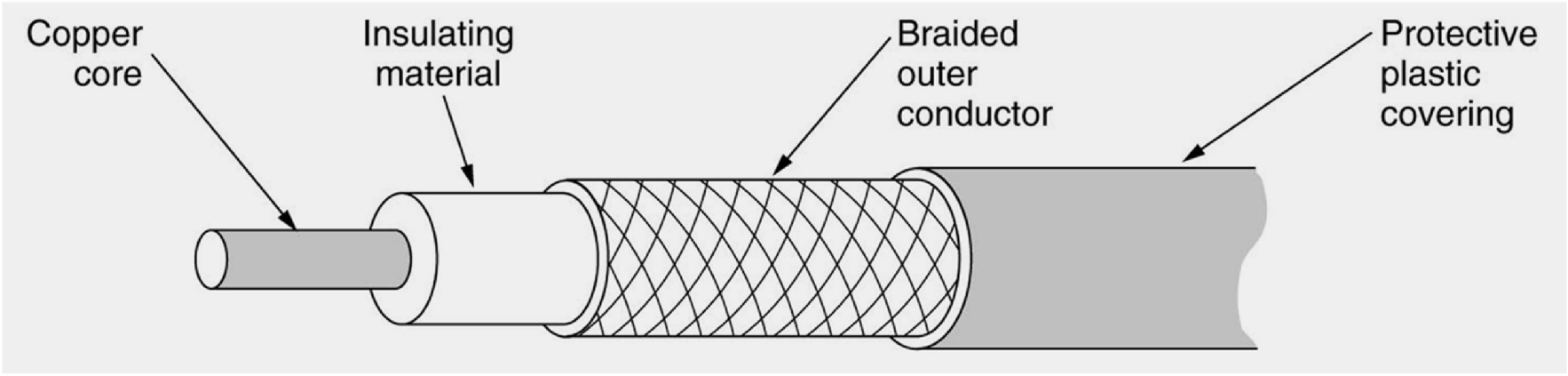
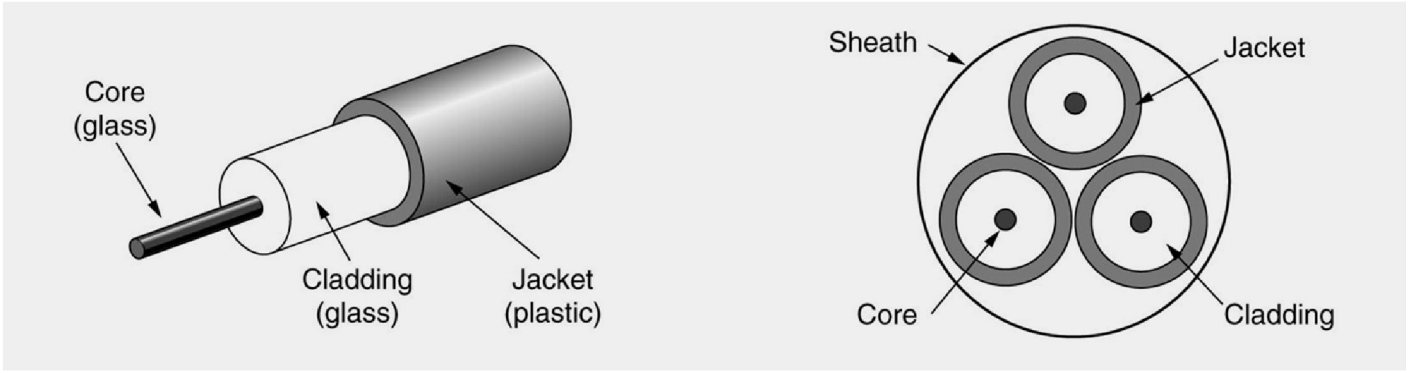
Transmission Media

- The Medium is the path along which the signal travels
- The type of medium determines the type of signal to be used and can affect the reliability of communications
- Conventional networks use copper wire
  - Low resistance to electrical current
  - The terms copper and wire are used interchangeably
  - Prone to interference from other wires close-by
  - This interference can be minimised by using Twisted Pair wiring and Co-axial cable

TP, Co-ax and Optical Fibre Cables





Twisted Pair

- Characteristics:
  - Comprised 2 insulated copper wires twisted together
  - These twists reduce crosstalk
  - Typically many pairs are bundled in a protective sheath
  - Very cheap and easy to use
  - BW: Cat 3 = 16MHz., Cat 5 = 100MHz., Cat 6 = 250MHz.
- Applications:
  - In office buildings for phone and computer connectivity
  - Residential telephone – the local loop

Coaxial Cable

- Characteristics:
  - Comprised of central copper conductor and a hollow outer cylindrical conductor
  - A surrounding sheath holds the inner conductors in place
  - BW: 1GHz.
- Applications:
  - Cable TV
  - Long distance telephone network
  - Computer connectivity (LANs)

Optical Fibre

- Characteristics:
  - Comprised of thin flexible transparent glass fibre core
  - This core is surrounded by glass or plastic cladding with a lower refractive index
  - Outer sheath provides rigidity and protection
  - Several fibres may be contained in one jacket
  - Two types of light Source used:
    - Light emitting diode (LED) - low cost
    - Injection laser diode (ILD) for higher data rates and greater distances

Optical Fibre

- Applications:
  - Long distance telephone connections
  - Metropolitan trunks
  - Rural exchange trunks
  - Local loop (becoming more popular)
  - LANs

Optical Fibre V Coaxial Cable

- Electromagnetic isolation i.e. no interference
- Lower Attenuation hence greater repeater spacing (50km v 5km for copper)
- Greater Capacity – up to 10 Gbps over many km's
- Requires only single core for complete circuit
  - Hence smaller in size, lighter in weight

Wireless Transmission

- Two configurations
  - *Omni-directional* e.g. radio station
  - *Directional* e.g. microwave/satellite links
- Radio Transmission Characteristics:
  - Networks that use EM radio waves are known as Radio Frequency networks
  - There is no physical connection between stations
  - Transmission is achieved using an antenna

Terrestrial Microwave

- Characteristics:
  - Waves travel at higher frequency than radio typically 2 – 40 GHz
  - High frequency allows:
    - High Bandwidth implies high data rate e.g. 120 Mbps
  - Waves are focused into a narrow beam by a parabolic dish antenna (higher frequency implies smaller dish)
  - Waves are received by a similar dish antenna
  - Line of sight required (although not always possible)
  - Prone to interference from rainfall and other dishes
  - Prone to misalignment in storm

Terrestrial Microwave

- Applications:
  - Back-to-back installations used on long haul links (their main application)
  - Also, used where there are difficulties laying cables e.g. mountain top installations common with mobile phone networks

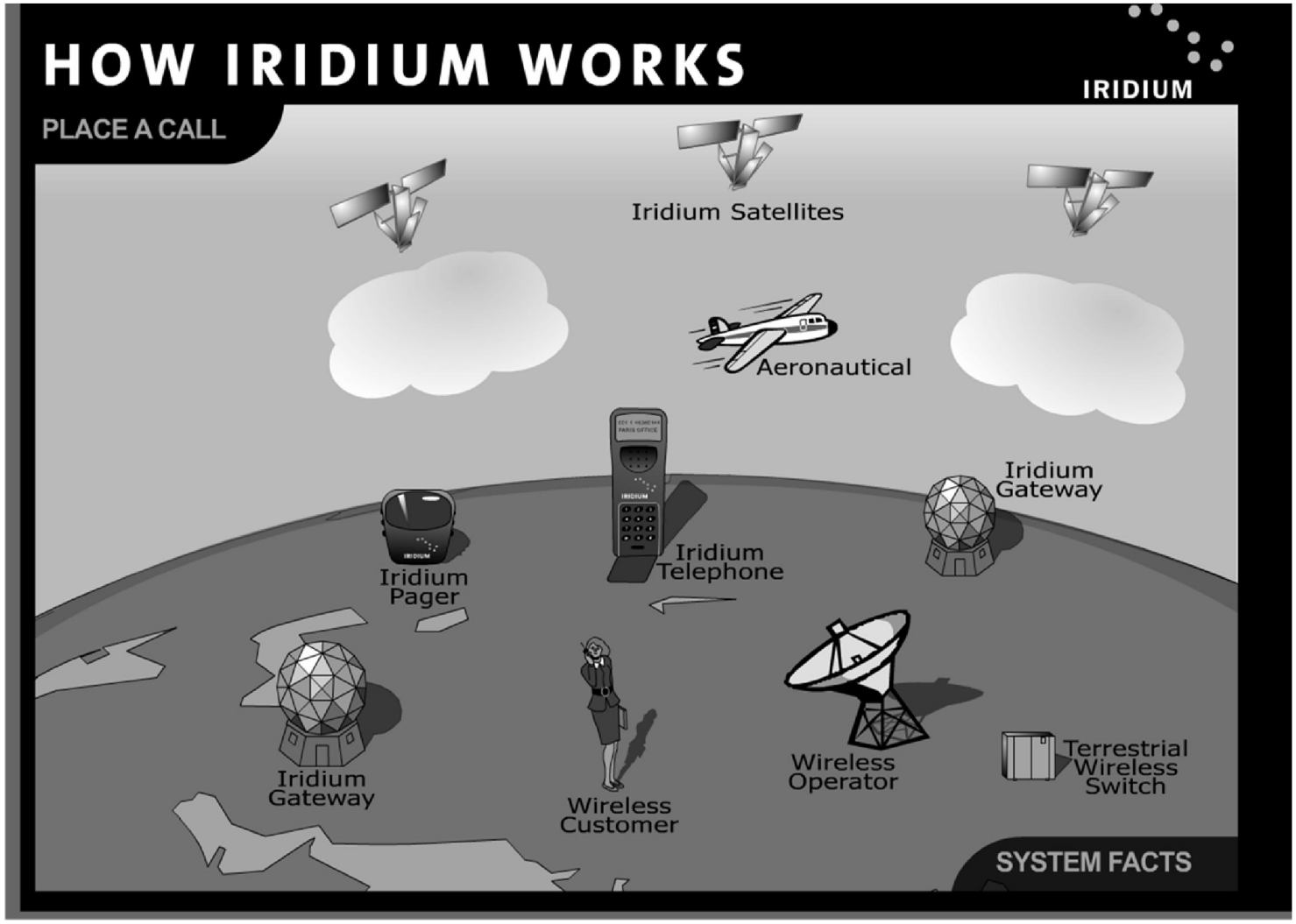
Satellite Microwave (aka Satellites)

- Satellites can link two or more ground stations – i.e. acts as a *relay*
- Satellites use two different bands (frequency ranges) to communicate:
  - Different frequencies allow full duplex comms. on the *up* and *down* links
- Two types of Satellite (GEOs and LEOs):
  - GEOs remain stationary over a point on earth
  - LEOs move rapidly across the sky

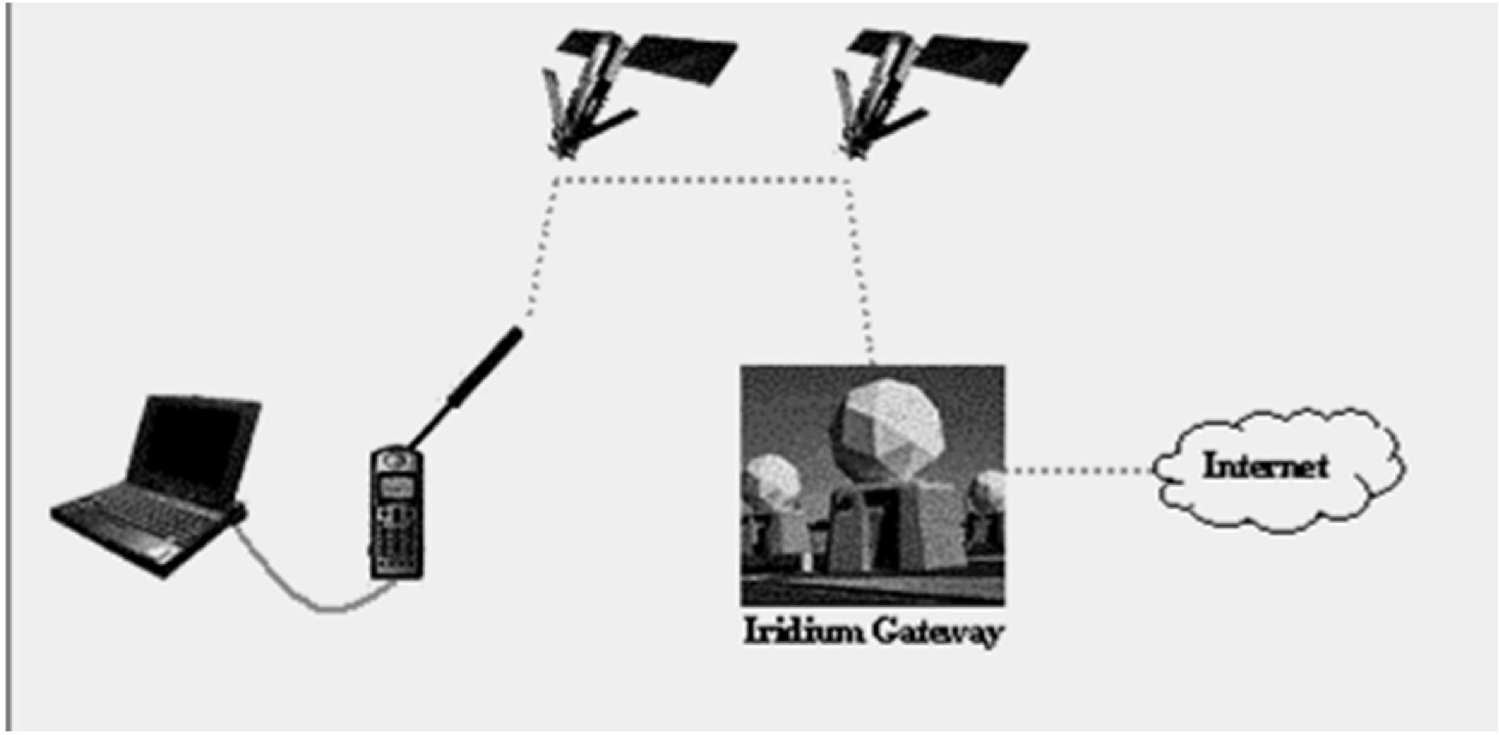
Satellites

- Characteristics:
  - Originally operated in range 1 – 10GHz.
  - The 4/6 GHz band is saturated
  - 12/14 GHz now open for service
  - Inherent propagation delay (time delay) approx. 0.25sec.
- Applications:
  - Television distribution
  - Long-distance telephone transmission
  - Private business networks

The Iridium Satellite Network



Using Iridium Network for Computer Comms.



Infrared

- Characteristics:
  - Does not require antennae or special license to operate
  - Uses LED
  - Very low cost
  - Cannot penetrate obstacles i.e. requires line of sight
- Applications:
  - Remote controls
  - Computer-to-computer connectivity e.g palmtops, mobile phones etc.

Bluetooth

- Characteristics:
  - Uses the 2.4 GHz. ISM band (Industrial, Scientific and Medical)
  - Uses low power implies short range (approx. 10m)
  - Comprises 79 channels of 1MHz. Each
  - Uses FSK and achieves 1 bit per Hz. i.e. 1Mbps per channel
- Applications:
  - Connection of a variety of computing devices

The E-M Spectrum