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A Call Admission Control (CAC) Scheme Based on Cooperative Agents

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1 Introduction

High-speed networks including ATM networks will support asynchronous traffic sources with rates ranging from low bit-rate to high bit-rate traffic. When a number of bursty traffic sources send cells, the network is inevitably subject to congestion and the available network resources are not used efficiently. Therefore, adaptive and intelligent Call Admission Control (CAC) schemes are needed in order to have a better use of network resources.

Most of the traditional approaches for CAC reported in literature use fixed threshold or predetermined values based on the connections priorities to permit or refuse the entry of a new connection in the network. The threshold schemes are restrictive and the network resources are not used efficiently. The use of large number of priorities appears to be ad hoc and unnatural.

This paper proposes a CAC scheme which is based on cooperative agents [1]. There are two types of agents: simple and intelligent agents. The intelligent agent is based on fuzzy logic. The fuzzy membership function is a continuous function unlike the abrupt and discrete threshold of traditional approaches.

The proposed scheme is part of an agent-based distributed routing strategy, which uses the CAC to decide whether a new connection can be allowed or refused into the network. In this paper, we deal only with CAC scheme. We introduce the structure of the proposed CAC scheme and explain how this scheme works.

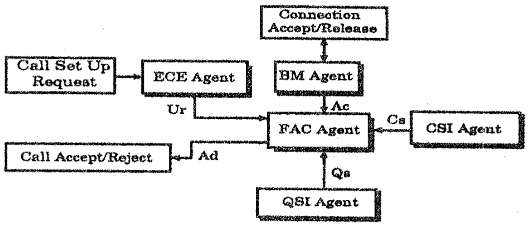

Figure 1: CAC scheme.

2 CAC Scheme

The CAC function is based on the traffic parameters and the requested connection Quality of Service (QoS). The CAC scheme is shown in Fig.1.

The CAC scheme has four simple agents: Equivalent Capacity Estimator (ECE) agent; Bandwidth Management (BM) agent; Congestion State Information (CSI) agent; and Quality of Service Information (QSI) agent. The ECE agent estimates the equivalent capacity of the a connection in order to gain from statistical multiplexing of bursty connections [2]. The BM agent works in this way: if a connection is accepted, the connection bandwidth is subtracted from the available capacity of the network, otherwise, if a connection is released, the connection bandwidth is added to the available capacity of the network. The CSI agent decides whether the network is or isn't congested. The QSI agent determines whether allowing a new connection violates or not the QoS

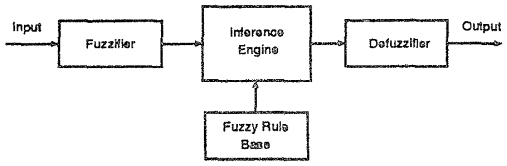

Figure 2: FLC structure.

guarantee of the existing connections.

The main component of the CAC is the Fuzzy Admission Controller (FAC) agent, which is an intelligent agent. The FAC decides to accept or reject a connection that is attempting to enter the network. The Fuzzy Logic Controller (FLC) is the main part of the FAC. Its basic elements are shown in Fig.2. They are the fuzzifier, inference engine, Fuzzy Rule Base (FRB) and defuzzifier. The FLC uses the shape of triangular and trapezoidal membership functions, because they are easy for tuning.

The input linguistic parameters of the FAC agent are Quality of service Qs, Network congestion parameter Nc, Available capacity Ac, and User requirements Ur. The output linguistic parameter is the Acceptance decision Ad.

The term sets of Qs, Nc, Ac, and Ur are defined respectively as:

$$\begin{aligned} T(Qs) &= \{Satisfied, NotSatisfied\} = \{S, NS\}; \\ T(Nc) &= \{Negative, Positive\} = \{N, P\}; \\ T(Ac) &= \{NotEnough, Enough\} = \{NE, E\}; \\ T(cs) &= \{small, medium, big\} = \{sm, me, bi\}. \end{aligned}$$

The term set of the output linguistic parameter $T(Ad)$ is defined as {Reject, Weak Reject, Not Reject Not Accept, Weak Accept, Accept}. We write for short as {R, WR, NRA, WA, A}.

The membership functions for input and output linguistic parameters are shown in Fig.3. The FRB forms a fuzzy set of dimensions $|T(Qs)| \times |T(Nc)| \times |T(Ac)| \times |T(Ur)|$, where $|T(x)|$ is the number of terms on $T(x)$. The FRB shown in Table 1 has 24 rules. The control rules have the following form: IF "conditions" THEN "control action". Statements on conditions go like "the Qs is satisfied" or "the Nc is congested". Likewise, statements on control action might be "reject" or "accept".

3 Conclusions

In this paper, we proposed a CAC scheme which is based on cooperative agents. All agents cooperate together in order to achieve an efficient CAC. The CAC scheme is part of an agent-based distributed routing strategy, which uses the CAC to decide whether a new connection can be allowed or refused into the network. We introduced the structure of the proposed CAC scheme and explained how this scheme works. The evaluation of the proposed CAC scheme is for the future work.

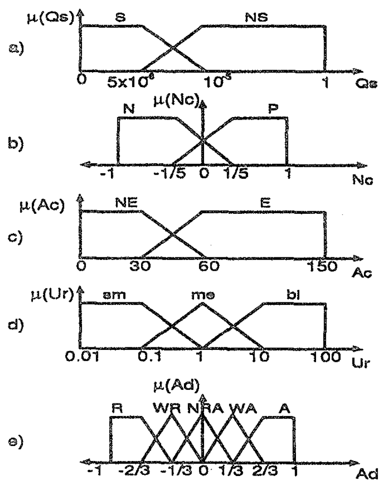

Figure 3: Membership functions for a) Qs, b) Nc, c) Ac, d) Ur, and e) Ad.

Table 1: FRB.

Rule	Qs	Nc	Ac	Ur	Ad
0	S	N	NE	sm	NRA
1	S	N	NE	me	WR
2	S	N	NE	bi	R
3	S	N	E	sm	WA
4	S	N	E	me	NRA
5	S	N	E	bi	WR
6	S	P	NE	sm	WA
7	S	P	NE	me	NRA
8	S	P	NE	bi	R
9	S	P	E	sm	A
10	S	P	E	me	A
11	S	P	E	bi	A
12	NS	N	NE	sm	R
13	NS	N	NE	me	R
14	NS	N	NE	bi	R
15	NS	N	E	sm	WA
16	NS	N	E	me	NRA
17	NS	N	E	bi	R
18	NS	P	NE	sm	WR
19	NS	P	NE	me	R
20	NS	P	NE	bi	R
21	NS	P	E	sm	WA
22	NS	P	E	me	NRA
23	NS	P	E	bi	WR

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