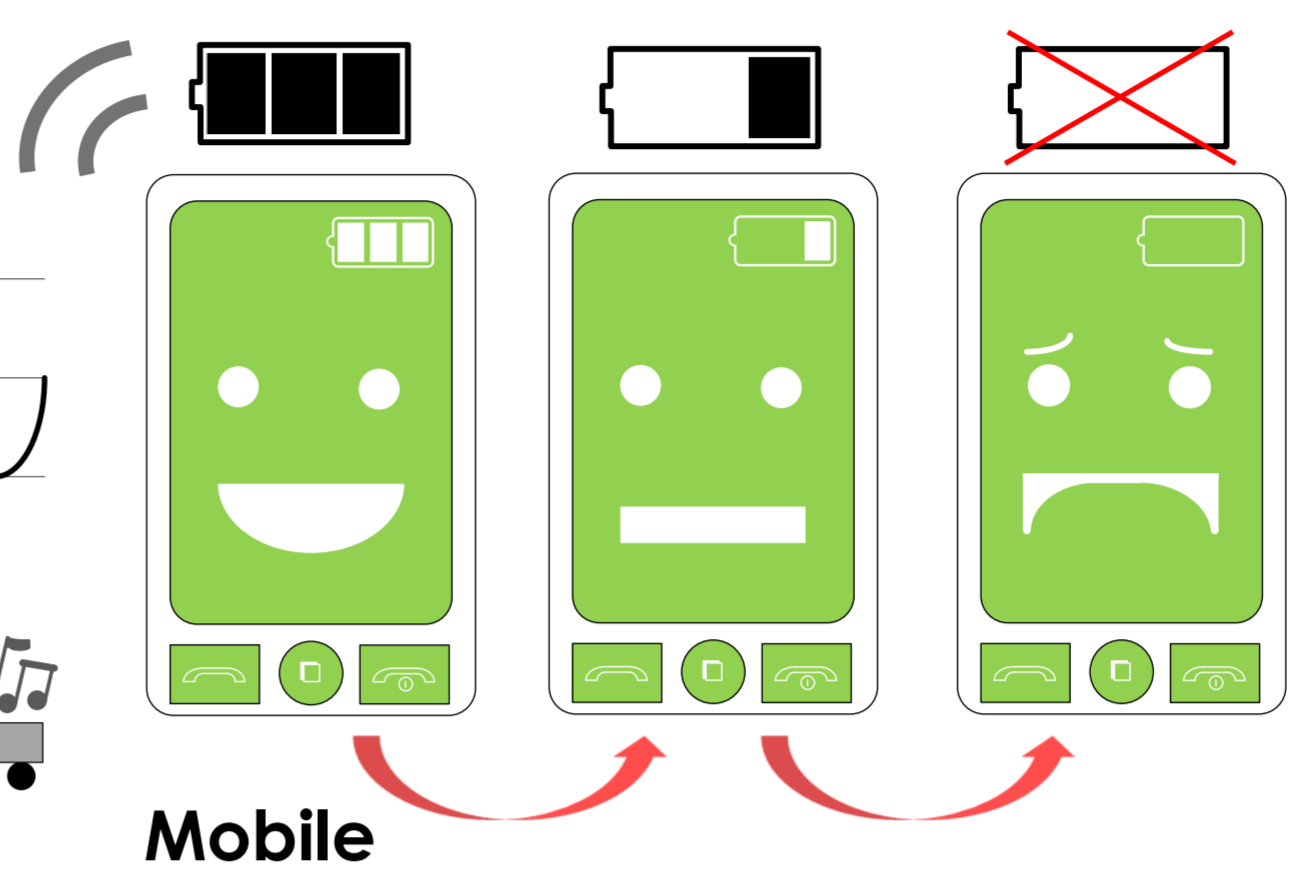
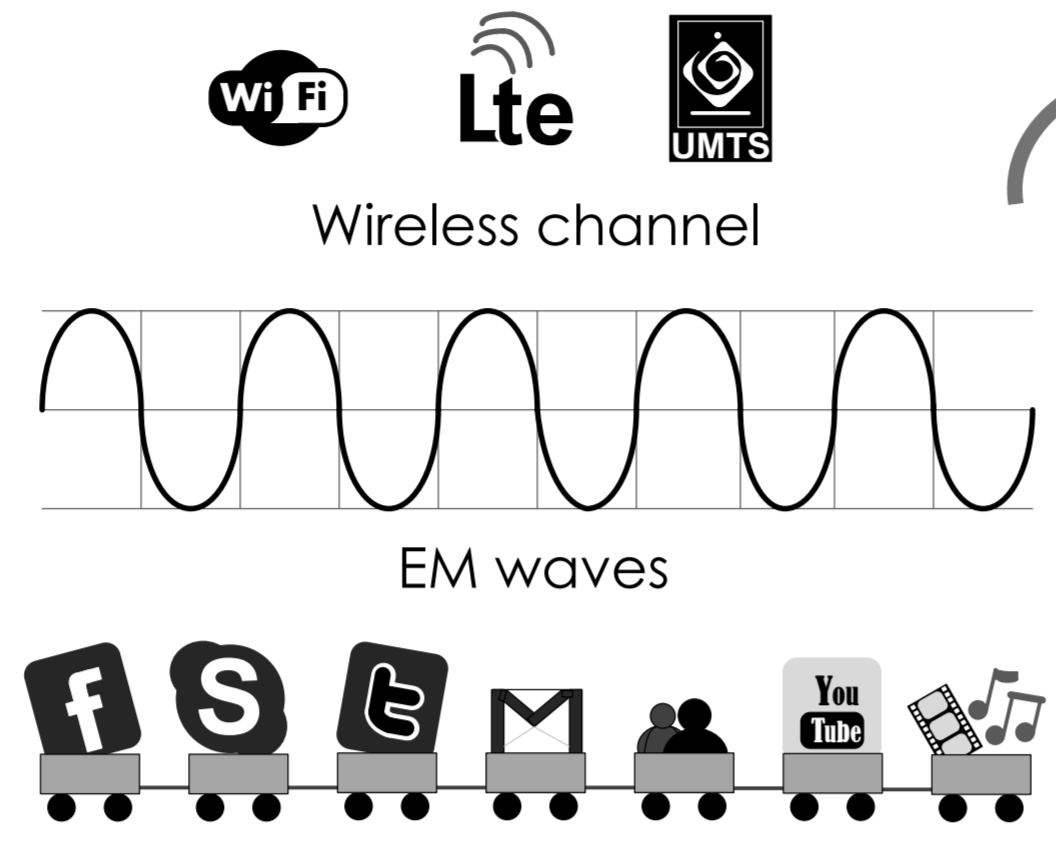
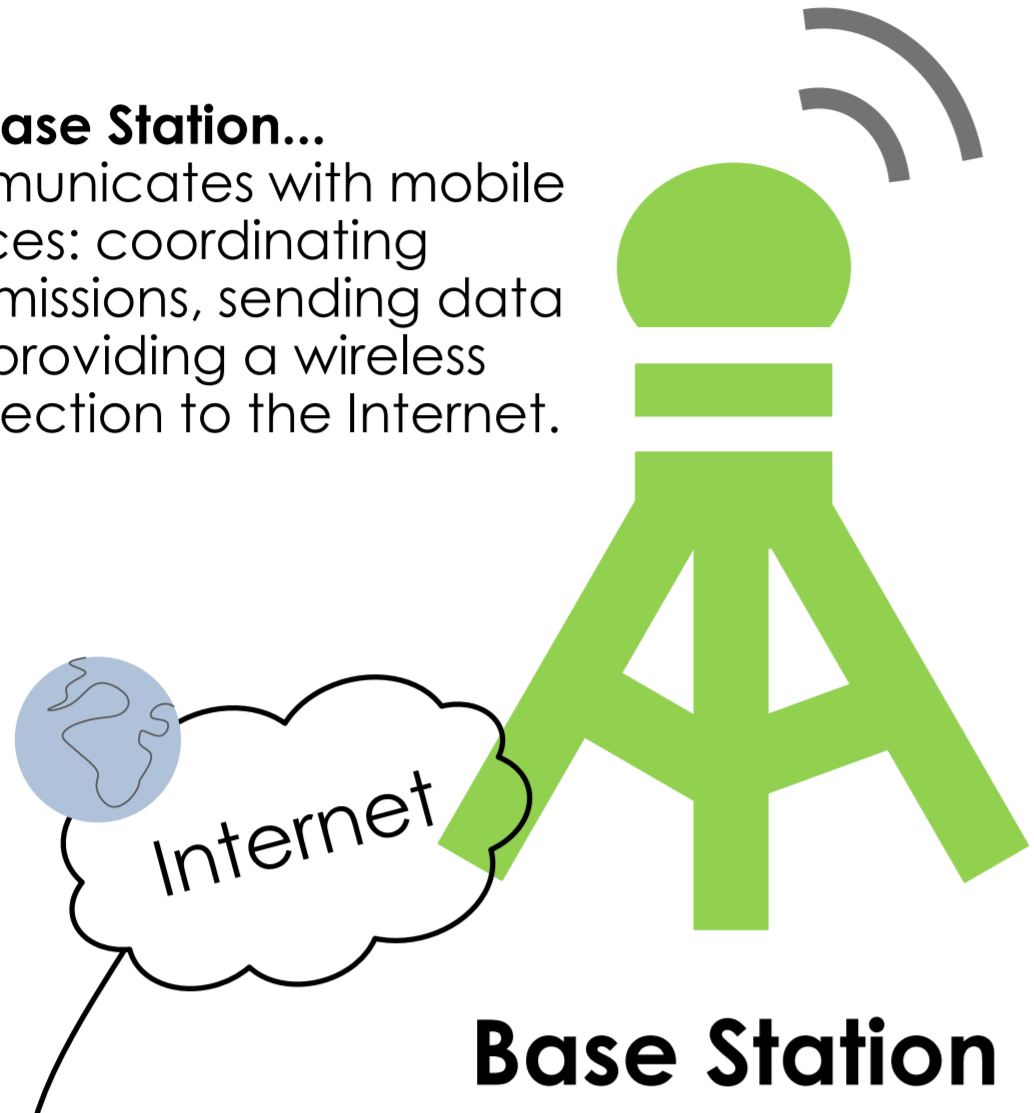


ENERGY EFFICIENT MEDIUM ACCESS CONTROL PROTOCOLS AND NETWORK CODING FOR GREEN WIRELESS NETWORKING

Raúl Palacios | Fabrizio Granelli | University of Trento, Italy | www.fp7-greenet.eu

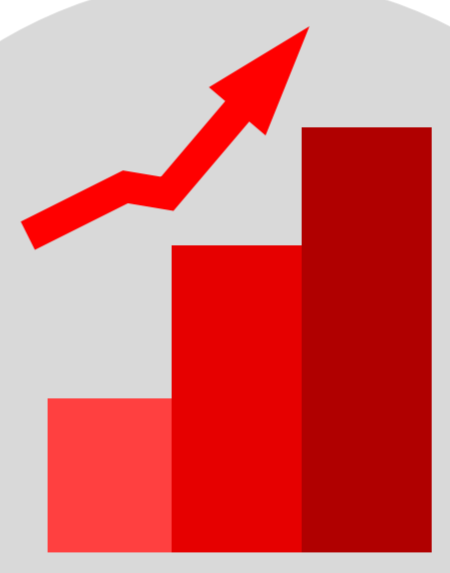
The **Base Station...** communicates with mobile devices: coordinating transmissions, sending data and providing a wireless connection to the Internet.



The **mobile device...** communicates with the base station: monitoring the wireless channel, to transmit or receive data to or from the base station.

THE PROBLEMS

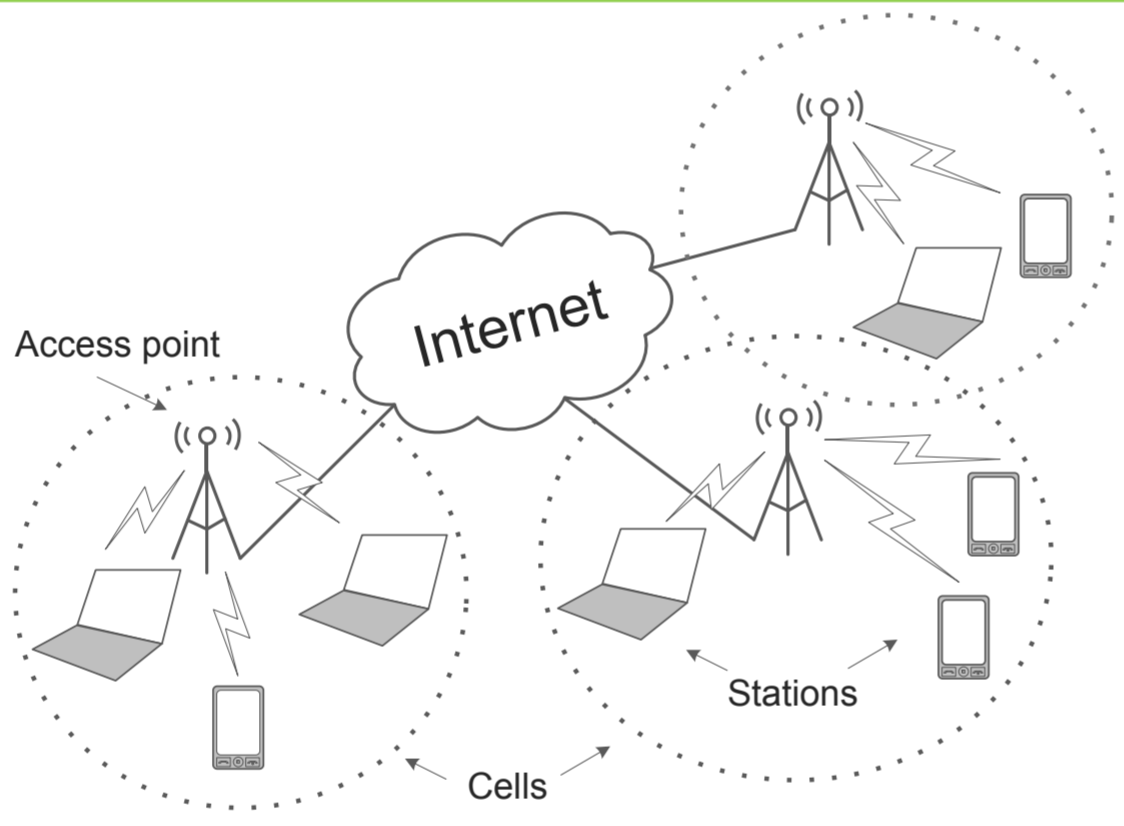
The **energy consumption and carbon footprint** of base stations are ever-increasing year after year.



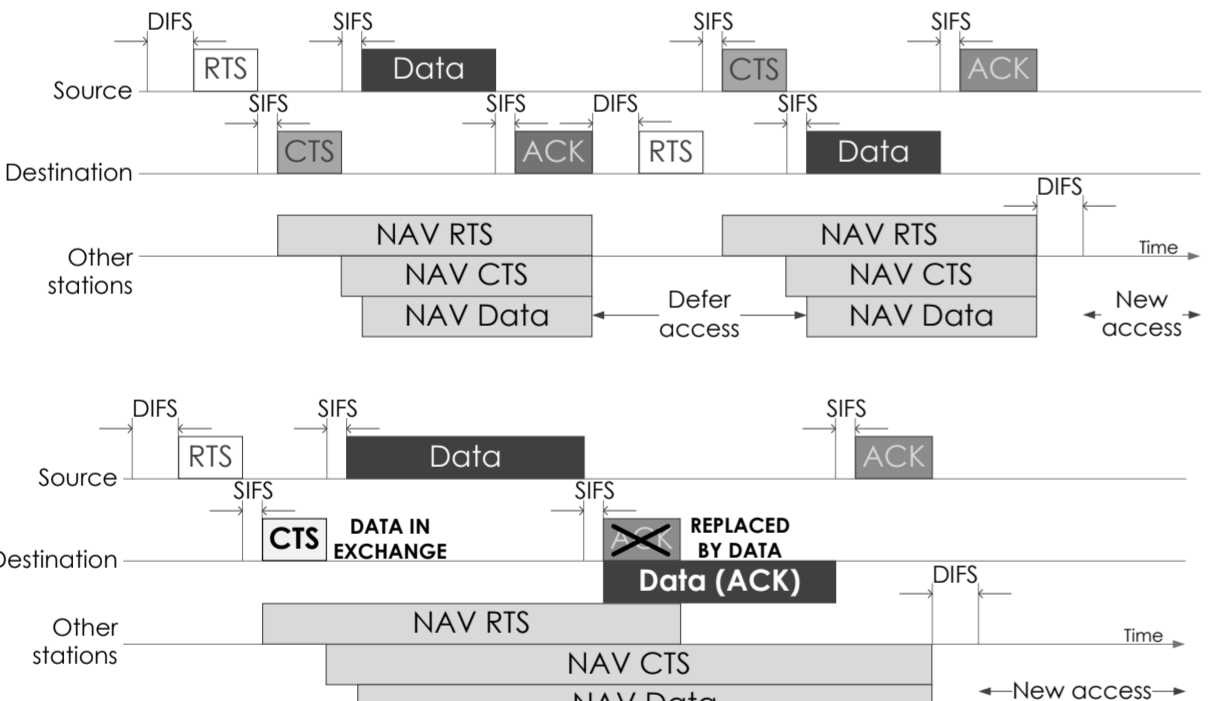
The **radio interface** severely limits the **battery life** of a mobile device.

THE SOLUTIONS

INFRASTRUCTURE WIRELESS LOCAL AREA NETWORKS (WLAN)



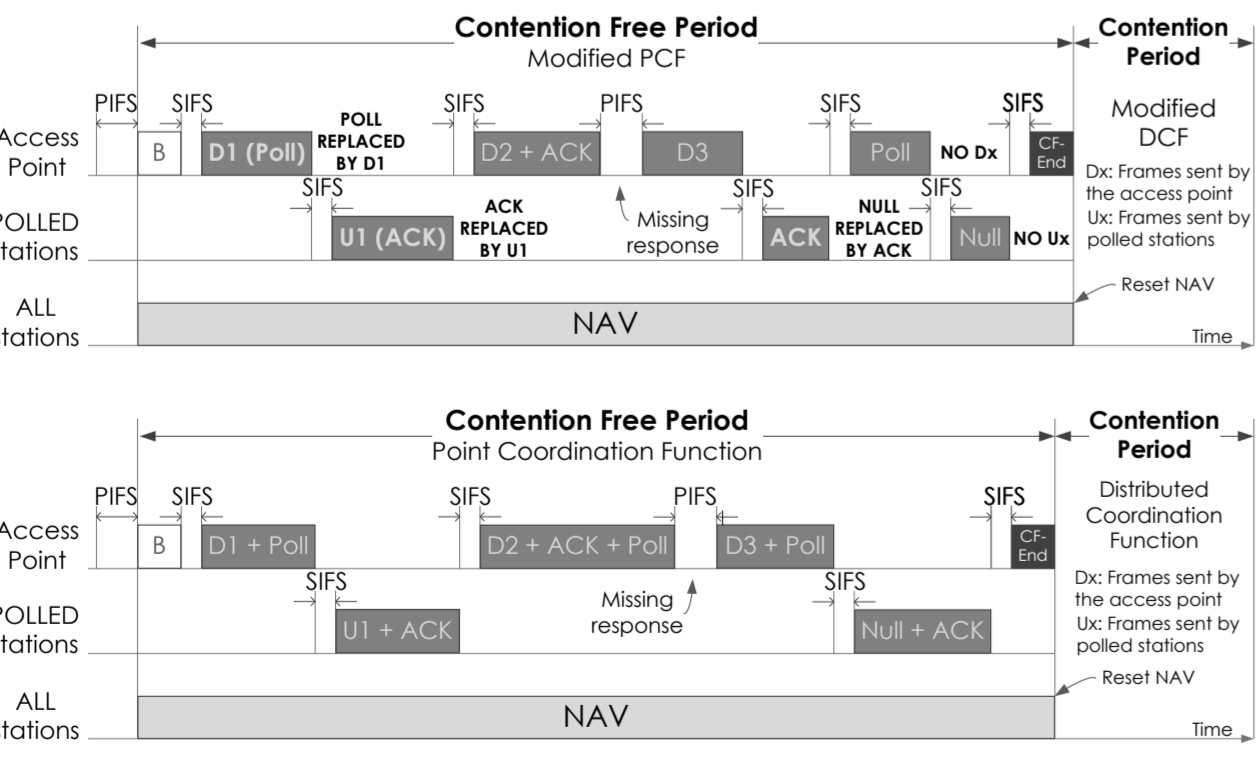
IEEE 802.11 Distributed Coordination Function (DCF)



Standard DCF: Based on the carrier sense multiple access with collision avoidance (CSMA/CA), a successful Request-To-Send/Clear-To-Send (RTS/CTS) handshake only allows an initiating source to send data to its intended destination.

Modified DCF: a successful RTS/CTS handshake can be used to convey *bidirectional data* in exchange between a source and its intended destination.

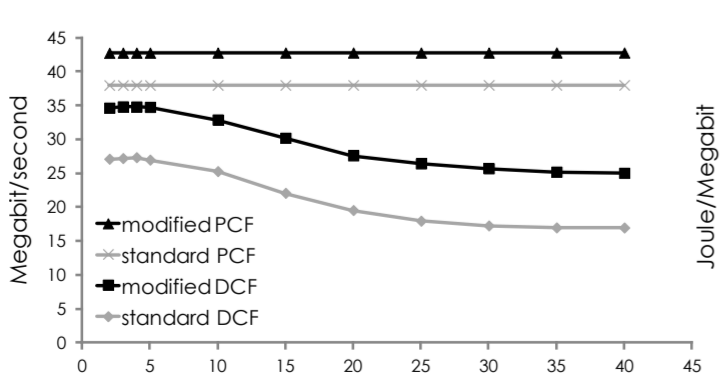
IEEE 802.11 Point Coordination Function (PCF)



Standard PCF: the access point sends downlink data and polls stations and each polled station must reply with uplink data or a null frame.

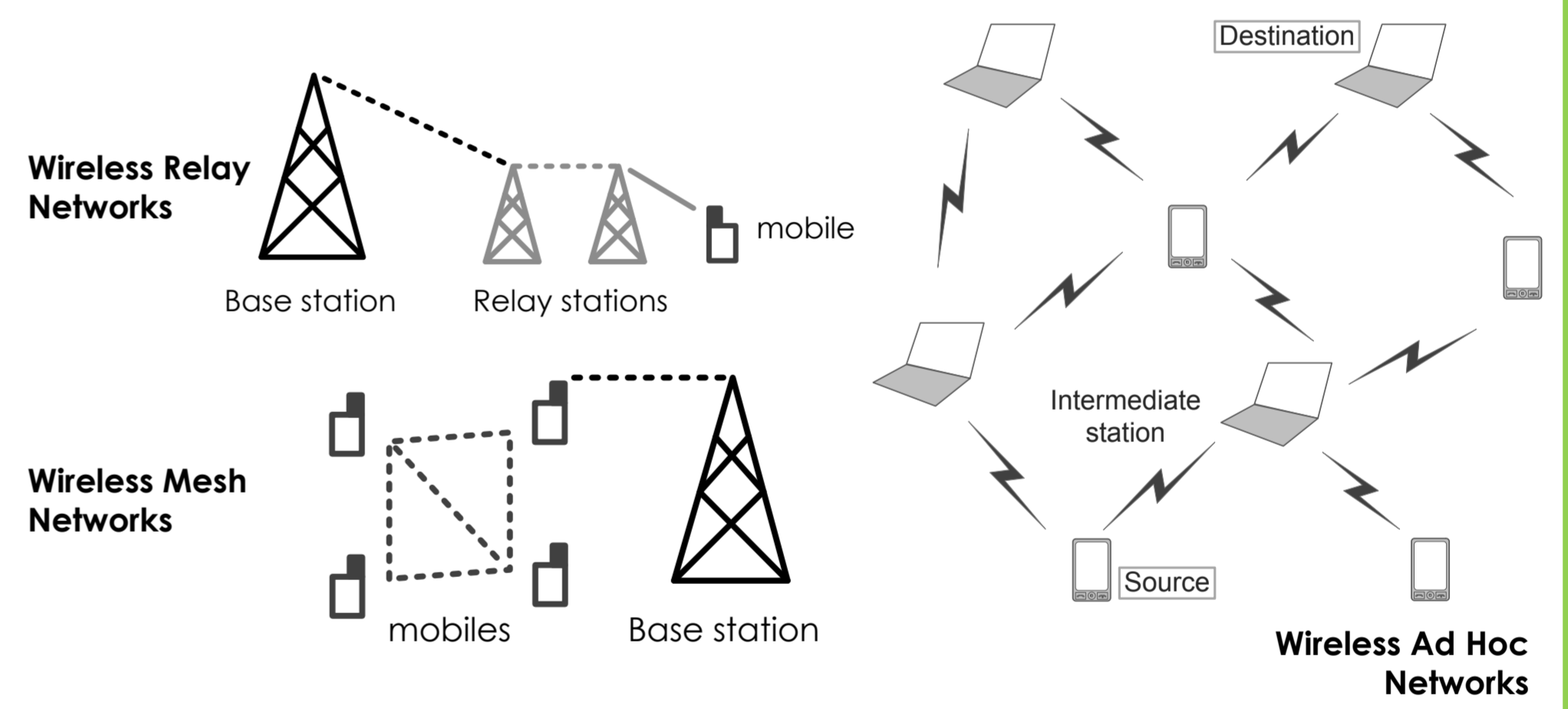
Modified PCF: each station, upon reception of downlink data, can send an uplink frame with equal duration of the downlink frame.

Efficiency of data transmission: The average throughput of the network is improved 30% and 11%, with modified DCF and PCF, respectively.

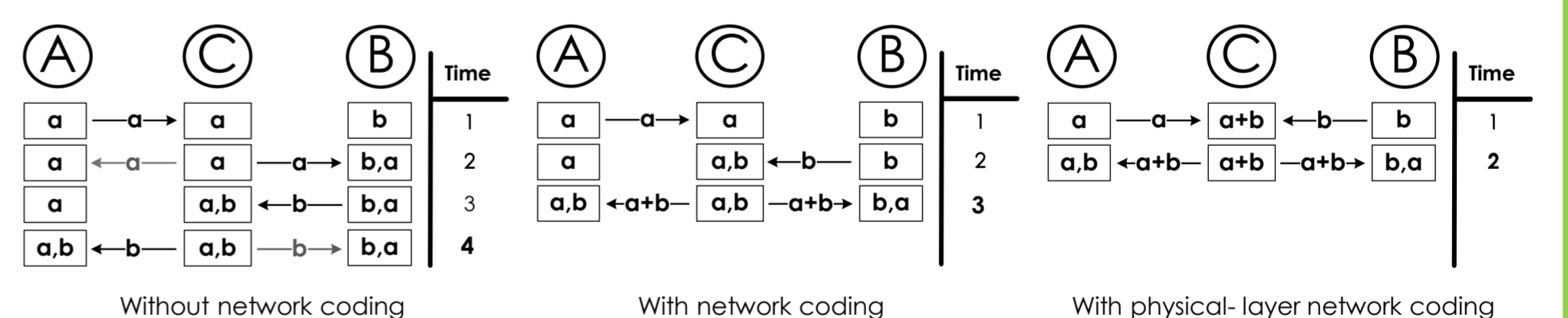


Energy efficiency: The average energy efficiency of the network is enhanced 30% and 11%, with modified DCF and PCF, respectively.

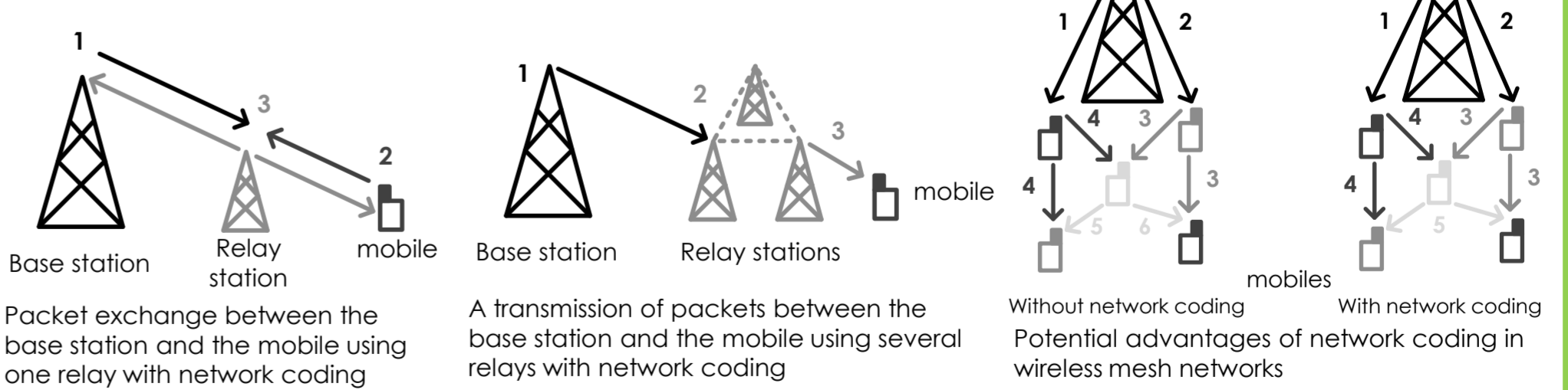
MULTIHOP WIRELESS NETWORKS



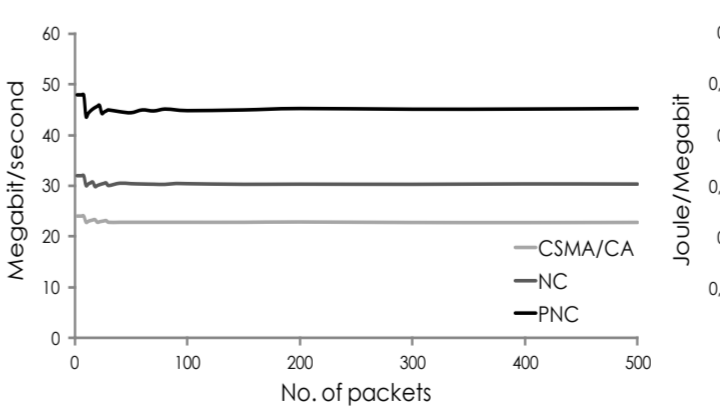
The use of **network coding** can help reduce the number of transmissions and the number of redundant packets, hence significantly reducing the energy consumption.



Application scenarios involving network coding



Efficiency of data transmission: The average throughput of the network is improved 24% and 49%, with network coding (NC) and physical-layer NC (PNC), respectively.



Energy efficiency: The average energy efficiency of the network is enhanced 19% and 33%, with network coding (NC) and physical-layer NC (PNC), respectively.