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PERFORMANCE ANALYSIS OF QoS BASED DYNAMIC HANDOVER MECHANISM IN HIGH SPEED VEHICLES

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Abstract- Mobility has become a mandatory feature of the future Internet as mobile computing gains increasing popularity among Internet users. The rapidly evolving heterogeneous wireless environment provides a variety of communication resources for the mobile host. In order to fully benefit of these wireless access networks an efficient and quality oriented mobility management system has to be employed. This paper presents an innovative solution for handover management based on an estimation of multimedia streaming quality which considers both quality of service and user quality of experience in the decision making process. The proposed solution aims at improving the user perceived quality in the context of mobile multimedia streaming by efficiently exploiting all the communication resources available to the mobile host. QoE Hand allows users of multimedia content to be always best connected in IEEE 802.11e and IEEE 802.16e environments. Simulation-based performance evaluation shows the performance improvement, both in Quality of Service and user perceivedquality, when the proposed solution is used compared to other mobility solutions.

I.INTRODUCTION

The advance of heterogeneous networking access tech-neologies real-time multimedia applications and protocols has formedaexcess of new wireless connectivity scenarios featuring an ever-increasing number of devices and multimedia networking entities. This heterogeneous multimedia as mart environment is changing the lifestyle of users and creating a human-centric multimedia wireless era. Hence the combination of heterogeneous networks in such a scenario, for instance IEEE 802.11, IEEE 802.16 and Long Term Evolution(LTE) in multi-access and multi operator systems, is bringing about new changes in the Internet by providing new chances, introducing well communication channels and raising the possibility of providing better Quality of Experience(QoE) declaration for users of wireless services. Continuous mobility allows mobile users to be always connected to the best network so that the user experience can be adjusted and maintained even during handovers. In this situation, the formation of novel cross-layer architectures is essential to allow vertical/horizontal seamless QoE-aware handovers in heterogeneous wireless networks. As a means of providing Interoperability and continuous mobility inheterogeneous systems, the IEEE announced the standard called IEEE 802.21 or MIH (Media Independent Handover Services) .The MIH is a middleware for heterogeneous networks, which has a set of protocols and mechanisms that allows IEEE or non-IEEE technologies to be combined, while ensuring both vertical and horizontal handovers. However, MIH alone is unable to provide either an ABC approach or QoE assurance for videos over wireless clients. In traditional handover schemes, such as MIH, users are Connected to access points that offer the best power present in a received radio signal or Quality of Service (QoS) metrics, such as loss and delay. In heterogeneous networks, the Received Signal Strength Indicator (RSS) and QoS metrics are not sufficient, by themselves, to support QoEaware seamless mobility. This is because these low-level quality metrics cannot measure the subjective aspects of multimedia content with regard to user perception/satisfaction. In view of this, cross-layer heterogeneous wireless QoE architectures with multi-homing, quality estimator, mapping and adaptation are documented as key factors in the success of coming multimedia systems .A mobile multimedia architecture with a video quality estimator must be calculated with the aim of estimating user perception at the currently connected as well as candidate access points (which will be used in the handover decision process) with low complexity and processing.This must be able to integrate comprehensivemonitoring schemes with service metrics, such as visualcodec, Group of Pictures (GoP) length, intra-frame dependency, spatial–temporal(motion and complexity) video activity, network impairments and other relevant factors, such as the capability of the wireless systems/service classes. QoE-aware estimate models can bedevised through efficient network cross-layer agnostic content-awareness, QoE monitoring and Artificial Intelligence(AI) methods along with the correspondingcognitive evaluation of the inputs of the users .One of the key issues when deploying heterogeneouswireless systems is that each domain must support different QoS models (e.g. IEEE 802.11e or IEEE 802.16) and offerthe same wireless service classes with different definitions or even service classes with different compositions.The QoE-aware mapping mechanisms must be able to map application requirements and user perception into available wireless service classes on the basis of information about the available service classes within or between wireless networks (multi-access and multi-operators) and scores for the level of video quality given by the quality estimator.

This suggests a QoE Handover Architecture for Converged Heterogeneous Wireless Networks, called QoEHand. QoEHand extends MIH to allow QoE-based seamless mobility and video quality optimization through the use of video quality estimator ,mapping and adaptation schemes. Compared with existing MIH solutions, QoE Hand identifies the most suitable connection with the aid of a specifically designed set of decision making modules, which take into account the QoE needs of the applications/clients, available wireless resources and human experience Simulations were carried out in a multi operator IEEE 802.11e/IEEE 802.16e system to measure the benefits of the proposed solution and its impact on user perception by employing objective and subjective QoE metrics.In the context of heterogeneous wireless networks the mobility management solution may exploit several communication resources (networks) simultaneously in order to maintain the required level of QoS for mobile host.

II. Related works

This system uses a modular method to manage the mobility and video quality estimator components to offer unified mobility. Our proposal uses the same modular (i.e., quality estimator, mapping and a set of adaptation components)and self-organized technique and also estimates the need of a QoE-aware of media independent handover system on the user's view. A mobility server for unified vertical handover in IEEE802.21 MIH networks is offered. Information about the wireless channel circumstances is calculated and used to offer unified handover. However, the proposed solution does not take account of the presence of networks with different classes, which are expected in wireless systems. Moreover, it does not allow QoE assurance for users of multimedia content. A QoS architecture to provide a level of quality assurancefor applications in heterogeneous environments is discussed, while in a systematic performance evaluation approach just focused on QoS parameters over heterogeneous wireless networks is presented.Another video quality estimator, known as Pseudo-Subjective Quality Assessment (PSQA), and its extensions use a Random Neural Network to map network impairments and video characteristics of user perception. A set of applications has already used PSQA. However, PSQA-based solutions only use QoS parameters, such as packet loss, as input for the assessment scheme and do not consider videos with different temporal and spatial complexity levels during the video quality prediction process.

The proposal in implements a schedule-based approach that draws on information about delay, loss and current network resources, and adjusts the scheduler to improve the video quality of delivery. However, this work does not provide seamless handover or follow its procedures in accordance with the user´s experience/QoE (only QoS parameters are used). A MIH-based mobility scheme for IEEE 802.11 and IEEE 802.16e environment. The results showed that a wireless device can start its handover operation before the old link has been disconnected, and thus there is a reduction in packet losses and the latency. Another solution also uses a make-before-break scheme to support seamless mobility, but by using a Session Initiation Protocol (SIP)-based mobility management. Our proposal follows the samemake-before-break approach to provide seamless handover, but we also introduce the QoE video quality estimator, mapping and adaptation support, as required for heterogeneous networks. Few works have studied the benefits of an integrated QoE-aware wireless networking architecture with seamless mobility and heterogeneous support. Our technique pursues to overwhelm the boundaries of existing proposals by permitting mobile users to be ABC with QoE maintenance in multi-operator wireless backgrounds.

III.A QOE handover architecture for converged heterogeneous wireless networks

The goal of the QoE Hand is to ensure QoE-aware seamless mobility and optimization support for real-time multimedia applications in converged heterogeneous wireless networks. This objective is achieved by extending MIH with key QoE-aware video quality, mapping and content adaptation components. In handover periods, QoEHand enhances MIH in identifying the most suitable connection (and BS) with the aid of a specifically designed set of decision-making modules, which take into account the QoE needs of the current applications, human experience, and available resources in IEEE 802.11e/IEEE 802.16 service classes. QoE Hand agents are implemented, together with both Base Stations (BSs) / Access Points (APs) and wireless nodes, by following the recommendations of theof the MIH proposal.QoEHand extends MIH/ IEEE 802.21 through the QoE-aware mapping, video quality estimator and adaptation components. Thus wireless devices can always be best connected (withQoE assurance) in multi-operator/access networks.

A.QOE video quality estimator

The video quality technique implements the real-time in multipath and multi-operator heterogeneous networks. It is a video quality estimator which assembles the QoE video in real timecommunication.The video quality estimator takes into account the current network condition network and different video constraints that directly affect the quality of the video in terms of MOS expectation. Thus, these parameters enable QoE Hand to measure the quality level of videos even when they have different coding designs, categories, comfortable types andpackage loss rate. The video characteristics are collected from the network by using a packet inspector module. In addition, a cluster-based Multiple Artificial Neural Network (MANN) model is implemented to map video characteristics and network impairments into Mean Opinion Score (MOS) as a means of providing results that correspond as closely as possible to a human observer. The QoE video quality estimator operates in two modes, as follows: (1) monitoring the quality level of current video flows. If the predicted MOS indicates a low video quality, the adaptation scheme is triggered to adjust the video content to the current network conditions, (2) during the mapping or adaptation process, the video quality estimator is triggered to inform the MOS for videos in each wireless class.

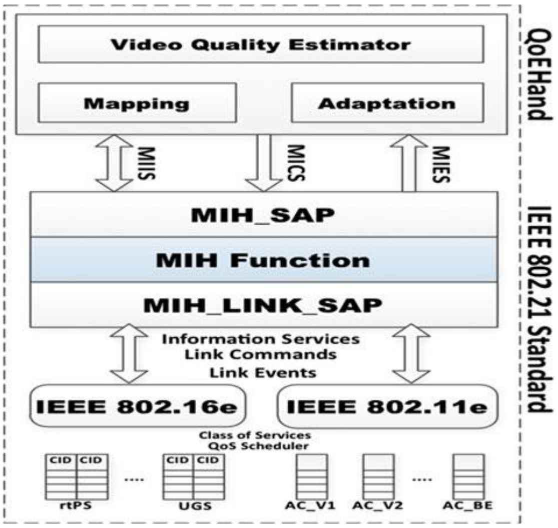

Fig 3.1: IEEE 802.21 standard with QoEHand components

The video quality estimator uses a set of feed-forward back-propagation networks that are supplied with MOS.MOS is the most widely used subjective metric, recommended by the ITU , and obtained by asking observers to grade the quality of videos on a five-point scale (Excellent, Good, Fair, Poor and Bad).

B .QOE MAPPING MECHANISM

The mapping process is carried out by drawing on information about the available classes (IEEE 802.11e or IEEE 802.16e QoS models) within or between networks (in multiple paths when possible), application QoS/QoE requirements, the video quality estimator score and mapping policies. The last of these decides which and when mapping methods must be used to carry out a request. After the mapping decision, the MIH QoS scheduler is triggered to map/link the packets in the selected service class.

The Mapping policies define two main mapping methods mapping process is carried out by drawing on data about the accessible service classes within or between networks (in multiple paths when possible), application QoS/QoE requirements, the video quality estimator score and mapping strategies. It selects the best class for an emerging multimedia request (its flows/components), called Full and Partial- Matching.
A full-matching mapping is achieved when the quality level score of an application in a class is better than the minimal level. If there is more than one class result in the same quality level score, the policy scheme only considers the service class that has more available resources in terms of bandwidth. If the most suitable wireless service class is unable to assure a full matching (due to congestion or the existence of service classes with different configurationsin terms of loss, delay and jitter support), theadaptation scheme is triggered to seek a potential adaptation for the applications that match the current network conditions. This adaptation can be carried out by intra application adjustments or by requesting re-mapping withthe aid of partial matching rules.

Depending on the business strategies, the nature of the multimedia content and the video quality level score, a set of dynamic partial matching mapping approaches can be applied as follows:
• Downgrade class mapping: In this approach, a less Important class is chosen to accommodate the application that assures a good/acceptable level of quality (video quality estimator score C minimal video quality level requirement).
• Scalable coding mapping: This approach takes into account the importance of each scalable flow (scalable video coding) of an emerging multimedia application during the mapping process. It maps high priority application flows into the best class and lower priority flows into a less significant class.
•Hierarchical component mapping: This approach selects service classes according to the order of priority of different multimedia components. Video communication is much more sensitive to packet loss than audio communication because the human eye can often detect small glitches in a video stream caused by relatively minor packet loss, to the extent that enjoyment and/or understanding are more severely affected.
Hierarchical 2D/3D mapping: This scheme maps 2D or 3D video frames based on the importance of each frame type in user experience.

C. QOE ADAPTATION MECHANISM

The adaption device which is used to control the quality level of new or current applications.As declared previous, one problem rising from multioperatorwireless systems is the fact that each network provider can support different QoS models (e.g., IEEE 802.11e or IEEE801.16) and can offer the same class of service with different definitions. For this purpose, when the mapping process is not best (perfect match), the QoE Adaptation modifies (e.g., downgrades) the quality level of the emerging applications if the network resources in a service class are unavailable (e.g., in congestion periods). The lower adaptation process is irregular whenthere are accessible resources in the earlier service class over. In this case, the QoEHand can produce MIH to handover the wireless client to the old network and maps allthe flows into the earlier service class.Since the achievement of our continuous suggestion depends on approving a make-before break approach, the resources that are allocated and not used in previous or candidate service classes, are released by soft-state operations, for illustration after a handover.

A set of network adaptation profiles can be obtained by the adaptation mechanism to control the quality level of new or current applications. This is achieved as follows:

• 2D/3D frame dropping adaptation: This approach drops packets in accordance with the visual importance of each frame encoded with common hierarchical 2D and 3D MPEG/H.264 codecs.

Scalable video code adaptation: This approach adjusts The quality level of applications by dropping or adding Low important flows of scalable multimedia applications.

• Hierarchical component adaptation: Media flows within an application should be marked with different priorities. Audio packets are marked with low priority and video packets with high dropping priority if voice is more critical for the success/quality of the multimedia application.

• Region of Interest (ROI)/regions in the videos that are of most interest to the viewer: This scheme marks in-ROI (e.g. face) packets with low and out-ROI packets with high dropping priority.

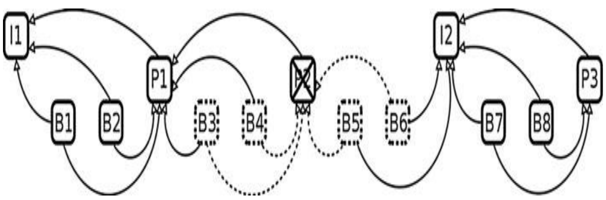

Fig 3.2: MPEG structure with broken dependences

IV. QoE Hand: MIH integrated architecture

Later presenting the functionalities of the mapping, adaptation, and video quality estimator, QoEHand will be described and integrated in an IEEE 802.21 system. Each BS or AP (both with MIH) informs before the connection (both IEEE 802.11e and IEEE 802.16), which service classes (including the current channel conditions in terms of loss, delay, and bandwidth) are available to connect the application of the wireless devices. The MIH establishes communication between the lower and upper layers on the basis of a set of IEEE 802.21 primitives defined as Service Access Points (SAPs). There are three SAPs: MIH_SAP, MIH_NET_SAP and MIH_LINK_SAP. The MIH_SAP allows the communication between the MIH and the upper layers. The MIH_NET_SAP is used to exchange information between MIH entities. The MIH_LINK_SAP is the interface between the lower layers and MIH.

V.PERFORMANCE EVALUATION

Imitation experiments were approved out by expending the Network Simulator 2 (NS2) and Evolved (to control the video distribution). The objective was to analyze the benefits of QoEHand and its effect on IEEE 802.11e and IEEE 802.16e networks, equated with a system without QoEHand (without video prediction, mapping and adaptation – and only with MIH functionalities), by calculating QoE subjective (MOS) and impartial (Video Quality Metric VQM) metrics. The VQM values vary from 0 to 5, where 0 is the best possible score. The QoEHand video quality estimator was made with the aid of MATLAB. The RTP payload header includes a field that specifies the current frame. Four profiles were designed in the system to define the assistances of QoEHand with different circumstances and experiments:

(i)Pure_MIH (without QoEHand);

(ii) QoEHand_Full, when a full mapping match is accomplished duringthe handover and there are accessible resources in the service class of the external network;

(iii) QoE Hand_Part profile, which re-maps all the packages of a video structure into a less significant class in the objective system, because the most appropriate wireless service class cannot declare a full-matching (e.g., due to congestions);

(iv) QoE Hand_Drop which controls the video quality level by dropping video packages in descending order of importance, from the viewpoint of the user´s observation. The ITU-T MOS reference was used for a personal evaluation with 55 viewers.

The Single- Stimulus (SS) method was used in the experiments, because it is appropriate for large-scale tests, where a achieved video sequence is displayed by itself, without being combined with its unrefined reference description. The test platform used was a Desktop PC with Intel Core i5, 4GB RAM and a 21” LCD monitor. A software tool was applied to show the video sequences and gather the user´s scores. 10 different wellknown Internet video sequences were selected for the experiments with different levels of complexity and motion. The video sequences were encoded in MPEG4 format and the period varied from 10s to 30s. The GoP length was 18, which is what can be estimated for common Internet video streaming. To deliver a large enough video database and increase the reliability of the system, each selected video was simulated 10 times by varying the congestion periods (from 0% to 50% in steps of 5) in a service class, resulting in a total of 100 (received) videos with a different package loss rate. A multi-operator scenario is used to evaluate the QoEHand. QoEHand can work on both fixed and mobile systems, where handovers can be triggered due to the movement of a mobile device to a new AP/BS or due to congestions in a service class. In order to simplify the experiments, assume that the wireless nodes are fixed implement both IEEE 802.11e and IEEE 802.16e interfaces and handover to a new network or service class due to congestions. Two service classes were configured in each network (IEEE 802.11e – AC_V0 and AC_V1 / IEEE 802.16e - Real-time Polling Service (rtPS) and Non-real-time Polling Service (nrPS). The service class, in which the user is receiving the video in the current network, will experience congestions of from 5% to 50% in steps of 5 by concurrent traffic. Hence, QoEHand will interact with MIH to modify (handover, remapping or drop packets) the video quality level based on one of its 3 profiles (QoEHand_Full, QoEHand_Part and QoEHand_Drop). 10 simulations were carried out for each video, where, in five cases, the receiver practiced congestions in a service class of an IEEE 802.11e network.

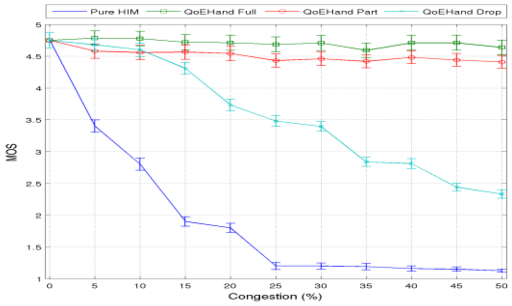

Fig 5.1: Congestion x MOS

As illustrated in Figure 3, the MOS results illustration that QoEHand assures an excellent quality level for the videos during congestion periods when the QoEHand_Full and QoEHand_Part profiles are used. In the QoEHand_Part, the videos still have a good-to-excellent quality level even when re-mapped to a less important class (nrPS or AC_V1) with a packet-loss rate of approximately 2%. The QoEHand_Drop attempts to keep the application at an excellent quality level of up to 10% of congestion and at a good/regular quality level of up to 30% of congestion. However, when the Pure_MIH is used, the video quality level was considered poor by all the observers, if there was a minimum of 10% of congestion in a wireless service class. When anframe is dropped, the error is spread through the rest of the GoP and the quality is bad/poor, because the MPEG decoder uses the frame as a reference point for all the other frames within a GoP.

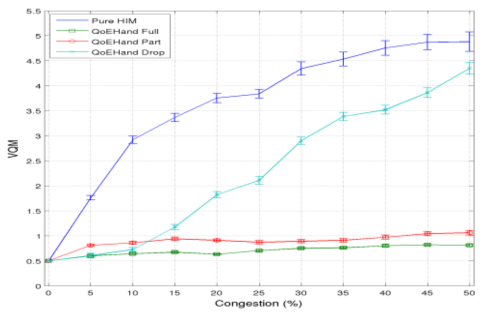

Fig 5.2: Congestion x VQM

The VQM results for all the tests are shown in Figure and demonstrate the benefits of QoEHand profiles in a QoE-aware converged wireless network (e.g., by analyzing blurring, global noise, block distortion and the colour distortion of the videos). The QoEHand_Full profile kept the VQM values at around 0.75 throughout the experiments. Compared with the QoEHand_Full profile the QoEHand_Part, on average, reduced the video quality level by 0.3 for all the simulations. In congestion periods of a service class, the QoEHand_Dropkeeps the VQM values at less than 1 when the congestion rises to 10%. Since the B and P frames are rejected first, the impact on the user´s perception is kept to a minimum when the system is configured with QoEHand_Drop. If it exceeds a congestion rate of 5%, the Pure_MIH profile can no longer assure the minimal quality level for the videos.

VI. CONCLUSION

Evolving multimedia wireless networks will allow users to be linked to the best QoE-aware wireless access network, where seamless mobility will be joined with respect for the user´s likings. This paper proposes a modular architecture called QoEHand to maximize the QoE of wireless clients in MIH IEEE 802.11 and 802.16 systems, by organizing quality estimator, mapping and adaptation mechanisms.QoEHand can be adjusted to operate with different technologies, such as LTE, and wireless service class. Simulation experiments were passed out to demonstration theeffect and benefits of QoEHand in an IEEE 802.11e and IEEE 802.16e multioperator system.The results reveal that QoEHand_Full and QoEHand_Part profilesallowed the video to keep an excellent MOS during all the experiments, while QoEHand_Drop in a maintained videos at an excellent quality level up to 10 % of congestion.

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