PRACTICAL IMPLEMENTATION OF A MODEL FOR EVALUATING THE CHARACTERISTICS OF INFORMATION INTERACTION OF THE INTERNET OF THINGS

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The term «Internet of things» is used as a keyword to cover various aspects related to the expansion of the Internet in the physical sphere through the widespread distribution of spatially distributed devices with built-in interaction functions [1]. The process of interaction is the most important in the operation of devices, and modeling of this process should definitely be considered. The author proposes the simulation model and a state diagram based on multi-agent approach, presents and describes the principle of operation of a simplified simulation model of the interaction of one logical unit with a server using the simulation system AnyLogic.

The concept of the Internet of things (IoT) consists in the emergence of a computer network of things, a network of physical objects with integrated technologies of interaction both among themselves and with the external information environment and simply with the external environment of the real world.

Given the fundamental characteristics of the networks of the IoT, when developing a model of information interaction, it is appropriate to use the capabilities of simulation modeling (SM). In practical implementation, simulation modeling is based on four paradigms: discrete-event modeling, dynamic modeling, system dynamics in the sense of Forrester and multi-agent approach [2].

In all four versions of the SM considered, that the simulator advances the system time and creates at each next step the current time layer of the system. This layer contains information about the possible upcoming and recent changes that have occurred for recurring recalculation of indicators. The simulator advances this time layer forward in model time along the set of facts of the causal chain that it tracks and reaches its goals. This principle is the essence of computer SM [2].

All types of the paradigm are essentially just another their implementations, having different approaches to constructing trajectories and changing states. All of them use a causal mechanism for advancing processes over time. The differences relate only to the choice of a particular set of basic mathematical and software objects, and the logic of simulation of processes is the same. The trajectory of the functioning of the simulated object is carried out by advancing the system time [2].

From the viewpoint of realization of logic interconnection and software mathematical simulation objects used agent-based modeling approach of information interaction.

Figure 1 shows the simulation model of interaction.

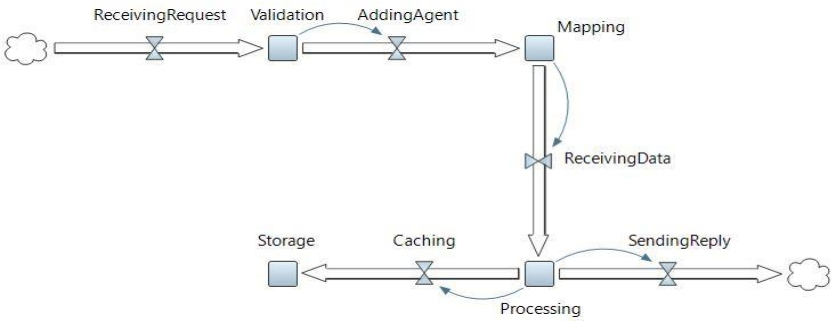

Figure 1 – The simulation model of interaction

The model operates as follows: in a stochastically, the specified requests come from network agents. If the agent passes the validation successfully and has a certificate for receiving / transmitting information and transmits a request for the first time since it was found in the network, then it is added to the network map to identify it in space. After processing and storing information in memory, a control command is sent from the server to the agent, to which the agent must send a notification of receipt. In the process of going through all the stages of the circuit, the following situations may occur:

1. Request rejection – agent data transmission request is rejected due to the occurrence of collisions of data sources or no route for transmission.

2. Multiple mapping – repeated addition of the same agent to the card. The problem is solved by removing the object from the map, if after a specified time does not come from him.

3. Looping – sending the same command to the agent after disconnection / connection. If the agent cannot execute the transferred command, the system will offer to execute this command again until it is executed, or after a certain number of attempts, information about which is stored in memory.

4. Successful request – the request was successfully accepted and information interaction took place.

The IoT market is saturated mainly with mobile objects, which are supposed to be able to move freely, or following a certain algorithm. During its movement, such an object can leave and enter the network coverage area, depending on the standard and the frequency range used, the coverage radius may vary (IEEE 802.11). The first two information blocks of the state diagram describe the movement and connection of the agent to the network, and then the exchange of information with other agents and network participants. Validation of an object occurs immediately before its connection. Once connected, the agent starts sending and receiving messages. If there is no reply to the message, the agent is considered disconnected from the network. In addition to the probability of disconnecting the agent from the network, there is also the possibility of a collision between several objects that are trying to transmit information simultaneously. The state diagram of interaction process is shown in Figure 2.

Figure 2 – The state diagram of interaction process

In order to understand the process of data processing in agent-based approach, we consider a simplified simulation model of the operation of one unit and its processing of data. Since equipment is part of the process, it is necessary to create an interface between the process and the agent representing the equipment [3].

The server interactions model was created in the AnyLogic simulation system is shown in Figure 3, the state diagram structure of which is shown in Figure 4.

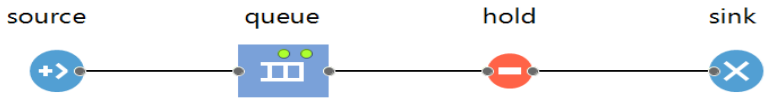

Figure 3 – Server interactions model

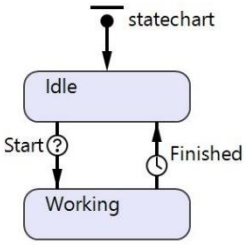

Figure 4 – The state diagram of interaction process

In this model, the state diagram is a simplified model of equipment. When the state diagram goes into a wait state, it checks to see if there are any agents in the queue. If so, it enters an operational state and, when the work is completed, unlocks the hold object, allowing the agent to exit the queue. The holding object is configured to re-lock after the agent passes. The next agent will arrive when the equipment is in a standby state.

As a result of the simulation model of information interaction based on a multi-agent approach, it is shown that the design of IoT systems affects processes and sets tasks that require modeling of information interaction processes, which allows for the predicted traffic build optimal modes of such systems.

References:

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