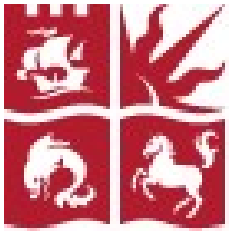
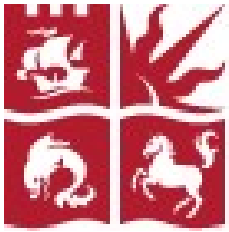


EENGM4221:
Broadband Wireless Communications

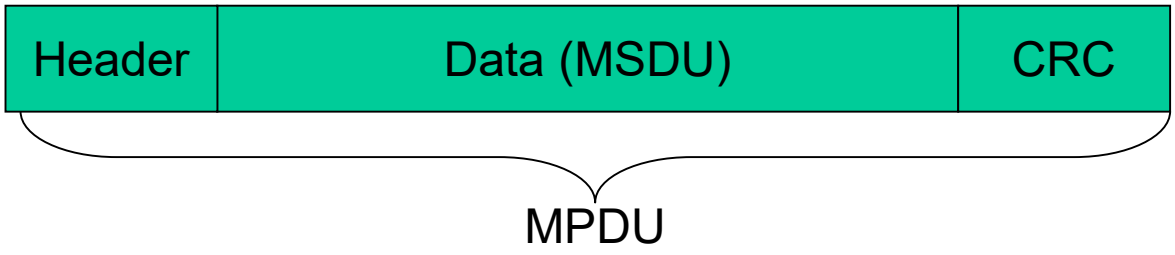
Lecture 12: 802.11 DCF MAC

Dr Simon Armour

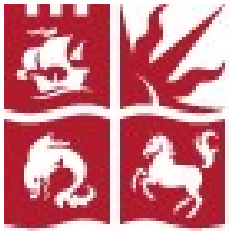
MSDU to MPDU



- The 802.11 MAC takes an MSDU from the layer above and converts it to an MPDU by adding:
  - MAC Header (source and destination addresses, fragment number etc)
  - CRC Check Field
- Consequently, the addition of the header and CRC represent redundancy
  - The header and CRC are fixed in length
  - The data size may vary according to the size of the MSDU

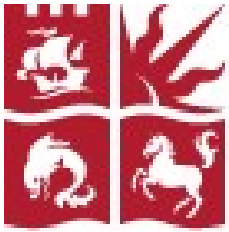


Fragmentation



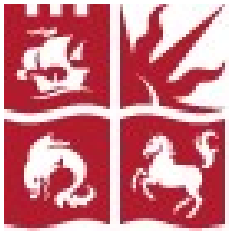
- The 802.11 MAC also allows for Fragmentation
- A Fragmentation Threshold is defined (in bytes)
- Any MSDU larger than the threshold is divided into as many fragments as necessary to get below the fragmentation threshold
- Each Fragment is converted into a separate MPDU
- The benefits are that the smaller fragments are less likely to:
    - Contain errors resulting from the wireless PHY
    - Suffer a collision on the medium
  - Further, if a fragment is lost due to error or collision, it is only necessary to retransmit that fragment, not the entire MSDU
- The cost is greater redundancy
  - An MSDU divided into n fragments has n headers and n CRCs added
- The Fragmentation Threshold is usually controlled by network manager – check the GUI for your own WLAN!

DCF MAC – CSMA

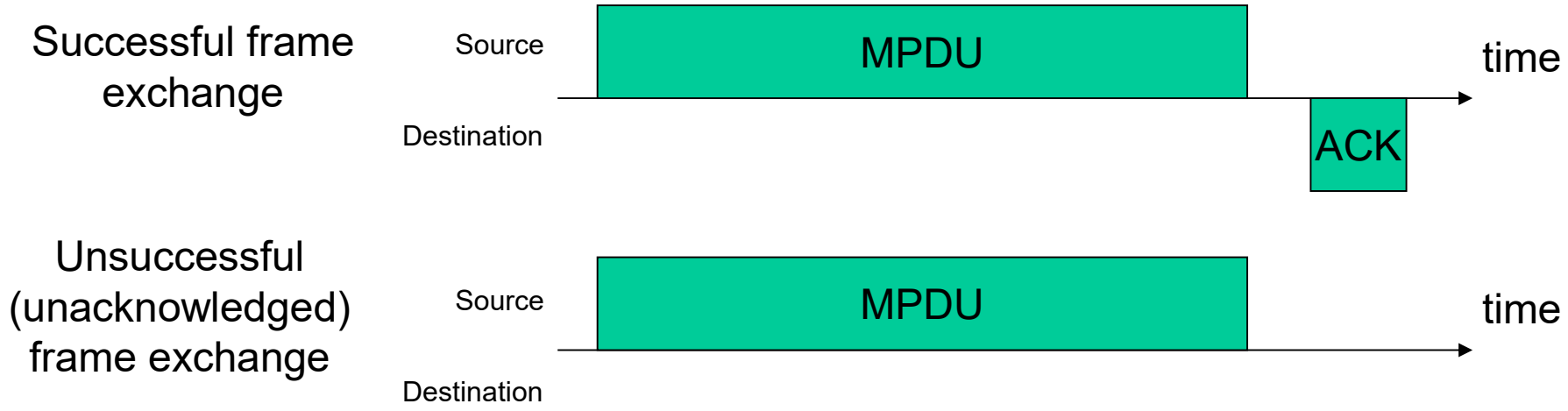


- The Underlying principle of the DCF is Carrier Sense Multiple Access (CSMA)
  - CSMA essentially means ‘Listen before talk’
  - Nodes wanting to transmit first sense the medium
  - If it is in use, they must wait and try again later
  - If not they may attempt to transmit (its actually not quite that simple…)
  - DCF mandates that the destination node transmits an explicit ACK to confirm correct receipt of the current frame
- This protocol (and many others) are best illustrated by a frame exchange diagram
- This shows frames transmitted by the different nodes in the network against a time axis

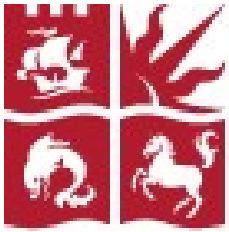
DCF MAC – Frame Exchange



- An explicit ACK is required to complete the frame exchange
  - Otherwise an error (collision) is inferred
  - No NACK is used

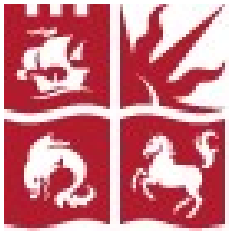


DCF MAC – Unacknowledged Frames

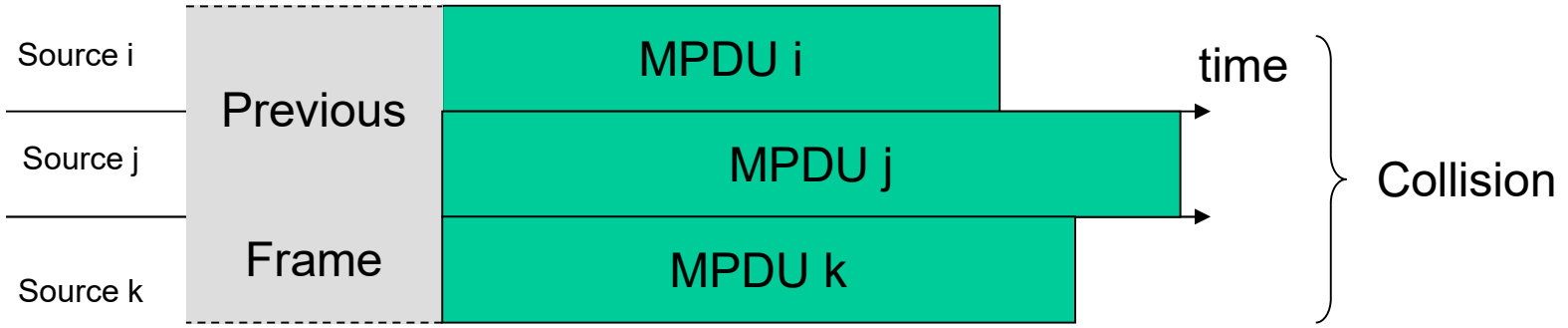


- Errors may occur for example due to:
  - PHY layer errors due to:
    - Delay Spread
    - Thermal Noise
  - MAC layer errors – collisions in the medium
- The 802.11 MAC always infers the absence of the expected ACK to be due to collision – i.e. MAC failure
- This is arguably a big failing in the protocol – it assumes that any error must be its own fault and thus misinterprets all PHY layer errors

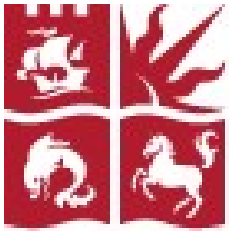
DCF MAC – The Collision Problem



- What happens if many nodes all want to transmit?
- They all have to sense the medium and then wait until it becomes free (i.e. the previous transmission finishes)
- If more than one node is waiting, they will all attempt transmission when the previous transmission finishes
- A collision is certain whenever any two nodes are waiting for the medium
  - This is quite a common occurrence if the network is loaded to anywhere near its capacity and load is well spread between nodes



Review of Lecture 12



- We have begun to understand the DCF MAC protocol used in 802.11.
- We identified two underlying principles in its design
  - Explicit ACKs
  - CSMA ‘Listen Before Talk’
- We have identified that these alone are not enough and we still have a fundamental problem with collisions that we must address