

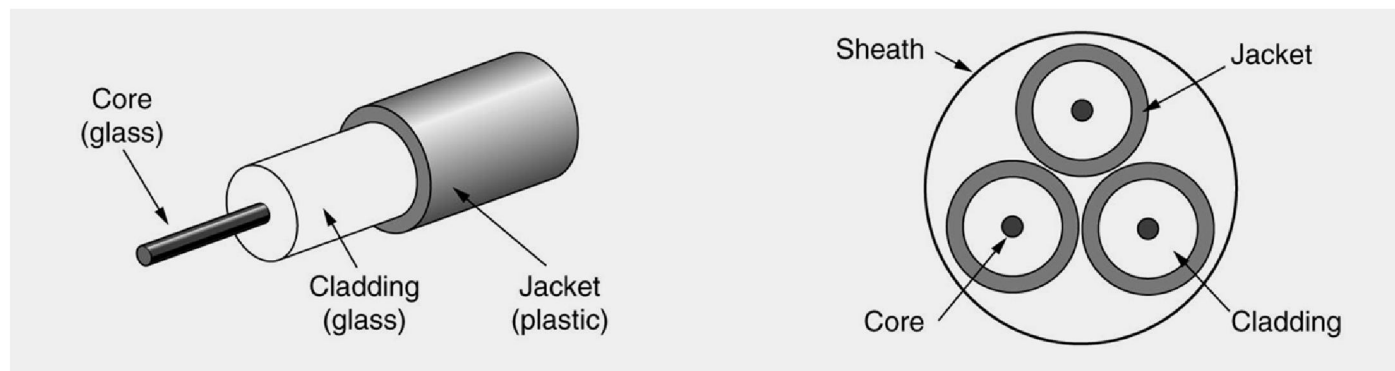
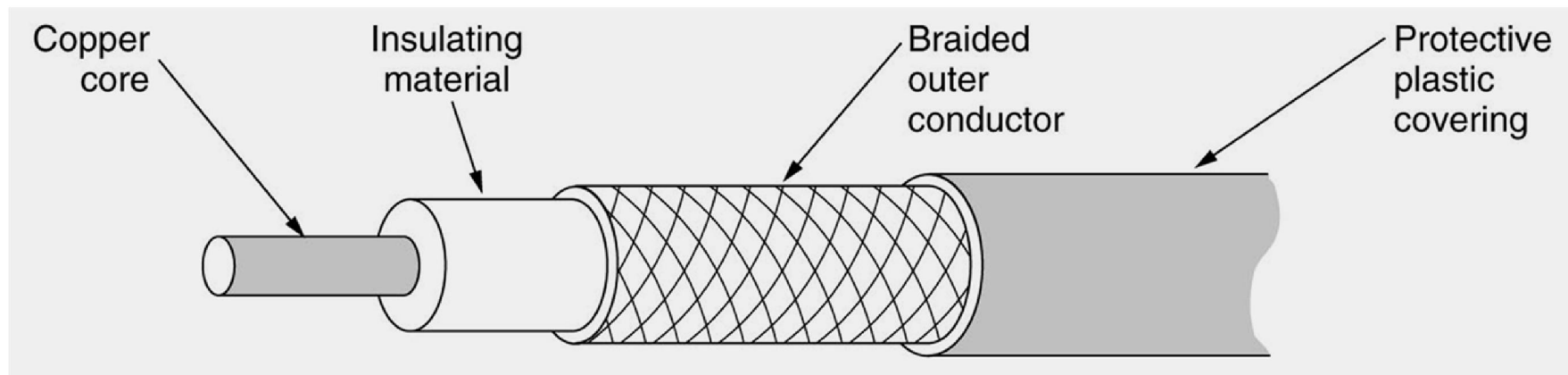
# Transmission Media

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- ◆ The ***Transmission 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

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# Twisted Pair

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## ◆ 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

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- ◆ 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

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## ◆ 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 bound in a single 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

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## ◆ Applications:

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

# Optical Fibre V Coaxial Cable

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- ◆ Optical Fibre cables offer the following advantages over Co-axial cables:
  - 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

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- ◆ 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 (RF)*** networks,
  - There is no physical connection between stations,
  - Transmission is achieved using an antenna.



# Terrestrial Microwave

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## ◆ Characteristics:

- Microwaves travel at higher frequency than RF. Typically 2 – 40 GHz.,
- This higher frequency allows for a larger bandwidth which implies a high data rate e.g. 120 Mbps,
- Waves are focused into a narrow beam by a parabolic dish antenna,
- 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

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## ◆ Applications:

- Back-to-back installations used on long haul links (this is their main application).
- Also used where there are difficulties laying cables e.g. mountain top installations.
- Very common with mobile phone networks e.g. the **3 Network** relies heavily on MW links.

# Satellite Microwave (aka Satellites)

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

# Satellites

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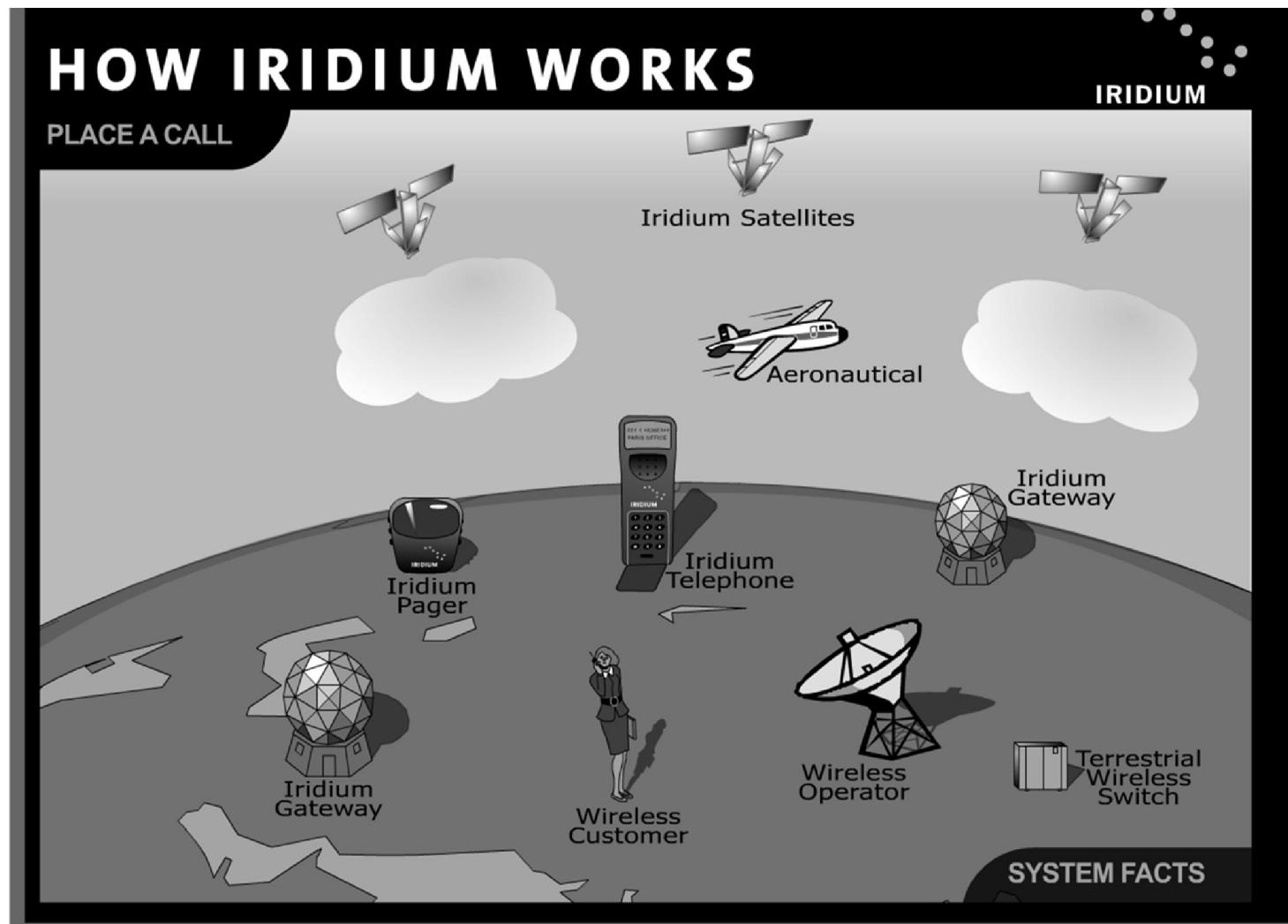
## ◆ Characteristics:

- Originally operated in range 1 – 10GHz.,
- The 4/6 GHz band is now saturated,
- 12/14 GHz now open for service.
- Inherent propagation delay (time delay) approx. 0.25sec.

## ◆ Applications:

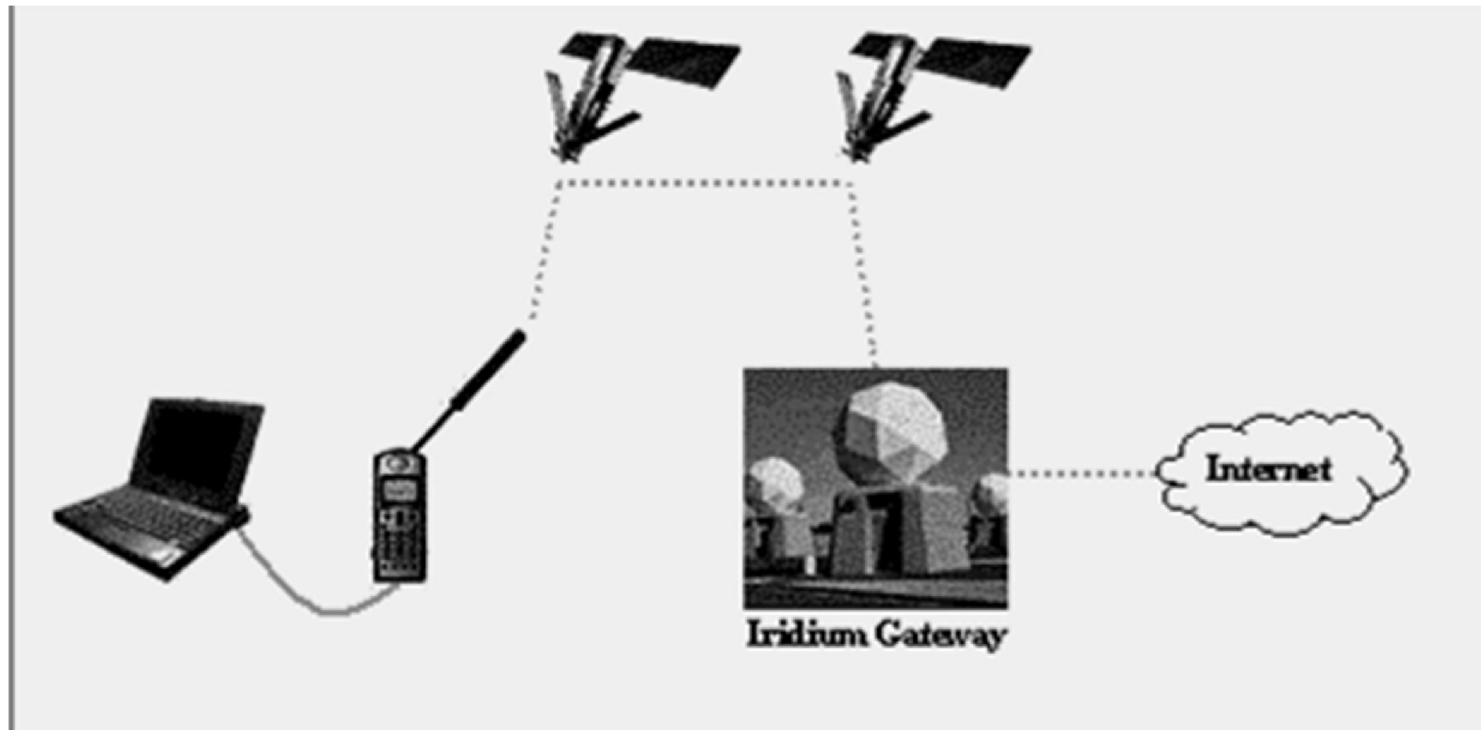
- Television distribution,
- Long-distance telephone transmission,
- Private business networks.

# The Iridium Satellite Network



# Using Iridium Network for Computer Comms.

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# Infrared

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## ◆ 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 mobile phones etc.

# Bluetooth

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## ◆ 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 a type of encoding called FSK which provides for 1 bit per Hz. i.e. 1Mbps per channel,

## ◆ Applications:

- Connection of a variety of computing devices



# The E-M Spectrum

