Fractal Traffic with Reference to Performance Analysis of Call Admission Control in Wireless Mobile Network

Sajid Shaikh, Naser Shaikh

Abstract— Call admission control is a provisioning strategy to limit the number of call connections into the networks in order to reduce the network congestion and call dropping. In wireless networks, another dimension is added call connection dropping or simply call dropping is possible due to the user's mobility. A good CAC scheme has to balance the call blocking and call dropping in order to provide the desired QoS requirements. Limited and time-varying wireless resources, user mobility and various application requirements promote the development of adaptive techniques. Focusing on the cell specific mobility, I propose a target utility-based rather than call drop probability-based solution to address the QoS stability intra/inter cell and tradeoff between carried traffic and degradation. Prediction and compensation methods are used in the proposed scheme with little assumption of fractal traffic and user mobility mode.

Keywords -Call admission control, fractal traffic, network.

Index Terms—About four key words or phrases in alphabetical order, separated by commas.

I. INTRODUCTION

Today, the Mobile and Internet communication is growing exponentially, with traffic statistics that mathematically exhibit fractal characteristics: self-similarity and long-range dependence. With these properties, data traffic shows high peak-to-average bandwidth ratios and causes data networks inefficient. These problems make it difficult to predict, quantify, and control data traffic, in contrast to the traditional Poisson-distributed traffic in telephone networks. In this paper an analytical methods is used to study fractal network traffic. The complementary characteristics of Universal Mobile Telecommunications System (UMTS) and 802.11 Wireless Local Area Network (WLAN) make it attractive to integrate these two technologies. In 1946, AT&T introduced the first mobile telephone in the US allowing telephone calls between fixed stations and mobile users. Due to the immaturity of the technology, the quality of service (QoS) was terrible. However, poor reception and high blocking probabilities (65% or more) could not suppress the demand for the mobile service. In the 1960s, Bell laboratories come with a novel idea of Improved Mobile Telephone Services (IMTS), which is the backbone of the first-generation mobile communication system.

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The demonstrations of cellular communication concept in 1970's, and availability of improved microprocessor systems, lead to the birth of first generation mobile communication system. The first-generation [4] of cellular wireless communication system was analog and progressively became available during early 1980s. It was popular for business users due to the convenient mobile nature of the service. Several countries (US, Sweden, Japan) started developing their own standard for mobile analog networks. Different frequency spectrum allocation and different protocols usage in different countries lead to limited mobility. The most successful analog systems are NMT (Nordic Mobile Telephone – Sweden, Norway, Finland), AMPS (Advance Mobile Phone Service – Asia, North America), ETACS (Extended Total Access Communication System – UK), and JDC (Japan Digital Cellular). As the popularity of wireless communication rise in the 1980s, the cellular industry faced practical limitations. For a fixed allocation of spectrum, a large increase in capacity implies corresponding increase in difficulties for enlarging the networks. In addition to the capacity bottleneck, the utility of first-generation analog systems was diminished by the proliferation of incompatible standards in Europe. Frequency spectrum allocation for mobile system varied differently with countries where there was no common spectrum allocation.

II. CALL ADMISSION CONTROL SCHEME

A. An adaptive admission control algorithms to keep the handoff dropping probability below a pre-defined level while maximizing utilization. It was investigated the inter-cell unfairness problem as a new performance evaluation criterion. According to the type of admission test and adaptive algorithm used to control the admission threshold. This admission control scheme was compared with other existing competitive bandwidth reservation method. This scheme solves the inter-cell unfairness problem and showed high utilization under a variety of traffic loads, call bandwidths and mobility conditions. In addition, it has extremely low complexity overhead and signaling load, making it readily implementable in real wireless networks. Through performance comparisons, it shows that admission control scheme which combines the simple admission test and the enhanced adaptive algorithm is superior to the others in terms of fairness and performance.

B. An adaptive call admission control algorithm based on the concept of guard channels. It is assumed that handoff calls have higher priority than new calls.

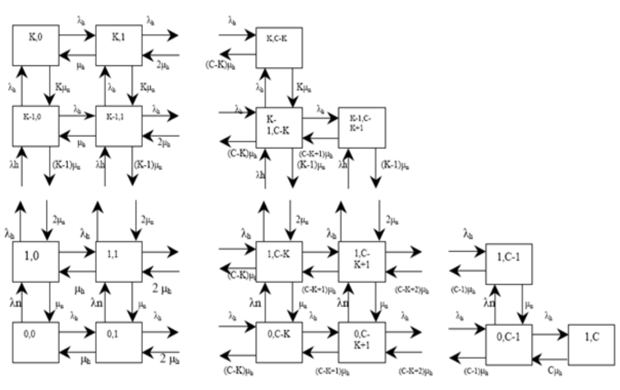
This adaptive algorithm can search automatically the optimal number of guard channels to be reserved at a base station, and it can also adapt to changes in traffic conditions such as changes in the call arrival rate. It is noted that changes in traffic conditions are inevitable in reality. Thus, fixed CAC policies such as fixed guard channel policies are less preferable in applications. It shows that a simple adaptation algorithm can be used to automatically determine the optimal number of guard channels to be reserved at a base station under changing traffic conditions. The simulation result shows that when traffic condition changes, fixed guard channel policy will suffer either from higher new call blocking rate (when the traffic load is low) or from higher handoff call blocking rate (when the traffic load is high).

III. NEW SCHEME FOR CALL ADMISSION CONTROL WITH REFERENCE TO FRACTAL TRAFFIC

In this scheme, the admission of new calls is limited into the wireless networks. The scheme works as follows:
"If the number of new calls in a cell exceeds a threshold when a new call arrives, the new call will be blocked; otherwise it will be admitted. " The handoff call is rejected only when all channels in the cell are used up. The idea behind this scheme is that it is better to continue on going calls rather than to accept new customers in the future, because customers are more sensitive to call dropping than to call blocking. Let C be the total number of channels in cell. It is assumed that the arrival process for new calls and arrival process for handoff calls are all Poisson, and the channel holding times for new calls and handoff calls are exponentially distributed. Here, the analytical results for the new call blocking probability Pnb are estimated. Fig. 1.1 indicates the transition diagram for the new call scheme. Let K be the threshold for the new calls. This diagram arises from the two-dimensional Markov chain [10] with the state space,

$$S = \{(n_1, n_2) \mid 0 \le n_1 \le K, n_1 + n_2 \le C\}$$

A.



B.

Figure 1.1: Transition diagram of new Scheme for call admission control with reference to fractal traffic

Let

λ -- The arrival rate of new calls.

λ_h -- The arrival rate of handoff calls.

$1/\mu$ -- Average channel holding time for new calls.

$1/\mu_h$ -- Average channel holding time for handoff calls.

Where

n_1 denotes the number of new calls initiated in one cell and

n_2 is the number of handoff calls in that cell.

Let

$q(n_1, n_2 : \bar{n}_1, \bar{n}_2)$ denote the probability transition rate from state (n_1, n_2) to state $(\bar{n}_1, \bar{n}_2)$

Then we have the formulae for new call blocking probability and handoff call blocking probability as follows:

$$p_{nb} = \frac{\sum_{n_2=0}^{C-K} \frac{\rho^k}{K!} \cdot \frac{\rho_h^{n_2}}{n_2!} + \sum_{n_1=0}^{K-1} \frac{\rho^{n_1}}{n_1!} \cdot \frac{\rho_h^{C-n_1}}{(C-n_1)!}}{\sum_{n_1=0}^{K} \frac{\rho^{n_1}}{n_1!} \sum_{n_2=0}^{C-n_1} \frac{\rho_h^{n_2}}{n_2!}} \quad (1)$$

$$p_{hb} = \frac{\sum_{n_1=0}^{K} \frac{\rho^{n_1}}{n_1!} \cdot \frac{\rho_h^{C-n_1}}{(C-n_1)!}}{\sum_{n_1=0}^{K} \frac{\rho^{n_1}}{n_1!} \sum_{n_2=0}^{C-n_1} \frac{\rho_h^{n_2}}{n_2!}.} \quad (2)$$

A. Simulation Models

When a new call request is generated, the location of the mobile users is random variable, and moving direction is chosen from uniform distribution on the interval as shown In Table 1.

Table1. Moving Direction

Random Number (0-1)	Direction
0 - 0.25	Target cell is North cell
0.25 – 0.5	Target cell is East cell
0.5 –0.75	Target cell is South cell
0.75 - 1	Target cell is West cell

The moving speed is uniformly distributed between 8 and 25 m/sec. The user's location and RSS is monitored at every second.

IV. CONCLUSION

Figure 1.2: simulation result of new Scheme for call admission control with reference to fractal traffic

The result shows that that as traffic increases, new call blocking probability increases. Handoff call [5] blocking probability increases by 49% up to 40 Erlangs after this traffic handoff blocking probability remains almost constant. MANET is hot concept in computer communications. There is much research going on and many issues that remain to be resolved. This Paper is focused the CAC aspect. There are many other issues related to MANET that could be subject to further studies. As ad hoc networks are formed without any centralized control it works better as distributed network, so that all these CAC schemes can be modified as distributed CAC for MANET and problem of fractal traffic can be solved

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