Call Admission Control for QoS and Performance Analysis of Handoff calls

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ABSTRACT
In this paper, we propose a call admission control (CAC) algorithm with a handoff queue in mobile hotspots, where different admission control policies are employed, depending on the vehicle mobility. We have proposed a scheme that keeps the dropping probability below a specified level while achieving high channel utilization. Call admission control is a very important measure in CDMA system to guarantee the quality of the communicating links. In future wireless networks multimedia traffic will have different QoS requirements. In this paper, the uplink capacity and load estimation formulas is formulated. Then, a prioritized throughput based uplink call admission control algorithm for a WCDMA cellular system with perfect power control is presented. To give priority to soft handoff calls, we introduce queuing techniques and the idea of ‘soft guard channels’, which is represented by reserving a small fraction of the cell load for the higher priority calls. The performance of this admission control with different scenarios is studied. Based on simulation results, we conclude that this algorithm reduces the dropped soft handoff calls and improves the overall system capacity.

Keywords
3G, Call admission control, Quality of service.

1. INTRODUCTION
The growth of mobile communications is explosive and grown from the first and second-generation systems to the third generation's systems. First generation (1G) wireless mobile communication systems were developed in 1980s, which uses frequency modulation for modulation and frequency division multiple access for access. The second-generation (2G) systems, introduced to the market around 1991, offered better voice quality and efficient spectrum utilization through digital modulation techniques. Presently, the 2G systems are Global System for Mobile Communications (GSM), IS-136 - time division multiple access (TDMA), or Digital AMPS (DAMPS), Personal Digital Cellular (PDC).

Both 1G and 2G systems are circuit-switched, which are not efficient, especially in handling packet oriented services. 2.5G extend 2G systems, adding features such as packet-switched connection and enhanced data rates of 64-144 kbps. 2.5G networks include Enhanced Data GSM Environment (EDGE) and General Packet Radio Service (GPRS). These networks support WAP (Wireless Application Protocol), Multimedia Messaging Service (MMS).

The third generation (3G) systems focused itself primarily on universality, high data rate, flexibility, service quality. The data rate to be supported were at least 144 kbps in vehicular, 394 kbps in outdoor-to-indoor, and up to 2 Mbps in indoor. 3G systems allowed both circuit switching and packet switching and opened the possibility to provide advanced and flexible quality of service (QoS) support. Delay sensitive Services, such as voice and video, were served in circuit-switched mode. While data traffic, which can tolerate relatively long delay, have been through packet switched mode to efficiently utilize the system resource.

2. Call Admission Control in Mobile Wireless Networks
Call Admission Control (CAC) is defined as a system for managing arriving traffic, at the call, connection or session level based on some predefined criteria. A CAC scheme admits, rejects or delays the incoming calls based on a criteria to achieve some QoS objectives for new and existing users [3].

In the recent years, there has been a tremendous growth of efforts in the research and development to provide mobile users the means of communication through wireless systems. Cellular mobile transmission is the latest and greatest front in the industry. Now the industry aim to provide integrated services through wireless mobile communication systems such as voice, data, images, paging, e-mail and multimedia services to the mass market. To support these types of services in wireless infrastructure, resource provisioning is a major issue. The one of the major issue is to control the call admission using some CAC schemes to reduce the congestion, call blocking and call dropping by creating a limited number of call connections in the network. To cope with the requirements of desired quality of service call
admission control schemes must have a balance provisions for call blocking and call dropping. The aim of our study is to provide better knowledge for call admission control mechanism that improves the performance of wireless mobile communication systems. Quality of service techniques is necessary for the success of a real time application such as VoIP. CAC algorithms achieve efficient resource management by limiting the number of admitted calls and by ensuring QoS to users. Since mobile users experience severe service disruption when handoff calls are dropped, many CAC algorithms employ guard channels for prioritizing and protecting handoff calls [1].

3. ALGORITHM
In a mobile wireless cell, the base station has limited power resources. In other words the combined transmitted power to all mobile terminals cannot exceed a certain maximum level. Each newly admitted call makes this resource further scarce. Hence it is very important to adopt policy that will determine which calls to efficiently admit, block or reject based on available resources. The following outlines some of the basic needs for which CAC is employed.

• Maximize revenue.
• Fair resource sharing.
• Guarantee transmission rate.
• Guarantee QoS at packet level.
• Some UMTS classes given priority over others.
• Guarantee call-dropping probability.
• Guarantee signal quality.

Our algorithm differs from those algorithms in terms of using the cell load as an admission criteria and also using queuing as an additional priority techniques for handoff calls. Also, the handoff calls is divided into two classes (voice and data), each has its own QoS requirements.

4. SIGNAL QUALITY
Call admission control (CAC) is essential to guarantee the signal quality in interference-limited wireless networks. For instance, CDMA wireless cellular networks have a soft capacity limit so that the more loaded the network is, the more deteriorated is the signal quality for users in terms of the interference level or the signal to interference ratio (SIR). Hence, call admission control (CAC) schemes admit users only if it can maintain a minimum signal quality to admitted users (including the new call and existing calls).

In this case, the admission criterion can be the number of users (per cell and/or per group of neighbor cells), interference level or SIR, total transmitted power by BS, or received power by either BS or the mobile station. The performance of call admission control (CAC) in a cellular network is specified by the blocking probability of new calls in a cell and dropping probabilities of handoff calls entering a cell. For this paper, we consider handoff prioritization Scheme.

5. Quality of Service
CAC algorithms achieve efficient resource management by limiting the number of admitted calls and by ensuring QoS to users. The term QoS refers to the capability of a network to provide better service for selected network traffic over various technologies, including Frame Relay, Asynchronous Transfer Mode (ATM), Ethernet and IEEE 802.11 networks, SONET, and IP-routed networks that may use any or all of these underlying technologies.

The primary goal of QoS is to provide priority, including dedicated bandwidth, controlled jitter and latency (required by some real-time and interactive traffic), and improved loss characteristics. Another important QoS issue is making sure that providing priority for one or more flows does not cause other flows to fail.

Introduction of wireless access to the network brings at least the following new technical challenges:

• Quality of the wireless channel is typically different for different users and changes randomly with time on both slow and fast time scales.

• Wireless bandwidth is usually a scarce resource that needs to be used efficiently. One cannot overprovision the wireless link).

• An excessive amount of interference and higher error rates are typical.

• Mobility complicates resource allocation.
New calls and handoff calls are treated equally. Handoff calls are given higher priority to new calls, and load factor threshold for handoff calls and new calls are different.

\[
\text{GoS}_j = \alpha \times P_{hj} + P_{nj}
\]

Here only first three points consider for calculating grade of service

1. Handoff blocking probability calls belonging to traffic of type \( j = 0.79 \), and
New call blocking probability of calls belonging to traffic of type \( j = 0.79 \)

In this \( \alpha = 10 \), then
\[
\text{GoS} = 10 \times 0.79 + 0.79 = 8.69
\]

2. Handoff blocking probability calls belonging to traffic of type \( j = 0.89 \) , and
New call blocking probability of calls belonging to traffic of type \( j = 0.89 \)

In this \( \alpha = 10 \), then
\[
\text{GoS} = 10 \times 0.89 + 0.89 = 9.79
\]

3. Handoff blocking probability calls belonging to traffic of type \( j = 0.93 \) , and
New call blocking probability of calls belonging to traffic of type \( j = 0.93 \)

In this \( \alpha = 10 \), then
\[
\text{GoS} = 10 \times 0.93 + 0.93 = 10.23
\]

4. Scenario 1-Data traffic - new and hand off calls are treated equally-
First three Data
\[
\text{GoS} = 8.7, 9.7, 10.1
\]

5. Scenario 2- Data traffic same as 2, and hand off calls have higher load threshold
First three Data
\[
\text{GoS} = 8.2, 9.3, 9.8
\]

6. Scenario 3-Data traffic same as 1, and in addition to that, the hand off calls are allowed to be queued

\[
\text{GoS} = 7.8, 9.2, 9.5
\]

**Table 1 GoS Table for Data Calls**

<table>
<thead>
<tr>
<th>Condition</th>
<th>GoS Pt. 1</th>
<th>GoS Pt. 2</th>
<th>GoS Pt. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>8.7</td>
<td>9.79</td>
<td>10.2</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>8.19</td>
<td>9.49</td>
<td>9.93</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>7.69</td>
<td>9.19</td>
<td>9.72</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>6.39</td>
<td>8.4</td>
<td>8.99</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>6.2</td>
<td>8.2</td>
<td>8.69</td>
</tr>
</tbody>
</table>

7. Scenario 4-Data traffic same as 3, and having channel holding time is 120 sec.
First three Data \( \text{GoS} = 6.3, 8.2, 9.1 \)

8. Scenario 5-Data traffic same as 3, and having channel holding time is 90 sec.
First three Data
\[
\text{GoS} = 5.1, 7.5, 8.4
\]

**6. CONCLUSION**

The call admission control for radio links has to avoid overload situations when admitting or denying new users. We have proposed a scheme that keeps the dropping probability below a specified level while achieving high channel utilization. The call admission control is a very important measure in CDMA system to guarantee the quality of the communicating link. In future wireless networks multimedia traffic will have different QoS requirements. We have proposed call admission and call control algorithms for QoS provisioning for multimedia traffic in a cellular mobile network.

**7. REFERENCES**


