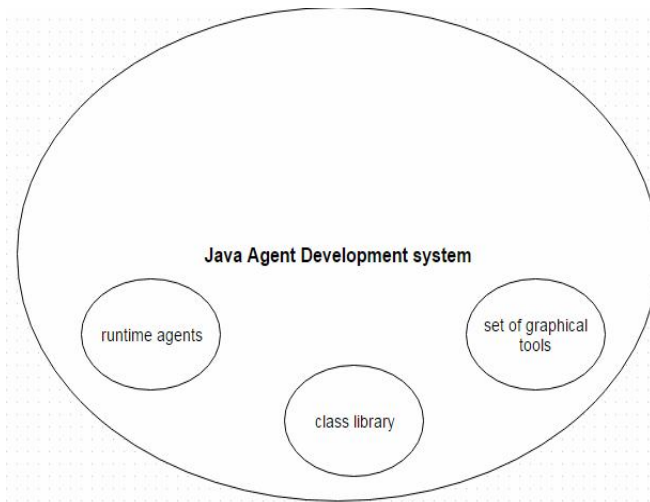
On Fig. 7 administrator distributes certain functionality on any number of hosts on the network. Each node can receive any number of collectors agents that monitor all events taking place on the host. All agents collectors report on its findings to the manager who passes it to agents analyzer. Critical events, detected by collector, transmitted immediately to the correlator (critical event - any event that is part of the scenario defined functionality). Correlator takes responsibility to transfer critical events received from the collector to the appropriate agents analyzers. On fig. 7 agent analyzer collects events from the manager and from the correlator

and perform analysis using the right method. Then the analyzer reports its findings to the manager and notify the system of detecting anomalies. Agents cooperate with each other because their task is to monitor critical events messages to other agents. Administrator, according to their needs, through an external interface manager may stop by some agents, send them to other locations and resume their activities. Agents can independently decide to redirect themselves. In other words, they can stop their performance, move to another location (host with the appropriate agent platform) and restart its execution. In addition, agents can clone themselves, especially in the case of increasing load on the network [9, 12].

Agents perform actions, but communication - is the only type of action. Putting communication at the same level as the action, the agent may, for example, to carry out a plan that includes both physical actions and communication. To make communication planned should clearly define the impact of the previous conditions for each possible session. Communication has semantic meaning. When the agent - the object of communicative action (that is, when he gets the message), he is able to understand the true value of actions and why it is done (to wit, the intention of the sender). Thus there is a need for the existence of universal semantics and standards. For this, authors give off Jade-technology, which allows you to implement development agents [10].

#### JADE-TECHNOLOGY

Java Agent Development system - an open source platform, created for the development of multi-agent systems and applications and supports FIPA-standards for intelligent agents. On fig. 8 the components of the system are represented by the authors.



**Fig.8.** Elements of Java Agent Development system

On fig. 8 one of the elements presented runtime agents in which they are registered and operating under control. Element class library used to develop agents systems. The third - a set of graphical tools designed for management and monitoring of vital functions active agents.

JADE is completely written in the Java programming language using opportunities such as Java RMI, Java CORBA IDL, Java Serialization and Java Reflection API. It simplifies the development of multi-agent systems through the use of FIPA-sheets (Foundation for Intelligent Physical Agents) and through a series of instruments (tools), which support the phase debugging and deployment system. This Agent platform can be distributed among computers with different operating systems. It can be configured remotely via GUI- interface (Graphical User Interface).

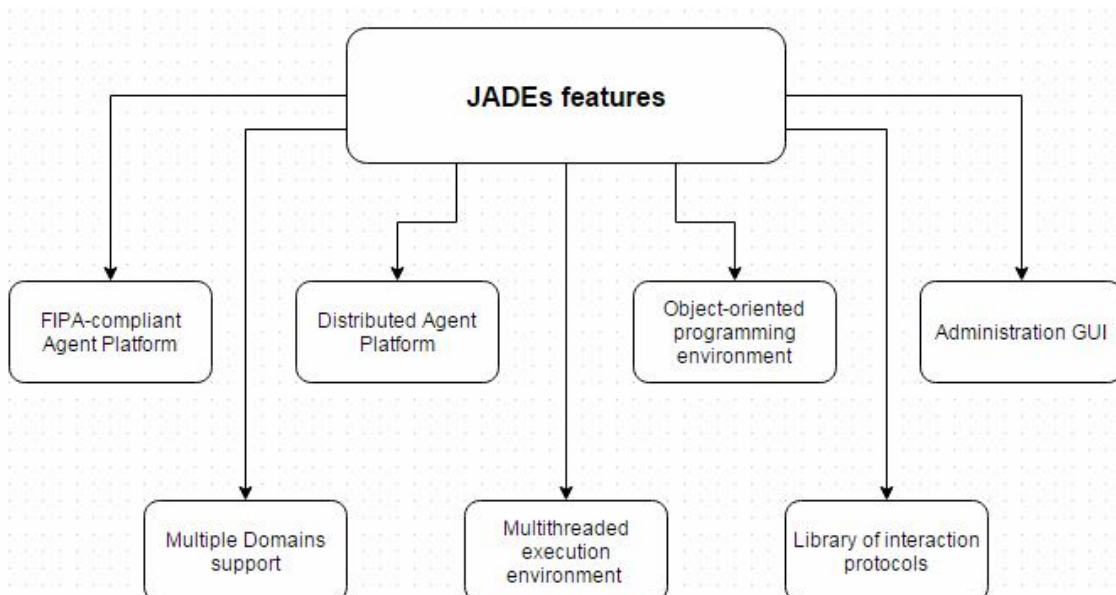
The process of configuring the platform is flexible: it can be changed even at runtime. You must move agents from one machine to another. The only requirement is to install this system on a machine Java Run Time 1.2,

which communication architecture offers flexible and efficient process messaging. This JADE process creates and manages the flow of all ACL-messages (Access Control List), which are private to each agent. Agents are able to address the queue by using a combination of several modes: blocking, voting, recess and comparison with the standard (this applies to search methods).

The authors analyzed that today the system uses Java RMI, event - notification and IIOP. Also, it is easy to add other protocols. In the JADE system provides the ability to integrate SMTP (Simple Mail Transfer Protocol), HTTP (HyperText Transfer Protocol) and WAP (Wireless Application Protocol). JADE uses a number of companies and academic groups. Among them are such well-known: BT, CNET, NHK, Imperial College, IRST, KPN, University of Helsinki, INRIA, ATOS and many others.

**JADES FEATURES**

The authors singled out the key features of the JADE systems that are on Fig. 9.



**Fig.9.** JADEs features

Shown in fig. 9 FIPA-compliant Agent Platform agent platform is based on FIPA-required specifications and include the types of systemic agents: AMS (Agent Management System) and DF (Directory Facilitator). These two types of agents are automatically activated when starting platform.

Distributed Agent Platform - is a distributed agent platform that can use multiple hosts, with each node runs only one Java Virtual Machine. Agents are implementing like Java-flows. Depending on the location of the agent, that sends a message, and the person who receives it, using suitable transport mechanism [6, 13].

Next possibility of JADE, suggested by the authors, is Multiple Domains support, which is based on the FIPA-specification DF-agents. They can unite in a federation, thus Multidomains of implementing agent environment.

Each JADE-agent has its own flow control that is able to work in multithreaded mode. Java Virtual Machine with the possibility Multithreaded execution environment with two-level scheduling conducts scheduling performed agents. Most of the concepts inherent FIPA-specification, have the ability Object-oriented programming environment, represented by Java classes. They form the user interface.

Library of interaction protocols using standard interactive protocols fipa-request and fipa-contract-net. To create an agent that would act in accordance with these protocols, application developers need only implement domain-specific actions. Under the system implemented in parallel JADE all independent of application logic protocol.

GUI. Simple operation management platform can be performed through a graphical interface that displays active agents and agent containers. Using the Administration GUI capabilities to create, destroy, break and resume action agents, create a hierarchy of domains and multi-agent federation DF (facilitators).

Investigation agent calculations following determining a number of advantages and disadvantages. The benefits of agent-based computing include: reducing the load on the network, asynchronous and autonomous program execution, dynamic adaptation, functioning in heterogeneous environments, robust and fault-tolerant behavior. The disadvantages are: problems of protection, limiting performance, a large amount of code, lack of a priori knowledge, methodologies and limited programming and implementation issues. Advantages and disadvantages affect the behavior, performance and system protection, network congestion, and scope of the program code.

## CONCLUSION

In this work the basic concepts of agent and agent-based computing systems are adduced in general by the authors. Were analyzed agent systems architecture and a description of their parts, the most popular technologies and platforms for their development, opportunities and tools, as well as their practical application. Illuminated main types of intelligent and mobile agents, their characteristics and advantages and disadvantages. Adduced the basic advantages and disadvantages of agent-based computing. The authors provides a visual

accompaniment theoretical material to better understand the article. Examples of real agents used in practice.

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