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Voice quality control in packet switched wireless networks

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Abstract

Wireless systems have engaged the evolutionary migration from traditional circuit switch technology to packet based technology. Presently all next generation wireless networks have been specified with a packet based Radio Access Networks (RAN), which implies that all the flaws of traditional packet based networks now also apply to voice. These flaws result in decreased speech quality derived from increased latency, jitter and packet loss. This thesis provides the basis for a solution that will facilitate voice quality control in a packet switched wireless network based on the integrated approach of providing Quality of Service (QoS) control across the Admission Control (AC) component, Bearer or Service Flow component and mapping across these components to the appropriate Quality of Service (QoS) metrics at the transport network.

The original contribution of knowledge to the field of electrical and information engineering is the proposal of a Quality of Service (QoS) framework and control mechanisms that result in the transmission of quality voice over a packet switched wireless network autonomous to voice specific signalling or media protocols. These proposals include: Heuristic Analysis in the Admission Control (AC) component; the addition of a voice service class Admission Control (AC) model; selection of a voice specific Bearer or Service Flow and the mapping thereof to a voice specific Quality of Service (QoS) queue or Service Flow at the transport or backhaul network. All these solutions are presented with the goal of ensuring the preservation of quality voice over a packet switched wireless network as governed by network quality metrics such as latency, jitter and packet loss.

This research delivers a comprehensive analysis of 4th Generation (4G) networks such as, Worldwide Interoperability for Microwave Access (WiMAX) and Long Term Evolution (LTE),

as specified by the standards bodies yet with focused orientation to the Quality of Service (QoS) framework provided by each of the standards. Specific investigations are targeted towards the Admission Control (AC) and Scheduling of physical resources over the air interface by the Media Access Control (MAC) and Radio Link Control (RLC) layer. Current research and industry led initiatives in the provisioning of quality voice, such as Circuit Switch Fallback (CSFB) and IP Multimedia Subsystem (IMS) are presented and include the associated advantages and disadvantages.

The results and recommendations of this research consist of a multi-faceted solution, commencing with the addition of Heuristic Analysis with Deep Packet Inspection (DPI) being proposed at the eNodeB or WiMAX Base Station (BS) level. An Admission Control (AC) scheme tailored for voice utilising Heuristic Analysis as an input is created, thereafter an identified QoS Class Identifier (QCI) Bearer or Service Flow and transportation Quality of Service (QoS) Identifier for voice is triggered by the User Equipment (UE) application or Bearer initiation procedures. The LTE Bearers and WiMAX Service Flows are tested with the intention of recommending an LTE Bearer and WiMAX Service Flow that will ensure compliance to the minimum required network quality metrics. Finally the testing of the invoking mechanisms is presented mapping the Quality of Service (QoS) metrics across each of the network components thereby completing the solution.