

WINES Simulator

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WINES - Wireless community NETworks Simulator

WINES (Wireless community NETworks Simulator) is a network simulator developed by following an Agent Based Modeling and Simulation (ABMS) approach in order to evaluate and analyse, from a high level techno-social point of view, the system behaviour of volunteer resource sharing cloud services deployed within wireless community networks (WCN).

The community cloud network architecture implemented in the WINES simulator is based on a hierarchical model similar to that of the well known Guifi.net, populated by different types of nodes, which can be divided into two main categories:

- Super Nodes (SNs) that effectively extend the network coverage by spreading the traffic to other nodes,
- Ordinary Nodes (ONs) or terminal nodes which do not extend the connectivity of the network, but act as simple end users

To further extend this classical community cloud architecture where both SNs and ONs are fixed within the network, we envision the participation of Mobile Nodes (MNs) by accessing to the WCN services throughout a wireless connection provided by the ONs, which act as wireless Access Points (AP).

Both ONs and MNs participate to the system as applicants and as resource providers, thus we implemented two separate resource sharing services: hardware resources sharing in terms of Virtual Machines (VM) instances according to the IaaS paradigm, and file sharing, referred to as DATA resources sharing within the simulator. Figure 1 shows the fully customizable main Graphical User Interface (GUI) of the WINES simulator.

The red squared nodes are SNs, the blue circles are ONs and the green triangles are MNs.

The WINES simulator implements an effort-based incentive mechanism which aims to reward the nodes in proportion to the percentage of resources offered respect to their total capacity. This approach ensures fairness in profit gains between nodes with different capacity. The mechanism uses a virtual coin (i.e., credits) that participants earn from their resource sharing activity and can then spend to acquire the desired resources from other users in the community.

Figure 1 - WINES main GUI

Mobility support

The widespread heterogeneity of users populating a WCN makes extremely difficult to accurately characterize their mobility within predetermined patterns. For these reasons we have chosen to use a synthetic mobility model such as the Random Waypoint, by setting pedestrian speeds for the users. As an example, the figure 2 shows a zoom of a WINES simulation in which the MN 55, connected to the ON 204, moves according to the implemented mobility model and connects to the ON 94 in order to remain part of the WCN. The intermittent activity of the MNs has been modelled by means wake-up and sleep alternation periods by using a Poisson discrete probability distribution.

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Figure 2 - Mobile Nodes mobility

A short video of an example simulation showing how mobile nodes move and dynamically change their access point can be found here:

[WINES_video](#)

User reliability and scheduling policies

The simulator characterizes the degree of stability and participation of a generic user in the resource sharing system using a reliability index, computed according to the time the user is active and with shared resources, respect to a reference time period. As shown in Figure 3, WINES allows to inspect in detail the various properties that characterize a single node, by simply probing the node through the simulation GUI.

Within the community cloud service, resource requests made by ONs and MNs need to be handled by the SN to which they are connected by selecting the node that share sufficient resources to meet the specific request, or by making a routing to a more suitable SN in another geographic area. The choice of which node has to act as service provider can be based on different scheduling policies.

WINES allows to compare the performances obtained using three different scheduling policies: random, Low Credit First, and a new scheduling policy named Most Reliable First, which performs the choice of the node to act as service provider using a specific reliability index.

Figure 3 - Single node's properties inspector

Performance evaluation tools

To properly assess the feasibility of the resource sharing system, it is necessary to consider the satisfaction degree of the generic user within the WCN. The WINES simulator computes user satisfaction throughout specific utility functions, well designed to take into account all possible issues which may arise in realistic system operation conditions. Furthermore, WINES allows to analyze the performance of the system during the simulation through real time generation of time series charts, as shown in figure 4.

Figure 4 - Time series charts

Download free version

A downloadable version of the simulator can be found at this link (JAVA Runtime Environment 7 or above is required for the simulator to run properly):

About the author

WINES has been developed by Fabrizio Vitelli for his Telecommunication Engineering Master's Thesis under the supervision of Prof. Pasquale Pace.

The Master Thesis is downloadable here (Italian language only).

For more info about the simulator, you may contact Fabrizio at fabvit86@yahoo.it.