Call Admission Control

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Outlines

✧ Call admission Control
  ✧ Definition
  ✧ Issues
  ✧ Design approaches
  ✧ Multiplexing
  ✧ Possible CAC Schemes
Introduction

✧ The purpose of an admission control algorithm is to decide, at the time of call arrival, whether or not a new call should be admitted into the network.

✧ A new call is admitted if and only if its Quality of Service (QOS) constraints can be satisfied without jeopardizing the QOS constraints of existing calls in the network.
Call Admission Control

✧ Admission control decision is made using a traffic descriptor that specifies traffic characteristics and QoS requirements

✧ Traffic characteristics:
  ✧ peak cell rate (PCR), sustained cell rate (SCR), maximum burst size (MBS), ...

✧ QoS requirements:
  ✧ tolerable cell loss, cell delay, delay variation
Issues

✧ Want to make efficient use of the network (i.e., accommodate as many calls as possible, and maintain a reasonably high level of network utilization)
✧ Want to guarantee quality of service for all calls that get into the network
✧ Tradeoff: can’t always have both!
Design Approaches

✧ Two basic approaches to admission control
  
  ✧ parameter-based admission control (PBAC)
    ✧ Computes the amount of network resources required to support a set of flows given *a priori flow traffic characteristics*
    ✧ *Better for real-time applications (peak & average rates)*
  
  ✧ measurement-based admission control (MBAC)
    ✧ Relies on the measurement of actual traffic loads in making admission decisions
    ✧ Higher network utilization
    ✧ Low service commitments
Multiplexing

✧ Two basic approaches

✧ Deterministic multiplexing

✧ Statistical multiplexing
Deterministic Bound

- We can define it by B/W or Delay requirements
  - Provides for the worst-case requirements of flow
  - Does granting a new request for service cause the worst-case behavior of the network to violate any delay bound?
    - For example, checks that the sum of all peak rates is less than the link capacity or not!
  - The traditional means of bandwidth allocation in telecommunications networks
  - Each traffic type has an inherent bit rate (e.g., voice traffic = 64 kilobits per second)
    - Allocate precisely that bandwidth for each call, for the duration of the call
Deterministic Bound

✧ **Advantages:**

✧ Simple

✧ Works great for CBR traffic (PCR = SCR)

✧ **Disadvantages:**

✧ Inefficient for VBR traffic (PCR ≠ SCR)

✧ Allocating PCR can waste lots of capacity
Probabilistic Bound

✧ **Basic idea:** “pack in” more than would be able to fit with deterministic multiplexing

✧ Interleaving of packets from different sources where the instantaneous degree of multiplexing is determined by the statistical characteristics of the sources

✧ Using the statistical characterizations of current and incoming traffics

✧ Takes advantage of the variable bit rate **“burst nature”** of traffic

✧ Not all traffic sources will need their peak rate at the same time (hopefully)

✧ Peaks and valleys should balance out
Probabilistic Bound

✧ **Advantages:**

✧ More calls can fit in the network
✧ Increases utilization, efficiency of network
✧ Statistical gain can be significant

✧ **Disadvantages:**

✧ QOS is hard to guarantee (100% guarantee)

✧ Always an element of risk, however slight
Deterministic versus Statistical Multiplexing

Source 1:
peak 12 Mbps, mean 8 Mbps
Deterministic versus Statistical Multiplexing

Bit rate

12 Mbps
Deterministic versus Statistical Multiplexing

Source 2:
peak 10 Mbps,
mean 6 Mbps
Deterministic versus Statistical Multiplexing

Bit rate

22 Mbps
(12 + 10)
Deterministic versus Statistical Multiplexing

Bit rate

22 Mbps
(12 + 10)

Average utilization will be 14/22 = 64%
Deterministic versus Statistical Multiplexing
Deterministic versus Statistical Multiplexing

Bit rate

Bit rate
Deterministic versus Statistical Multiplexing
Deterministic versus Statistical Multiplexing

Bit rate

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Deterministic versus Statistical Multiplexing

Bit rate

Bandwidth saving with Statistical Multiplexing

Bit rate
Possible CAC Schemes

- Peak rate allocation
- Mean rate allocation
- \((\text{Peak} + \text{Mean}) / 2\)
- Virtual Bandwidth [Murase 90]
- Schedulable Region [Lazar 91]
- Effective Bandwidth [Elwalid 93]
Peak Rate Allocation

- Allocate the peak cell rate for the source
- Same as Deterministic Multiplexing
- Guarantees that no cell loss occurs
- Guarantees that bandwidth is wasted if source is at all bursty (peak > mean)
- The amount of wasted bandwidth depends on the peak-to-mean ratio
Mean Rate Allocation

- Allocate bandwidth based on the mean rate (SCR)
- By definition, this is adequate over a long enough time duration
- Drawback is the delay for traffic bursts
- May not be enough capacity to handle bursts within a tolerable delay
(Peak + Mean) / 2

✧ Peak rate is the most that is needed
✧ Mean rate is the least that is needed
✧ "Correct" allocation must be in between
✧ But where is the real question!
✧ (Peak + Mean) / 2 is one guess
✧ Suitability depends on characteristics of source (e.g., time spent at or near each)
Can you do better?

✧ Of course!

✧ Effective Bandwidth: [Elwalid 93]
  ✧ Reflects the source characteristics & the service requirements

✧ Virtual Bandwidth: [Murase 90]

✧ Schedulable Region: [Lazar 91]
  ✧ The region in the space of possible loads for which a scheduling algorithm guarantees QoS
  ✧ The size & shape of the region depend on the scheduling algorithm, QoS constraints & traffic load
Summary

✧ Call Admission Control is one of the most difficult problems to deal with in IP network
✧ Difficult problem, no standard solution
✧ Lots of research activity
✧ Impossible to find a single ‘‘best’’ answer
References


Next Session

Traffic Control Access