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QUALITY SERVER IN THE ARCHITECTURE OF WI-FI OFFLOAD TECHNOLOGY

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Сервер качества в архитектуре технологии WI-FI OFFLOAD

В докладе рассматривается один из вариантов усовершенствования архитектуры Wi-Fi offload, которая позволит упростить реализацию передачи обслуживания между сетями.

Introduction. Wi-Fi offload technology enables unloading cellular networks by means of Wi-Fi networks. In this case there is the problem of the service transfer from one network to another. Therefore it is necessary to improve the network architecture for error-free handover implementation.

Main Part. It is proposed to use the server that will collect and process information about the handover realization. Specialized software has to make changes in the handover procedure based on these data.

Fig. 1 shows the improved scheme of handover using QS. Let us describe the parameters with which QS will be operated. There are three key handover performance indicators:

1. The frequency of unsuccessful handover (handover failure ratio, HQ1) is defined as the ratio of unsuccessful handover (NHO) to the number of attempts. Number of retries is the sum of the number of successful handover (SHO) and failed attempts and the number of failed HO (NHO):

$$HQ1 = \frac{NHO}{NHO + SHO}$$

2. The frequency of check handover (HQ2) is equal to the number of return (PP), divided into the total number of handovers:

$$HQ2 = \frac{PP}{PP + SHO}$$

If the connection that was transferred to another network and returned back in time, less critical Tcrit, then this handover is seen as the opposite (ping-pong).

3. The frequency of break lines (HQ3) is equal to the number of line breaks LF to the total spent connections SHO:

$$HQ3 = \frac{LF}{LF = SHO}$$

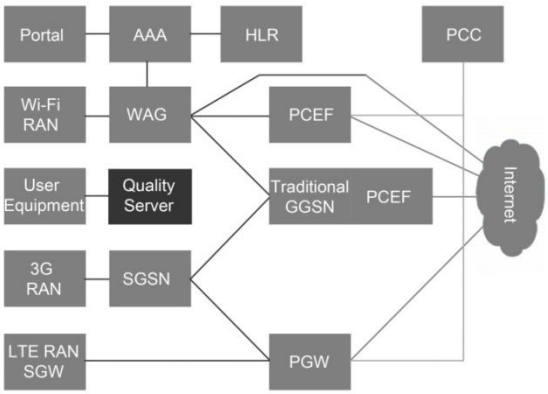

Fig. 1 Wi-Fi offload arcitecture scheme

The objective function consists of three indicators and takes into account their importance:

$$HQ = w_1 * HQ1 + w_2 * HQ2 + w_3 * HQ3$$

where w_1, w_2, w_3 - weighting coefficients. Their value is derived from the negative impact of errors on handover performance.

Assume that the server sends information to the user equipment after every *n* feasible handovers. SM on user equipment operates in a way that reduces the number of failed, ping-pong handover and cliffs on the radio on z_1, z_2, and z_3 presents respectively. Since the change in value does not depend directly on the passage of time, but on the number of handover, we take a uniform frequency handover execution time for greater clarity.

Let us create the error function of handover with using quality server:

1. The frequency of unsuccessful handover is defined as the difference between the number of unsuccessful handover without quality server and this amount multiplied by the correction coefficient per unit time divided on the total number of attempts to perform handover.

2. The frequency of check handover is determined as the number of check handover without quality server and this amount multiplied by the correction coefficient per unit time divided on the total number of attempts to perform handover.

3. Frequency of line breaks is defined as the difference between the number of line breaks without quality server and this amount multiplied by the correction coefficient per unit time divided on the total number of attempts to perform handover.

The value of the correction coefficients, depends primarily on the quality of the Software Module - software that is directly responsible for changes in the decision making process of handover. Since SM algorithm in this paper is not considered, value adjustment coefficients is taken within 5 - 10%. The choice of weighting coefficients provided retain mobile operators and determine experimentally for each network.

Schematically, the server process is illustrated in Figure 2.

where i1, i2 i3 - signals of the unsuccessful handover, ping-pong handover and break of radio line and f (i1), f (i2) and f (i3) - functions statistically processed by the server.

Let us look in more details at the QS structure. To get Wi-Fi performance under control, we advocate the deployment of an enhanced Wi-Fi management architecture (Fig. 3). The key components are the management block, Wi-Fi

network, destination UEs, data source, and cellular network. The red and black lines denote the control signal paths and user data paths. The Wi-Fi network and Wi-Fi traffic should be managed to maximize Wi-Fi system capacity and avoid Wi-Fi access failures. Wi-Fi network and traffic management are conducted by three functions in the management block. The monitoring database collects feedback from the APs and UEs via control signal paths. The Wi-Fi performance estimator uses the information in the monitoring database. The radio resource manager maintains the Wi-Fi network and controls the traffic using the control signal paths. The entities of the Wi-Fi network are APs, UE-MRs (mobile routers, MRs, or UEs using a tethering function). It is expected that some of the APs are controlled by the management block and have the function of monitoring the Wi-Fi radio environment. The management block monitors the Wi-Fi radio environment, estimates Wi-Fi performance, and conducts radio resource management. Then the effectiveness of the radio resource management is evaluated by monitoring. Cycling through these three management blocks keeps improving the user experience even in the face of drastic radio environment change.

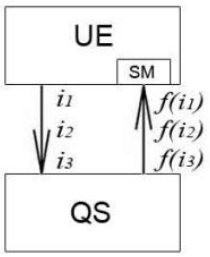

Fig.2 Interconnection between UE and QS

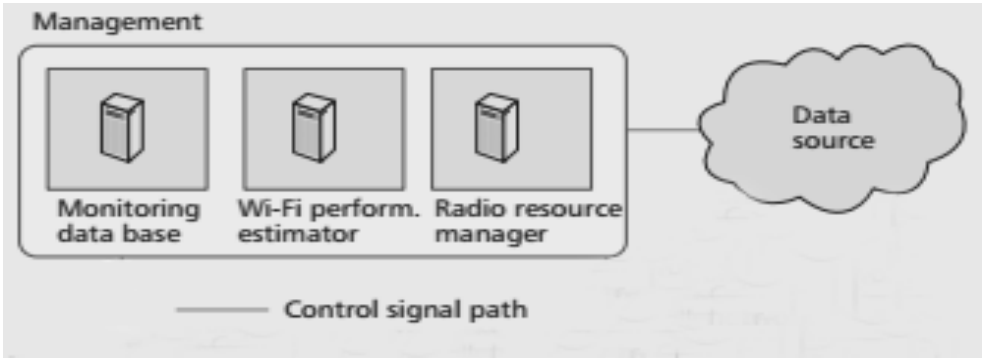

Fig.3 Scheme of the Quality Server structure.

Conclusions. In the paper the usage of additional quality server is suggested for improving the handover procedure based on statistical data. This helps to organize handover process with less number of errors. Schematically the structure of the Quality Server is shown. The future research will provide implementation of the suggested procedure for Wi-Fi offload.

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