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# EENGM4221: Broadband Wireless Communications

## Lecture 7: Dynamic Resource Allocation

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# Dynamic Resource Allocation (1)

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- ‘Dynamic Resource Allocation’ is a strategy for exploiting ‘Multi-user Diversity’
- The merits of other sources of diversity (Space, Time, Frequency, Polarisation etc) have been considered elsewhere
- Multiuser Diversity is another opportunity which is gained interest in Wireless Communications more recently

# Dynamic Resource Allocation (2)

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- We have seen that signal quality may vary substantially in several domains
  - Space (shadowing, non-isotropic radiation)
  - Time (free space, shadowing, narrowband fast fading)
    - Assuming there is some mobility in the channel, temporal change=spatial change
  - Frequency (wideband fading/frequency selectivity)

# Dynamic Resource Allocation (3)

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- The total available channel resource for the system will be divided between the links in the system by means of a Multiple Access strategy
- The variation in signal quality will affect the capacity of the individual links and how they vary will be largely uncorrelated
- The capacity of the communications system as a whole will be the weighted sum of the individual links

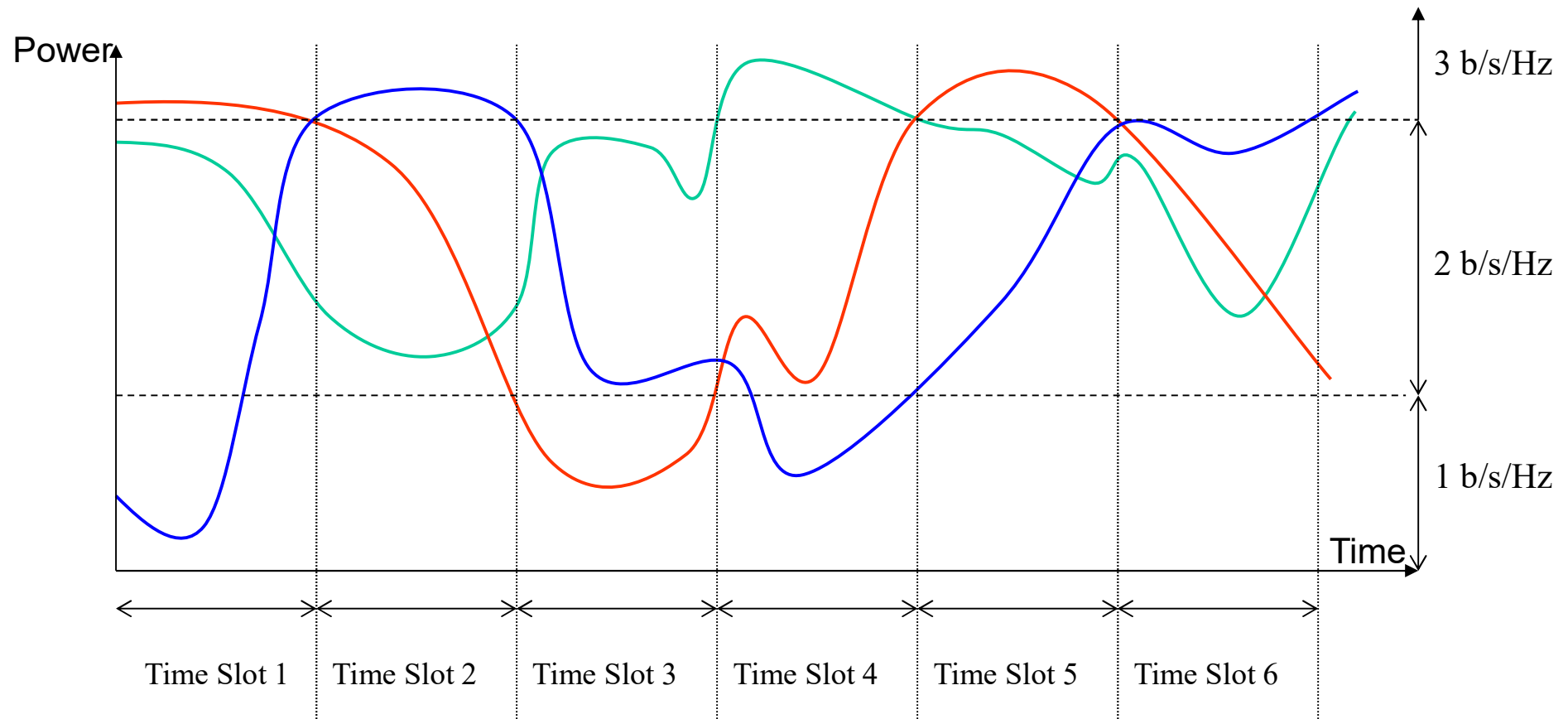
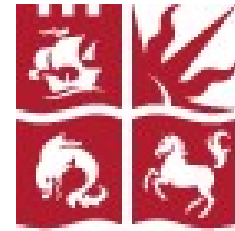
# Dynamic Resource Allocation (4)

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- The idea of Dynamic Resource Allocation is to allocate channel resources to different links dynamically with the aim of enhancing QoS
  - Allocate any given resource to the link which can make the ‘best’ use of it
    - An alternative name is ‘Channel Aware Scheduling’
  - DRA can only exploit diversity in a domain in which it is able to perform allocation – i.e. the domain(s) of multiple access

# Dynamic Resource Allocation – A First Simple Example



Ref:

04/02/2021

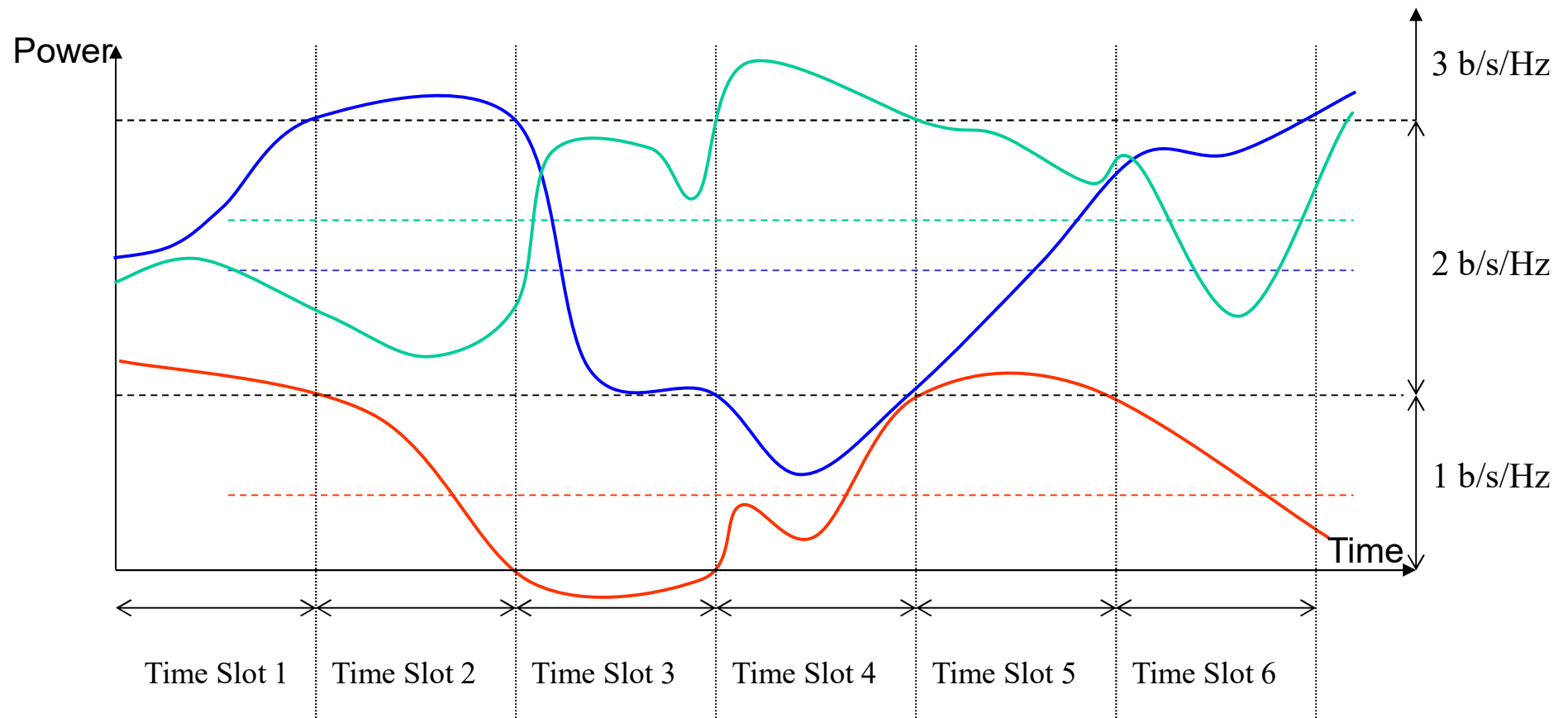
# Questions based on the first simple example

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- If we apply a ‘Round Robin’ allocation (assume Green, Blue, Red, Green, Blue, Red) what bandwidth efficiency is achieved?
- Would this ‘Round Robin’ allocation be fair?
- What bandwidth efficiency would be achieved by a greedy allocation?
- How would you expect Greedy to compare to Round Robin in terms of fairness?

# Dynamic Resource Allocation – a second simple example



Ref:

04/02/2021



# Questions based on the first simple example

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- What bandwidth efficiency does Greedy scheduling achieve here?
- Will Greedy scheduling be fair?

# Dynamic Resource Allocation – What Cost?

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- ‘There is no such thing as a free lunch’
- Multiuser Diversity Gain is achieved with no cost in terms coding, power, etc
- The ‘cost’ is that if the system is to dynamically allocate resources, it must notify all the devices in the communication system of changes to the allocation whenever they are made
  - This is an overhead – the control information occupies channel resources that would otherwise be used for data
  - The faster the allocation changes, the more the overhead
  - Ultimately, if the channel changes fast enough, there will be no benefit (or even a loss) from DRA

# Review of Lecture 7



- We have introduced these concepts:
  - Multiuser Diversity – an opportunity of improving the effective link quality of the whole system by exploiting the fact that different users in different places experience different channel conditions
  - Dynamic Resource Allocation – Our method for exploiting multiuser diversity
- We have introduced a simple example which we will work with in the synchronous session
- We discussed some of the costs and limitations of Dynamic Resource Allocation