A NEW QoS DRIVEN CALL ADMISSION STRATEGY ENABLING SOFT CAPACITY IN GSM NETWORKS

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I. ABSTRACT

A Call Admission Control (CAC) algorithm is responsible for using efficiently the available resources of the system in order to ensure that the system meets the Quality of Service (QoS) requirements of the user. In 3G wireless mobile networks the radio resources are also exploited by the soft capacity feature of the cluster. With soft capacity the available traffic channels in the central cell are dependent on the interference caused by the adjacent cells. This assumes low frequency reuse factor and fractional loading. On the contrary, in Global System for Mobile (GSM) networks the channel resources and the cell sizes are fixed, hence the realization of soft capacity is much more demanding. Soft capacity characteristics in GSM-like networks have been studied in [3] and fractional loading techniques have been studied in [4]. This paper merges the knowledge from earlier studies and proposes a new approach of exploiting soft capacity in GSM networks via system initiated handovers.

According to the cell planning model that is assumed, the traffic load is largely centralized and handled by the central cell of a seven-cell cluster. Therefore the system, in order to preserve the QoS in the central cell, initiates system handover call requests to the neighbouring cells. The CAC scheme searches for available system resources every time a new call or a handover request is issued. If the ongoing traffic exceeds load threshold decided by the provider then the system scans all the established connections in order to find one that can be handed off to a neighbouring cell. This decision is called QoS estimation and is based on a QoS Index. The QoS index is determined the size and the shape of the area in which the mobile is roaming.

One simple admission strategy that is applied in the second generation networks differentiates between new call and handover call requests and assigns higher priority to the latter by reserving resources for handover calls only [1,2]. The algorithm then checks for spare channels. If there are unoccupied channels then the handover request is admitted, otherwise the request is dropped. Similar procedure is followed for new calls, which are admitted if there are unassigned channels available, other than the channels reserved for handover calls or blocked if all channels are occupied. Based on this simple and straight forward CAC scheme, we developed a new 3G-like CAC algorithm for 2G networks that guarantees QoS in the cluster. The proposed call admission policy, by means of thresholds controls the traffic decentralization and enables the soft capacity features, despite the fact that the cell sizes and resources in the model are fixed.

In particular, this study assumes a seven-cell cluster system with fixed cell radius. The central cell, which is the cell under study, is assumed to cover an area with excessive traffic while the neighboring cells suffer from much less loading, therefore being used as reservoirs for the excess load of the central cell. This model although theoretical, represents a common situation in real networks. The proposed admission control strategy, based on the above cell planning model, decentralizes the traffic by handing over the excess load of the central cell to its neighbors. It has to be mentioned that the system initiated handover call requests (sih) are only issued from the central cell towards its neighbors. On the other hand, user initiated handover call requests (uih) due to the mobility of the user, who passes from one cell to another, can equally be issued by all cells in the cluster. The sihs are adequately controlled by the admission scheme in a way that QoS requirements are preserved in the cluster. Figure 2 showcases in a schematic representation, how the admission control strategy achieves traffic decentralization by initiating QoS-driven system handovers.

The proposed admission strategy comprises three main components-functions.

- The neighbouring cell resource monitoring function.
- The QoS Estimator.
- The central cell resource monitoring function.

The neighboring cell resource monitoring function checks the resources of the neighboring cell in order to prevent overloading of the neighboring cells. If the neighbor resources are adequate, the QoS estimator is reached, where the QoS index is checked as the last requirement for a sih to be performed. Additionally, the central cell resources monitoring function checks the available channels in the central cell every time that a sih cannot be initiated and the issued call must be serviced within the cell. If this function finds available channels in the central cell then the call is accepted, otherwise it will be handed over to a neighboring cell as a last-ditch effort.

The proposed system is tested against the simplified and prevailing Erlang-B and Handover Reservation systems. Such a comparison is fair in this case, since the proposed system is an improved variation of the well-adopted Handover Reservation scheme and the only handicap of the original system is the QoS estimator which is included in the cost of the proposed one. Moreover, the Erlang-B system is always presented as a down boundary for blocking probability and upper boundary of dropping for every scheme in comparison. The results for the central cell demonstrate the expected improvement of the system. In both cases (blocking and dropping) the proposed algorithm yields an important gain over the similar Handover Reservation algorithm. This improvement approximates one

order of magnitude for heavy load situations. Moreover, the performance of the proposed algorithm challenges even the Erlang-B performance in case of blocking with heavy traffic. Figures 9, 10 show the defect of the proposed algorithm. Both probabilities are increased in case of the neighbor cell. However, for a case study of centralized traffic such as this, this deterioration is not of importance. The probabilities are practically held below 10^{-10} in any case while the traffic in the central cell is relieved only by the proposed algorithm.

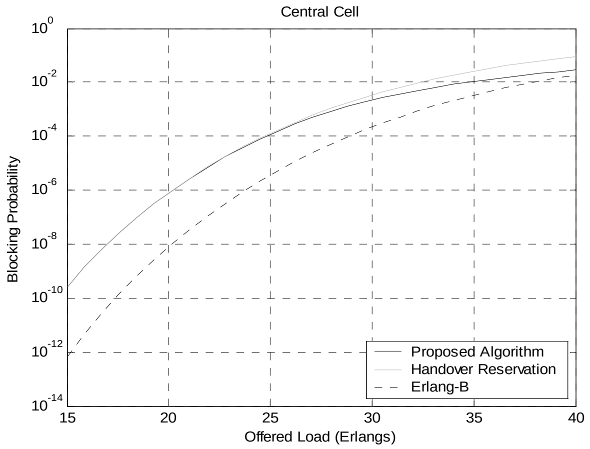

Figure 1 – Blocking Probability for the central cell

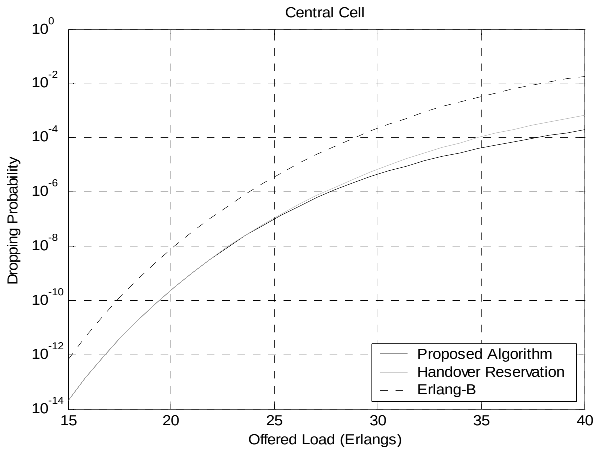

Figure 2 – Dropping Probability for the central cell

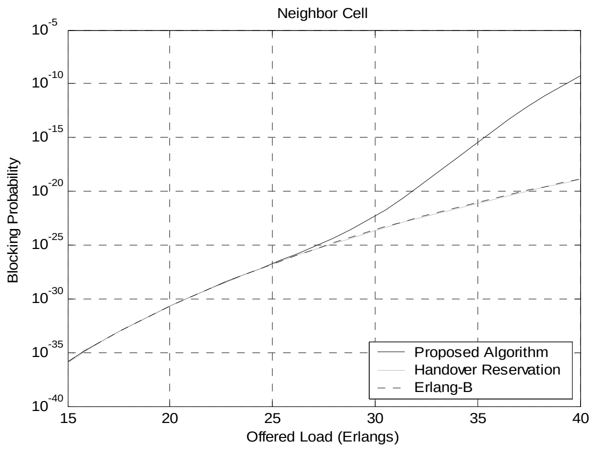

Figure 3 – Blocking Probability for the neighbor cell

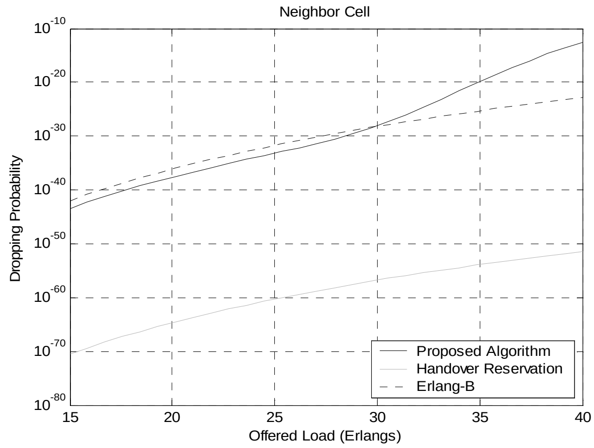

Figure 4 – Dropping Probability for the neighbor cell

II. CONCLUSIONS AND OPEN ISSUES FOR RESEARCH

The implementation of the proposed algorithm concerning the QoS driven admission strategy, can take place on the already installed systems with small interventions. The proposed algorithm creates the soft capacity feature in a 2G system with fixed cells and resources. Hence it offers a satisfying improvement of QoS for asymmetrically loaded systems by adding an insignificantly small fraction of complexity in the system. Further research is undertaken in the following fields:

- Implementation of the proposed algorithm to the neighboring cells also.
- The extension of the comparisons of the algorithm with more sophisticated algorithms.

III. REFERENCES

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