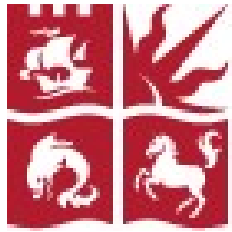


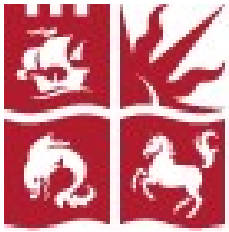
EENGM4221: Broadband Wireless Communications

Lecture 1: Revision, Architecture and Control

(and a little bit of traffic lights and roundabouts)

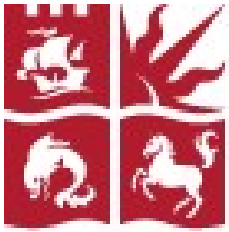
Dr Simon Armour

Revision



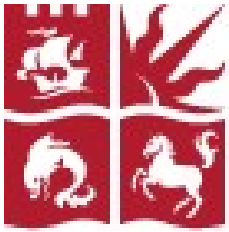
- Please take the time to read the full set of slides for BWC ‘Framework’ (part 2)
  - This should all be easy revision
  - You don’t need to do this revision before the first synchronous class but some time in the first few weeks of TB2 would be good

Architectures, Control Strategies and Infrastructure versus Ad-Hoc



- We will define and revise some terminology for wireless networks which does occasionally give rise to confusion and ambiguity.
- Wireless networks can be classified in terms of the following:
  - Topology
  - Single-Hop vs Multi-hop
  - Control
  - Infastructure vs Ad-Hoc

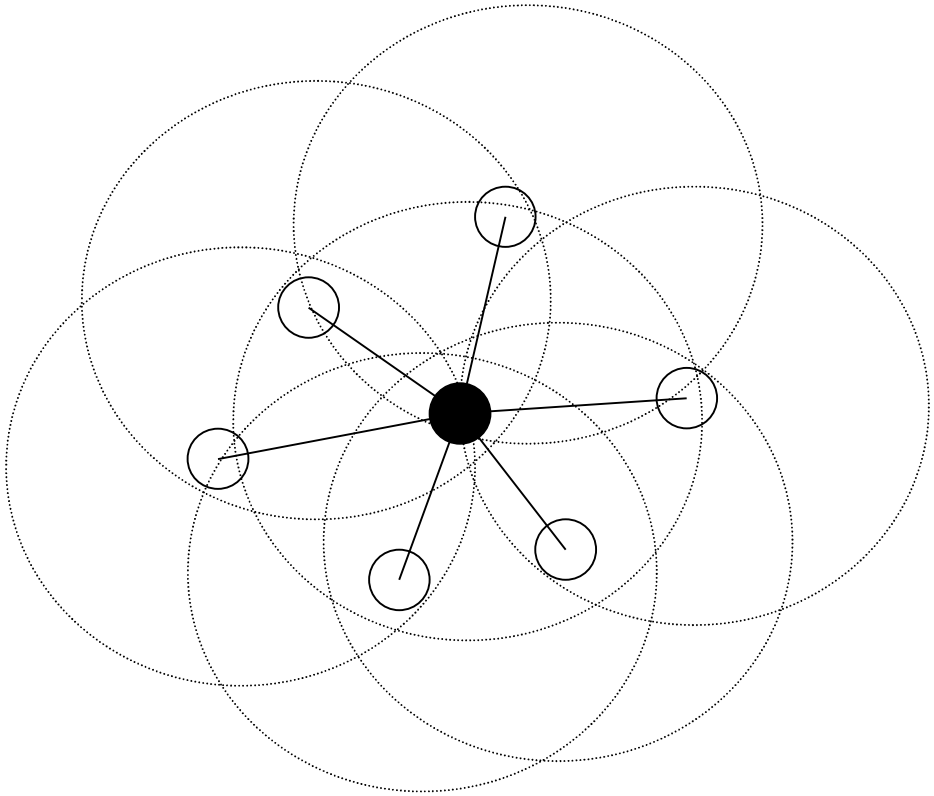
Network Topology



- A variety of network topologies may be identified in the general (not wireless specific) context:
  - Star
  - Mesh
  - Bus
  - Ring
  - Etc
- The nature of the wireless medium makes some of these more relevant than others for wireless communications, so we will focus on Star and Mesh network architectures

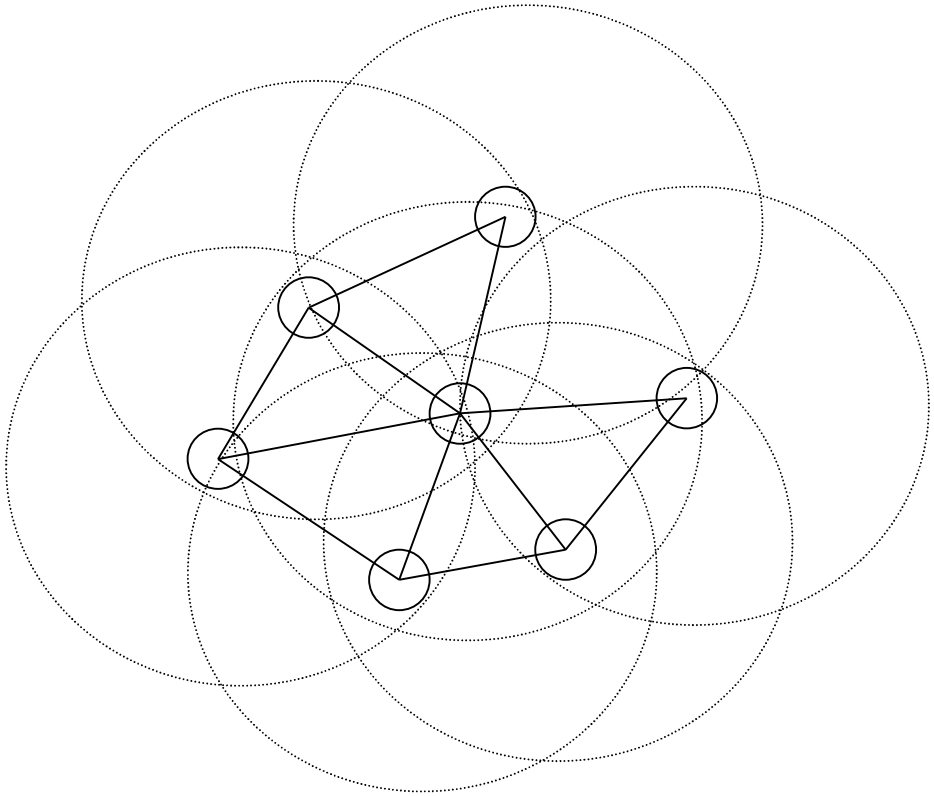
Star Topology

- A ‘central’ node (shown in black) communicates with all other non-central nodes (in white)
- Non-central nodes do not communicate directly with each other, even when they may have viable radio links between them
- A common topology in modern wireless communications, e.g.
  - Bluetooth, GSM, ‘3G’, WiFi (in infrastructure mode)



Mesh Topology

- There is no ‘central’ node
- Each node may communicate with any other node within range
- A less common topology but still used
  - E.g. WiFi in ‘ad-hoc’ mode



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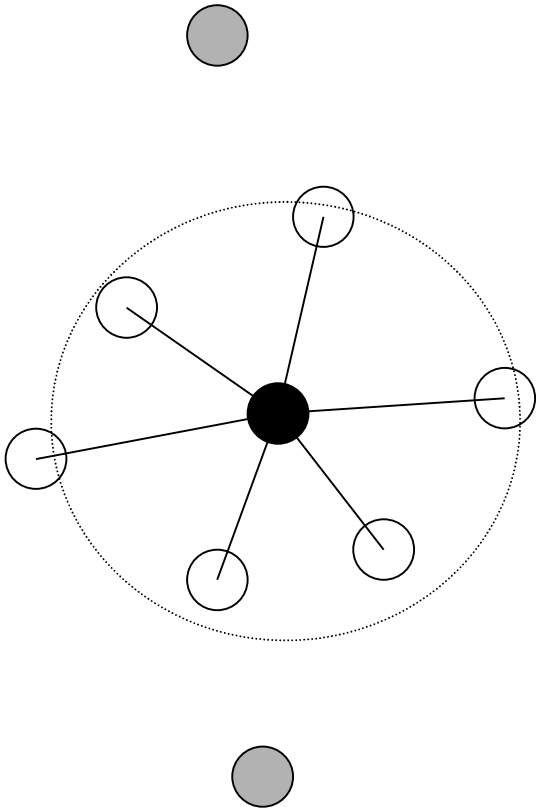
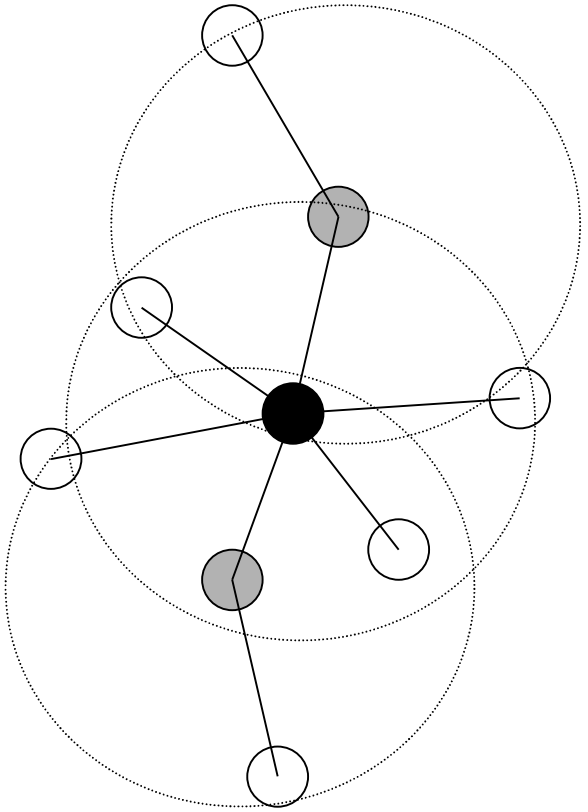
Single-Hop Networks

- Networks may also be classified as single-hop or multi-hop in terms of the number of wireless links (hops) allowed to link a non-central node to the central node
- Clearly, this terminology is not compatible with Mesh topologies
- The star topology example considered already is a single-hop case
- It can be seen that range of the network is fundamentally limited to within one hop of the central node
- Any nodes (illustrated in grey here) outside of the one hop range cannot be connected



Multi-hop Networks

- The network illustrated here extends its range beyond that of the single hop network by use of ‘relay’ nodes (shown in grey)
- This range extension is achieved at the expense of the additional complexity required to enable the use of relay nodes
- Repeat transmissions also reduce spectral efficiency
- The relay node might belong either to the network operator or to a customer
- Clearly other nodes in the network can act as relays and the principle can be extended to more than the two hops shown here
- Multi-hop strategies are NOT commonly employed in existing wireless networks but are seen as interesting for the future



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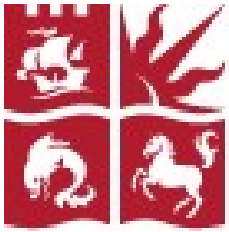
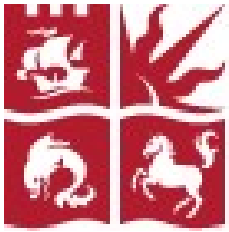
Control Strategies



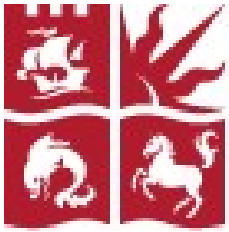
- In this context, control refers specifically to Medium Access Control
- Networks may be classified in terms of their control strategy as either:
  - Centralised
  - Distributed

Central Control



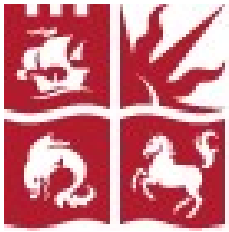
- In a centralised control strategy, one node dictates to all other nodes when they may access the physical medium. This node will contain an entity known as the Central Controller (CC)
  - Often, in a network with a star architecture, it will be convenient for the central node of the star to contain the CC
  - For this reason, star topologies and central control are sometimes deemed synonymous. This is not strictly accurate
    - Central Control may be employed in a Mesh architecture
    - A node other than the central node of the star may be the CC of a star topology network

Distributed Control



- In a network using distributed control, there isn't a single node responsible for controlling access to the medium
  - There is more than one
  - Most often in distributed control, we make all nodes equally responsible for controlling their own access to the medium
    - Each node must follow a set of rules that try to make medium access 'work well' for everyone

Infrastructure and Ad-Hoc Networks



- The terms Infrastructure and Ad-Hoc refer to whether or not the network contains a node which has a connection to a communications ‘backbone’ – typically a link back to a larger scale network and hence the internet
  - Infrastructure networks have such a node
  - Ad-Hoc networks do not
  - Cellular phone networks are a good example of an infrastructure network. Each cell is a wireless network in which the basestation is wired to the wired backbone network of the service provider
  - Bluetooth is an example of an ad-hoc network in which for example a mobile phone, audio headset and printer might link together to form a network in which none of the nodes is connected to a backbone
- These terms do occasionally give rise to confusion – Ad-hoc in particular is often wrongly taken to be synonymous with Mesh, Distributed control or multihop

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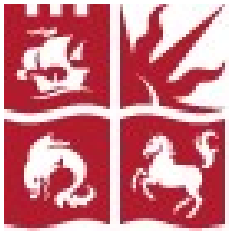
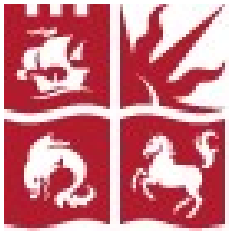
Questions for synchronous class



1. Which is better: Traffic Lights or Roundabouts?
2. More importantly, why do you think your choice is better?
3. Has Simon gone mad? If not, how are traffic lights and roundabouts relevant to Broadband Wireless Communications?

Review of Lecture 1



- We have reviewed four aspects of terminology that we are going to use in this course:
  - Star and Mesh Topologies
  - Single-hop and Multi-hop
  - Central and Distributed Control
  - Infrastructure and Ad-Hoc
- We have set some questions for discussion during our first synchronous class

Ref: