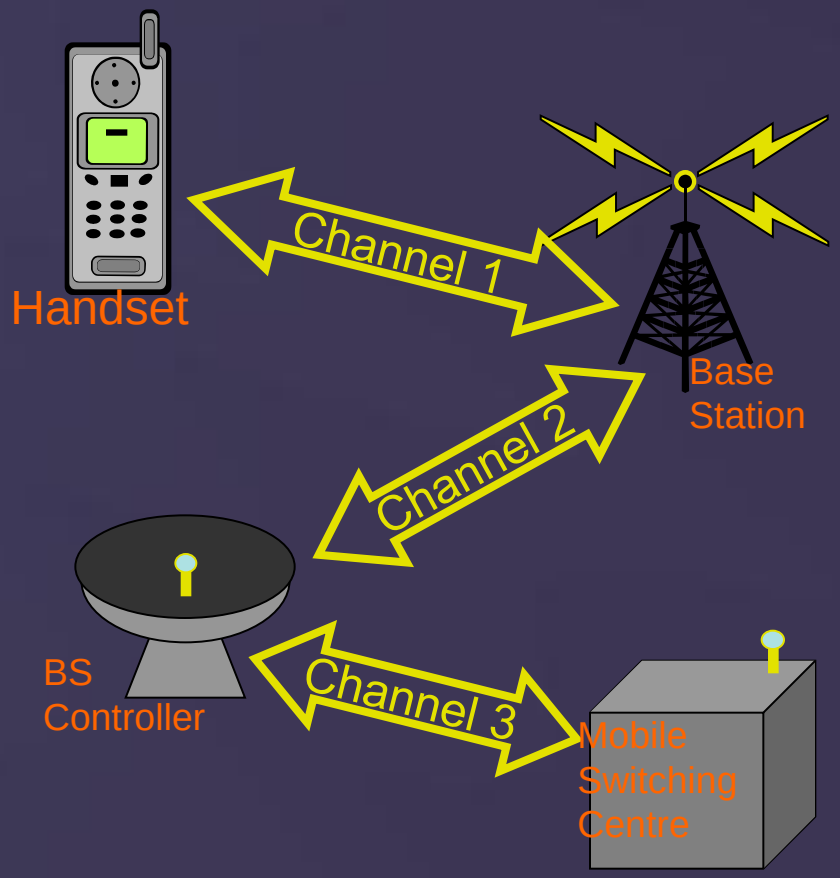
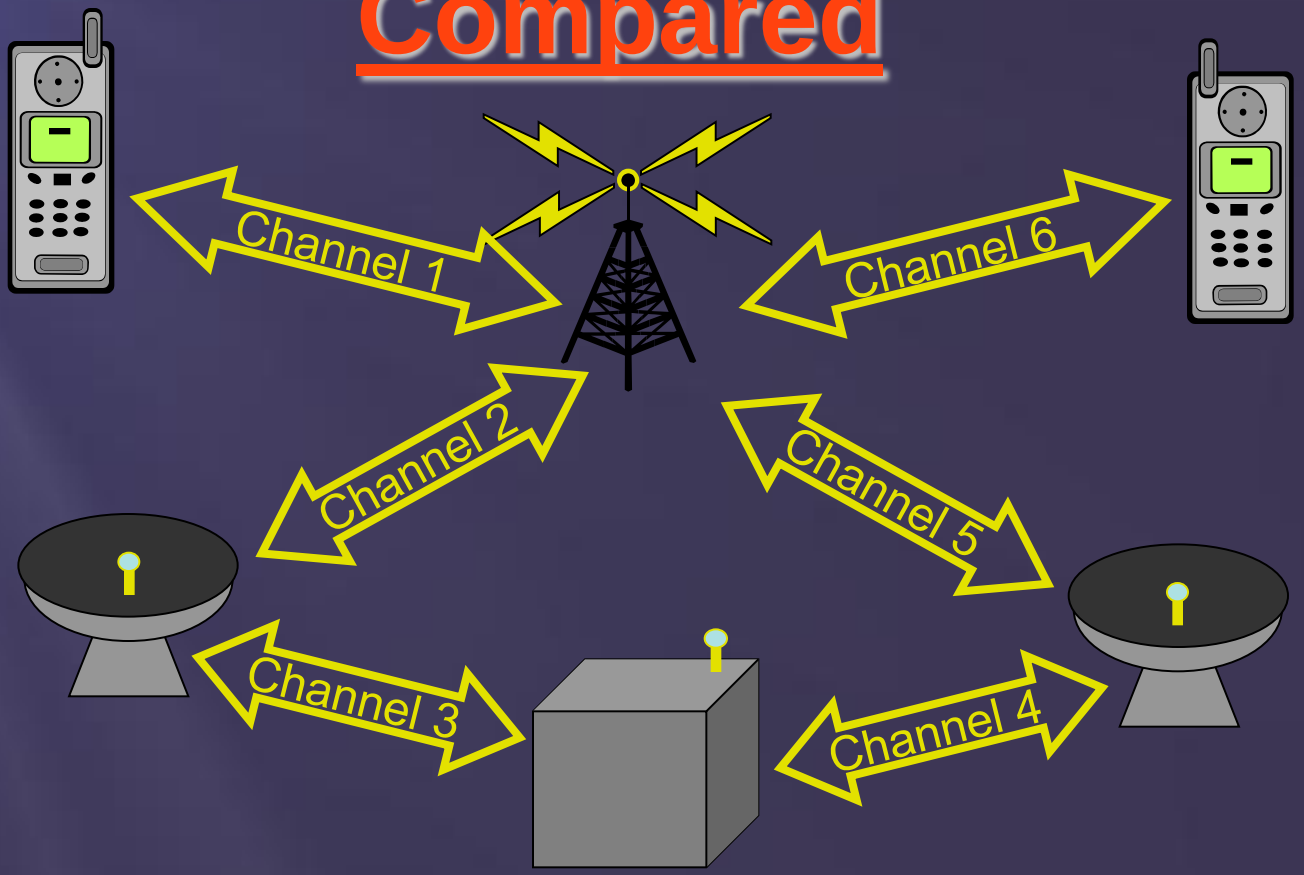
Connection Paradigms, Wireless versus Mobile and Bluetooth

Connection Paradigms Compared

- Circuit Switching
  - A dedicated channel (or circuit) is allocated between two communicating nodes and is only relinquished when one node explicitly cancels it.



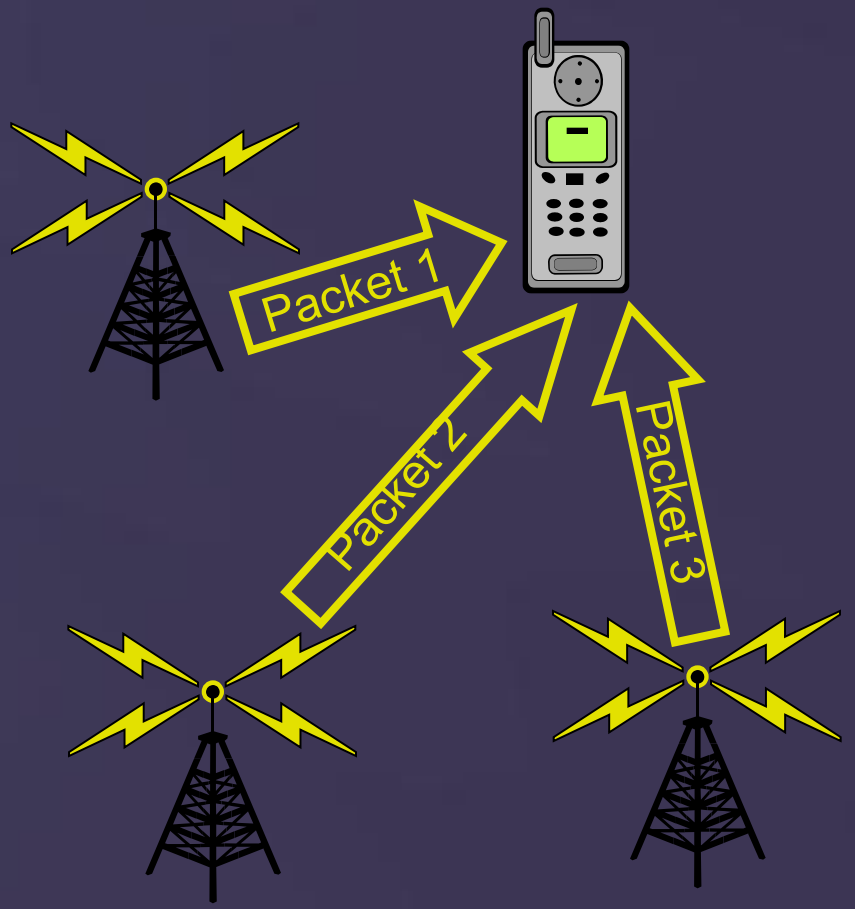
Connection Paradigms Compared



One problem with circuit switching is that if transmission on one of the channels in use is halted… the call is dropped

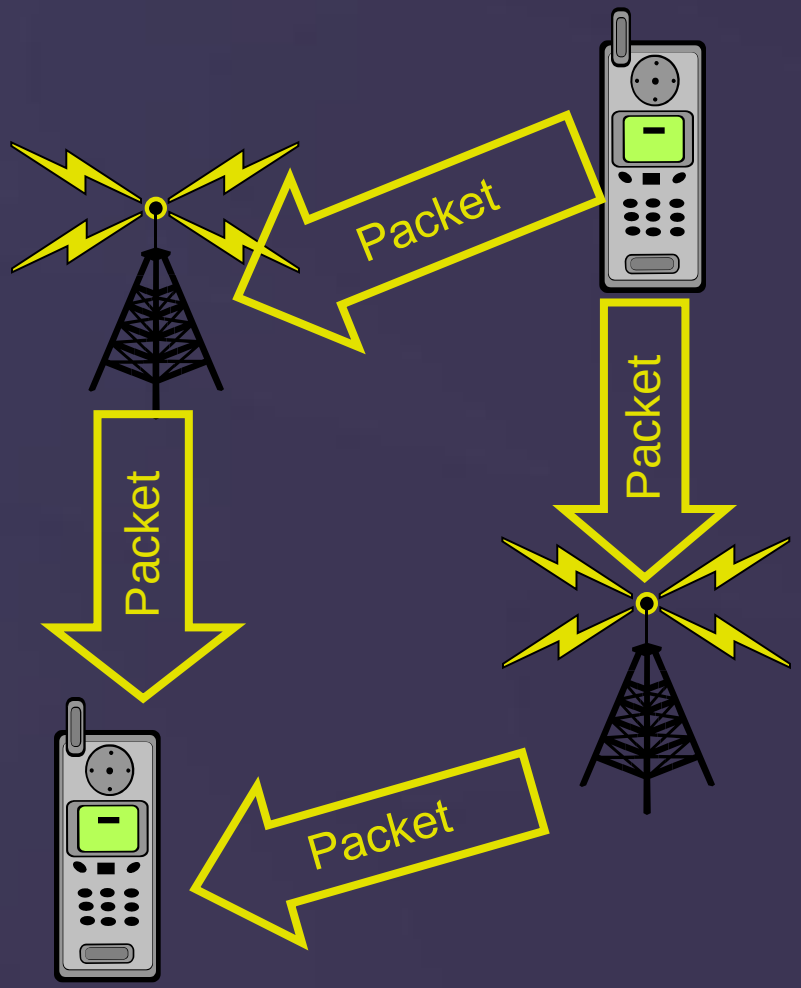
Connection Paradigms Compared

- Packet Switching
  - Packets of data sent through varying routes to appear at the destination
  - Packets may not arrive in the order they were sent and must therefore be rearranged at the receiver



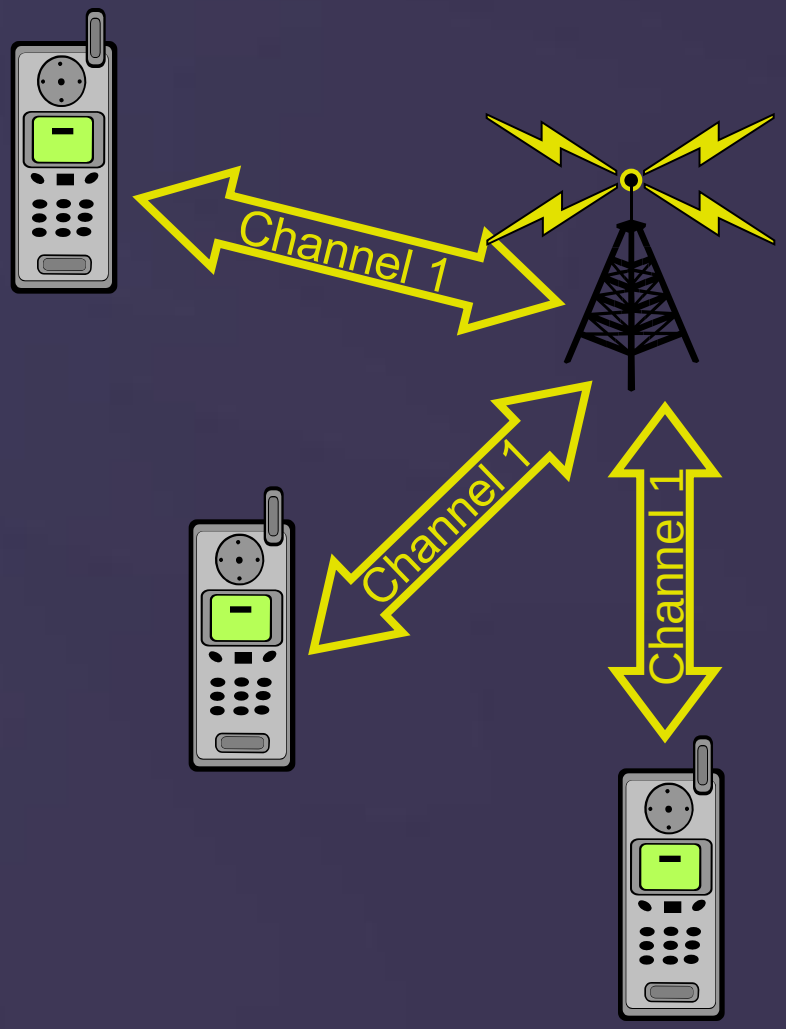
Connection Paradigms Compared

- One major advantage of packet switched circuits is that data can be re-routed if a connection fails



Connection Paradigms Compared

- Packet Switching
  - Channels can be shared with other nodes
  - Optimises bandwidth
  - Reduces latency
  - Increases robustness



Mobile Vs. Wireless

- Wireless
  - Communications through radio
  - Roaming not necessarily permitted
  - Local Area Network (LAN)
  - Personal Area Network (PAN)
- Mobile
  - Wireless with roaming
  - Wide Area Network (WAN)

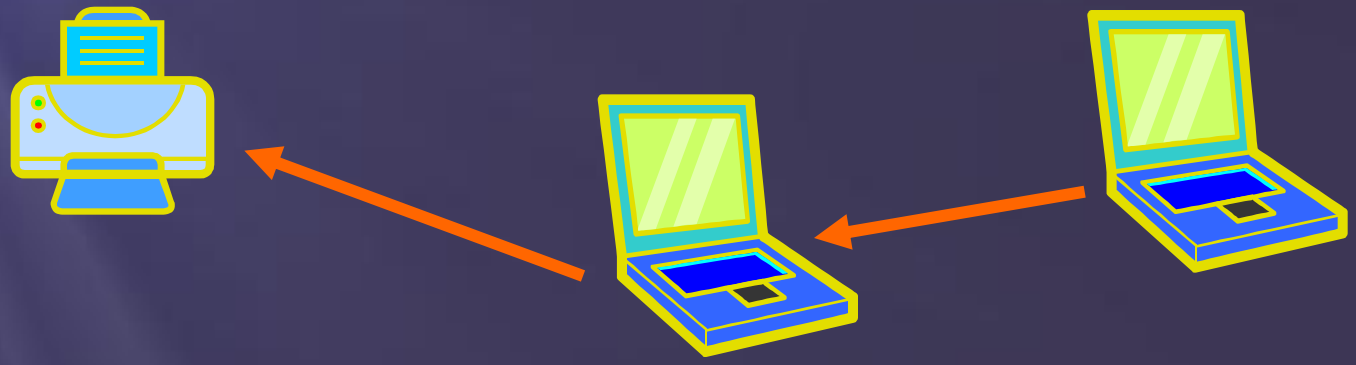
Wireless Networks

- Infrastructured
  - Planned network
  - Structure does not change
- Ad-Hoc
  - No pre-planning
  - No set time for communications
    - Device may join or leave network as desired

Infrastructured

- Mobile, within a given area
  - Think ‘Hot-Desk’
  - Reduced costs
  - Open plan offices
    - Workers set-up where they want
  - Planning necessary for access points
    - Signal strengths
    - Number of computers in range of one access point may cause problems

Ad-Hoc



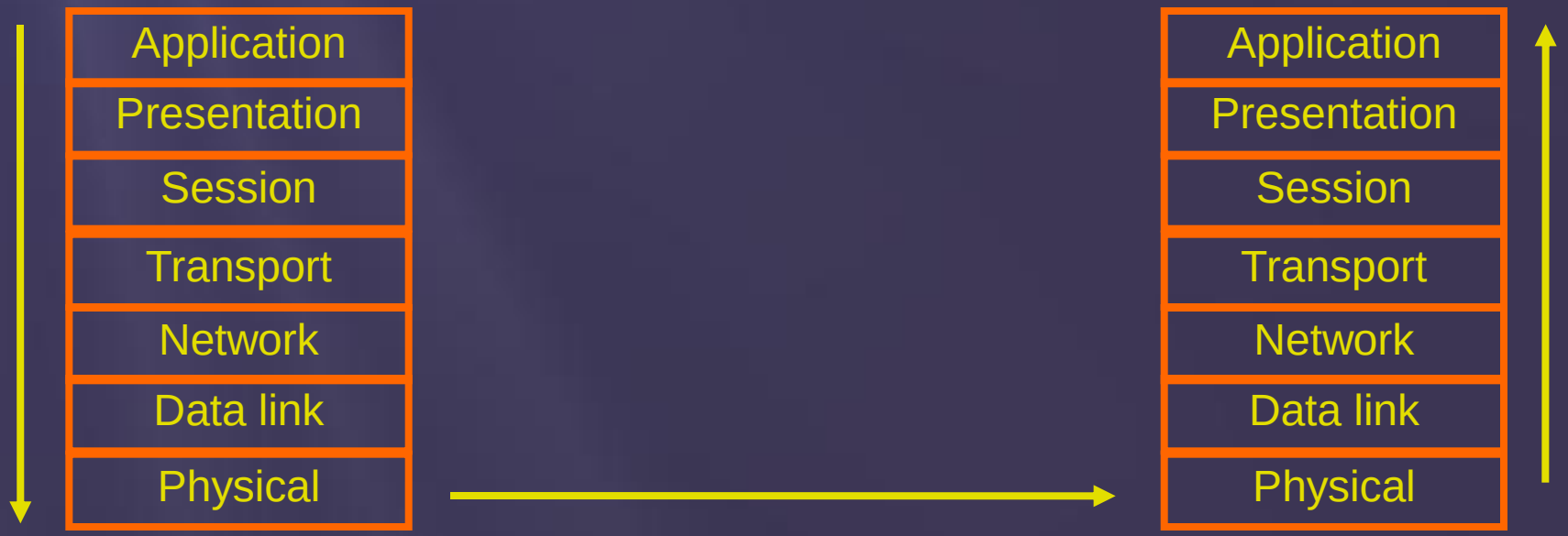
- Network is created as devices move within range of one another
- Devices use each other as stepping stones to access other devices

Ad Hoc

- Biggest challenge is to route the data
  - Fine line between getting the most out of the network and spending all your time routing!
- Mobile Ad-Hoc Networks (MANET)
  - Standardising the IP routing protocols
- Were going to look at
  - Bluetooth
  - WiFi

Open System Interconnection (OSI) stack

- Network standard defining what talks to what and at which stage
- Nominally 7 layers, each with a specific task
- Each layer can only communicate with those directly above/below
- All network protocols can be mapped to this stack
- But protocols do not necessarily use all layers



PAN: Bluetooth

- Originally Ericsson
  - Later Bluetooth Special Interest Group
  - Named after Harold Bluetooth, unified Norway and Sweden and stuff.
  - Bluetooth was supposed to unify multiple technologies i.e. laptops and PCs and printers and stuff
- Standards do cater for LAN
- Class 1 = 1mW = <1 metre
- Class 2 = 2.5mW = <10 metres
- Class 3 = 100mW = <100 metres

Industrial Scientific and Medical (ISM) Band

- ITU defined
- License free for non-commercial use
- Almost global
- Commonly 2.4GHz
  - Other frequencies available

Bluetooth: History

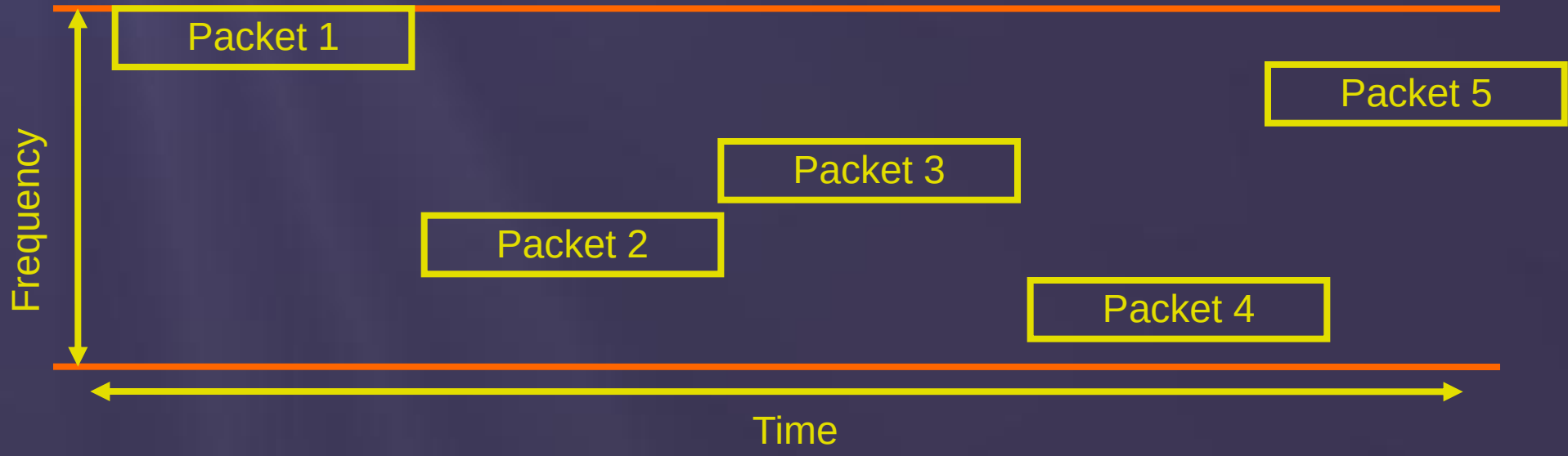
- 1.0 & 1.0B
  - Bluetooth Hardware Device Address (BD_ADDR) transmission used in ‘handshaking’ process, anonymity therefore impossible at protocol level
  - 1Mbit/s, 430Kbits/sec duplex in reality
- 1.1
  - Support for non-encrypted channels added

Bluetooth: History

- 1.2
  - Adaptive Frequency Hopping (jumps frequencies, avoiding those with high traffic), therefore reducing interference
- 2
  - Enhanced Data Rate 2.1Mbit/s
  - Reduced duty cycle – improved power consumption
  - Increased bandwidth allowing easier multi-unit network
  - Improved error control

Frequency Hopping

- Helps to reduce interference
  - Device transmits on one frequency for short time then hops to another
  - 1600 Hps
  - ARQ used to re-transmit packets in error
  - Can adversely affect other devices not using hopping in vicinity



Bluetooth: Connections

- All devices transmit certain info on demand
  - Name
  - Class
  - List of services
  - Device technical info (bluetooth spec, clock offset, features etc.)

Managing Bluetooth

- Whole idea is to conserve energy
  - Hence the different classes
- Four possible states In order of energy use (high to low)
  - Master
  - Slave
  - Parked
  - Standby

Managing Bluetooth

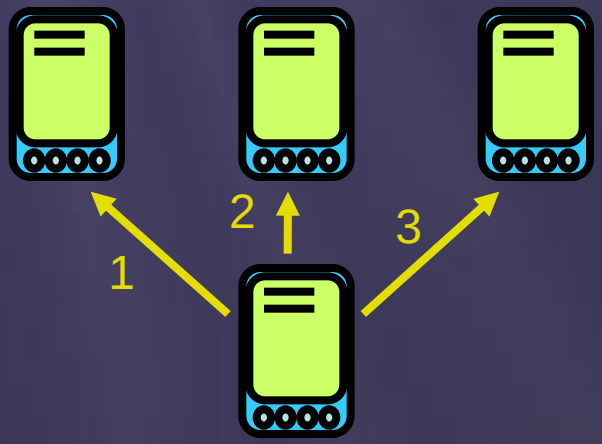
- Master
  - Initiates comms between devices
  - Controls piconet
- Slave
  - Member of piconet
  - Controlled by master
- Parked
  - Lower state of activity
  - Reactivated by master when required
- Standby
  - Listens, but not part of piconet

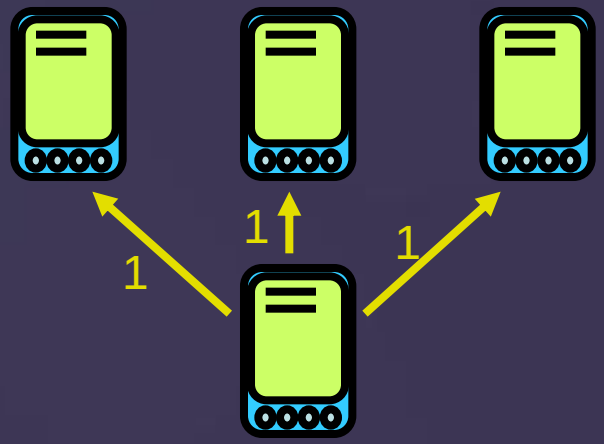
PAN: Bluetooth

- Maximum of 8 device piconet
  - All have same implementation but 1 acts as a master
  - All comms between slaves go through master
- Scatternet of 10 piconets connected within ‘bubble’ – dictated by transmission range
  - This is not available yet
  - Idea is one device acts as a master in one piconet and slave in the next

Bluetooth communication

- Unicast
  - Repeated sending to each device
- Multicast
  - Multiple devices ‘listen in’ to same packet transmission





A Future for Bluetooth?

- Ericsson thinks not
  - Not commercially viable to develop the technology further
- But many others do
  - Near Field Communication (NFC)
    - 424Kbps
  - ZigBee
    - 250 Kbps
  - IEEE 802.15.3a
    - 480Mbps