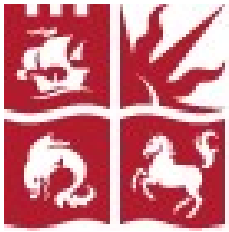
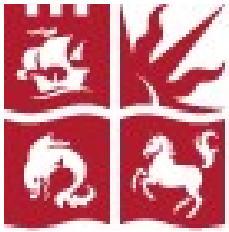


EENGM4221:
Broadband Wireless Communications

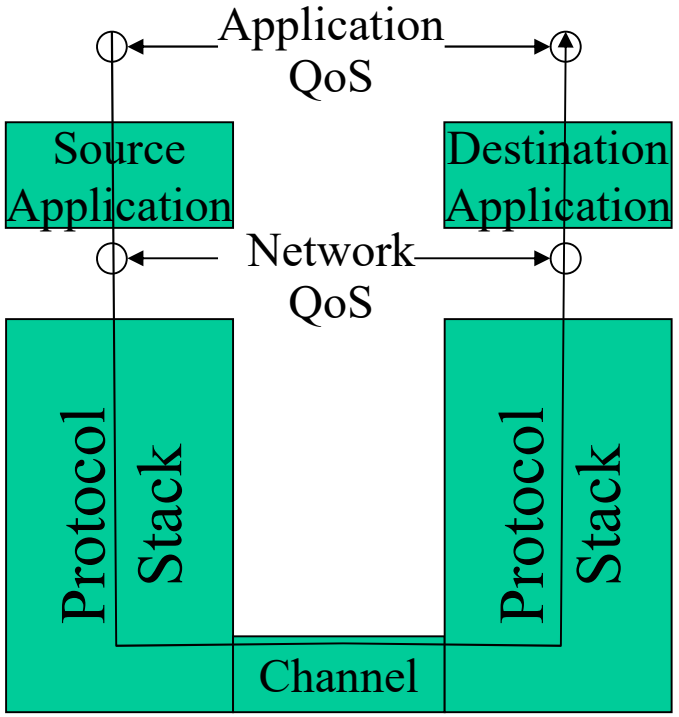
Lecture 2: QoS

Dr Simon Armour

Quality of Service

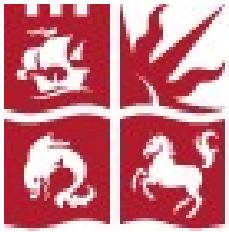


- QoS may be viewed from two perspectives:
  - The Quality of Service provided by the application to the User
  - The Quality of Service provided by the communication network to the application
  - We are concerned with the latter



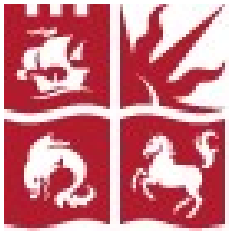
Ref: GANZ 2, 3

QoS Parameters



- From a network perspective, QoS refers to the ability of the network to meet the needs of a given application
- This can be quantified by an ensemble of parameters:
  - Data Rate/Throughput
  - Delay
  - Loss/Error Rate

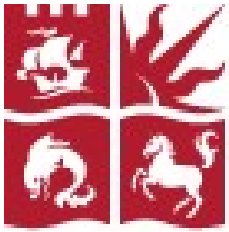
QoS – Data Rate (1)



- Many applications have particular Data Rate Requirements
- The requirements vary widely depending upon application
- Some applications generate a constant bit rate, others a variable bit rate (CBR and VBR applications)
- Different applications react differently when the available bit rate provided by the network varies from the nominal bit rate of the application

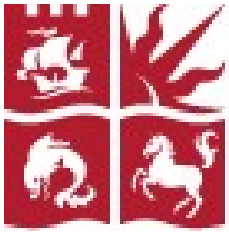
Ref:

QoS – Data Rate (2)



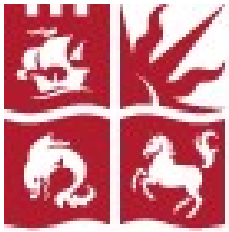
- Some applications may:
  - Fail completely if the bit rate provided by the network is less than that required (hard failure).
  - Cope with a data rate lower than that required, probably at some expense to the QoS perceived by the user.
  - Exploit a data rate greater than that required to improve the QoS perceived by the user.

QoS – Data Rate (3)



- One way to quantify the data rate provided by the network to the service is in terms of the mean data rate and the variation of data rate around that mean
  - Variation often referred to as jitter
- The amount of data rate jitter and the minimum data rate are likely to be important to some applications

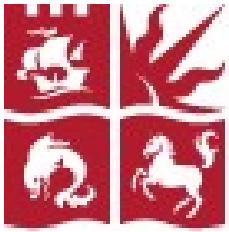
QoS – Delay



- Some applications also have delay requirements
- Delay can be measured at various points in the communications stack.
- Here, it is easiest to consider it between the source application (input to the network) and the destination application (output of the network)
- Delay may be similarly evaluated in terms of mean, variation around the mean (jitter) and maximum.
- Requirements again vary with the application

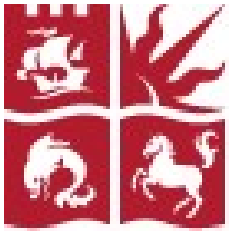
Ref:

QoS – Loss/Error Rate (1)



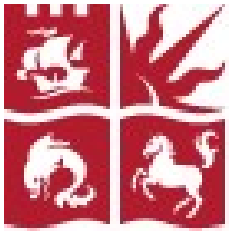
- Applications also have requirements in terms of the amount of lost/erroneous packets of data that they can tolerate
  - Many applications cannot tolerate any loss or error or at least begin to degrade the QoS to the user as soon as any loss or error occurs
  - For this reason, very intense error control is often implemented in the network often with multiple error control methods are each layer

QoS – Loss/Error Rate (2)



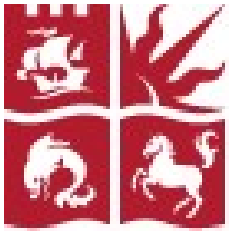
- There can be a subtle difference between packet loss and packet error
- Packet loss implies a complete failure to transfer a packet across the network, the packet of data is a complete unknown at the destination application
- Packet error implies that some semblance of the packet is communicated but that it is not exactly the same as that generated at the source
  - Some applications will reject an erroneous packet making it more or less the same as a lost packet
  - Error Resilient Applications can make use of an erroneous packet – it may be more useful than no packet at all

QoS Requirements



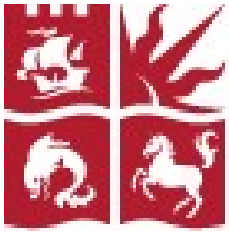
- Sometimes it is possible to design a communications system with a particular service in mind
  - GSM designed for Voice
- However, increasingly communications systems must be flexible and support many different services with very different QoS requirements
  - WiMax is a good example
- So the challenge is not just to provide QoS but to provide flexible QoS

QoS - Priority



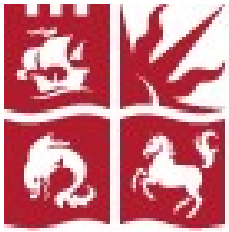
- Priority is another important issue relevant to QoS
- Inevitably, if demand is high enough, the network will not be able to provide QoS to all users
- It becomes necessary to decide what part of demand will be met:
  - Reduce QoS for all
  - Maintain QoS for some at the greater expense of others
  - Need to consider the implications of reducing QoS
    - Hard failure
    - Soft failure
- ‘Controlled Unfairness’

Questions to prepare for the Synchronous Class (1)



- What are the implications of the use of ARQ for QoS?
  - If you aren't sure what ARQ is, you need to do a little revision. ARQ stands for Automatic Repeat Request.
- What are the implications of buffering for QoS?
  - Not sure what we mean by buffering in this context? Think about packets of data being put into a simple First in First Out (FIFO) queue.

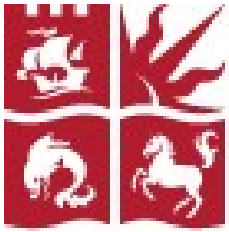
Questions to prepare for the Synchronous Class (2)



- What are the QoS Requirements of these applications:
  - File Transfer (eg ftp)
  - Voice Message
  - Telephone Conversation (64 kbits/s uncompressed)
  - Telephone Conversation (9.6kbits/s compressed, eg GSM)
  - Video Movie Clip Download
  - Broadcast Television
  - Video Conference Call
  - Video Conference Call (Error Resilient Codec)
  - Gaming
- It might be hard to answer these quantitatively in some cases. That's OK. Qualitative answers will be acceptable in many cases.
  - After the class I will provide some quantitative values as examples

Ref:

Review of Lecture 2



- We have made a distinction between Application QoS and Network QoS and agreed to focus on Network QoS in this course
- We have identified a requirement for an ensemble of QoS metrics
  - Throughput
  - Delay
  - Error rates
- Sometimes average is not enough!
- We discussed the design challenges that arise from QoS requirements
- We have raised some questions for the next synchronous class