

MOBILE COMMUNICATION— AN OVERVIEW

Lesson 01

Guided Transmission and Unguided Wireless Transmission

COMMUNICATION

- Communication— a two-way transmission and reception of data streams
- Transmission of signals for the voice, data, or multimedia streams
- Reception of the signals at receiver

SIGNALS

- Signals transmit through fibre, wire, or wireless medium
- Transmission according to defined regulations, recommended standards, and protocols

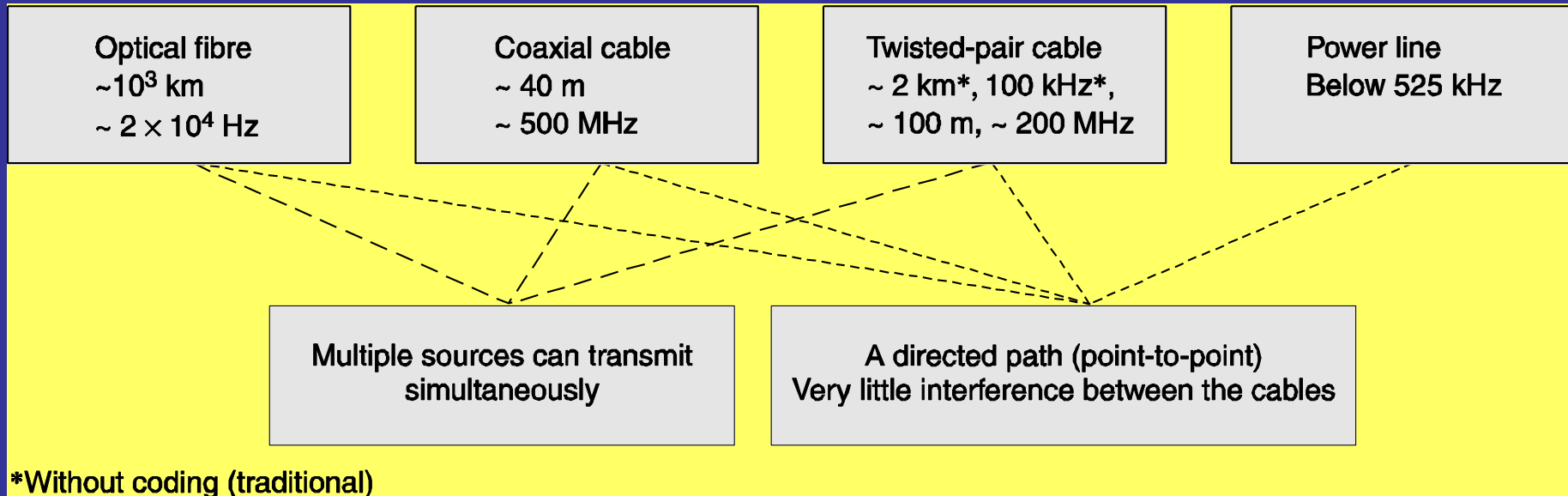
MOBILE COMMUNICATION

- Entails transmission of data to and from handheld devices
- Two or more communicating devices
- At least one is handheld or mobile
- Location of a device can vary either locally or globally
- Communication through a wireless, distributed, or diversified network

GUIDED TRANSMISSION

- Metal wires (Cables) guided transmission of data
- Optical fibres guided transmission of data
- Guided transmission of electrical signals takes place using various types of cables

FIBRE- AND WIRE- BASED TRANSMISSION AND THEIR RANGES



TYPES OF CABLES FOR GUIDED TRANSMISSION

1. Optical fibre for the pulses of wavelength $1.35 \mu\text{m}$ – $1.5 \mu\text{m}$
2. Coaxial cable for electrical signals of frequencies up to 500 MHz; up to a range of about 40 m

TYPES OF CABLES FOR GUIDED TRANSMISSION

3. Twisted wire pairs — for conventional (without coding) electrical signals of frequencies up to 100 kHz and up to a range of 2 km, or for coded signals of frequencies up to 200 MHz and a range of about 100 m
4. Power lines, a relatively recent advent in communication technology— used for long-range transmission of frequencies between 10 kHz and 525 kHz

ADVANTAGES OF GUIDED TRANSMISSION

- Transmission along a directed path from one point to another
- Practically no interference from any external source or path
- Large number of signal-sources simultaneously transmitted along an optical fibre, a coaxial cable, or a twisted-pair cable using multiplexing and coding

DISADVANTAGES OF GUIDED TRANSMISSION

- Signal transmitter and receiver both fixed (immobile).
- No mobility of transmission and reception points.
- Number of transmitter and receiver systems limits the total number of interconnections possible

UNGUIDED— WIRELESS TRANSMISSION

- Electrical signals transmitted by converting them into electromagnetic radiation
- Radiation transmitted via antennae that radiate electromagnetic signals

UNGUIDED— WIRELESS TRANSMISSION

- Various frequency bands within the electromagnetic spectrum
- Different transmission requirements
- $f = c/\lambda = (300/\lambda) \text{ MHz}$ [λ in meter]

VHF AND TV-VHF

VHF
50–250 MHz
Range: ~50

TV VHF channels—
174–230 MHz

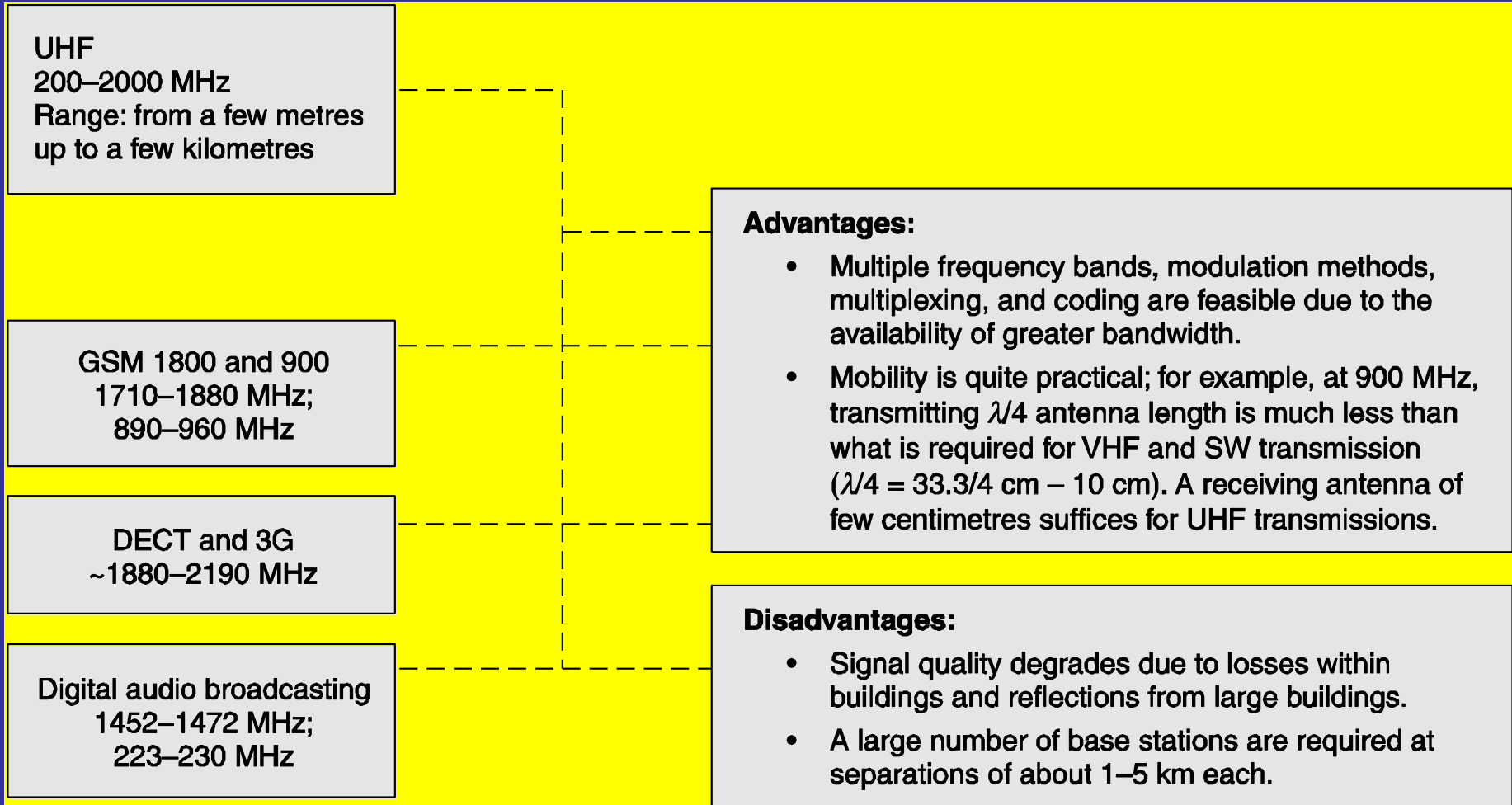
Advantages:

- Frequency modulation and multiple frequency band transmission is possible.
- Transmitting antennae length is 3 m to 60 cm (due to small $\lambda/2$ length) compared to above 10 m in SW and MW.

Disadvantages:

- Mobility is not practical as transmitting and receiving antennae length is 3 m to 60 cm and a directed multi-dipole or dish antenna is required at the receiving end.

UHF, GSM, DECT, 3G AND DAB



SUPER HIGH FREQUENCIES AND EXTREME HIGH FREQUENCIES MICROWAVES

- 2 GHz to 40 GHz (~15 cm to 0.75 cm)
[Microwave bands and satellite signal bands]
- Extreme high frequency (EHF): Above 40 GHz to 10^{14} Hz (0.75 cm to 3 μm)

INFRARED

- Far Infrared: Optical wavelengths between 1.0 μm to 2.0 μm and $[(1.5 \text{ to } 3) \times 10^{14} \text{ Hz} (=0.15\text{-}0.3 \text{ THz})]$
- Infrared: 0.90 μm to 0.85 μm in wavelength and $\sim (3.3 \text{ to } 3.5) \times 10^{14} \text{ Hz} [350 \text{ to } 330 \text{ THz}]$

ANTENNAE

- Devices that transmit and receive electromagnetic signals
- Most function efficiently for relatively narrow frequency ranges

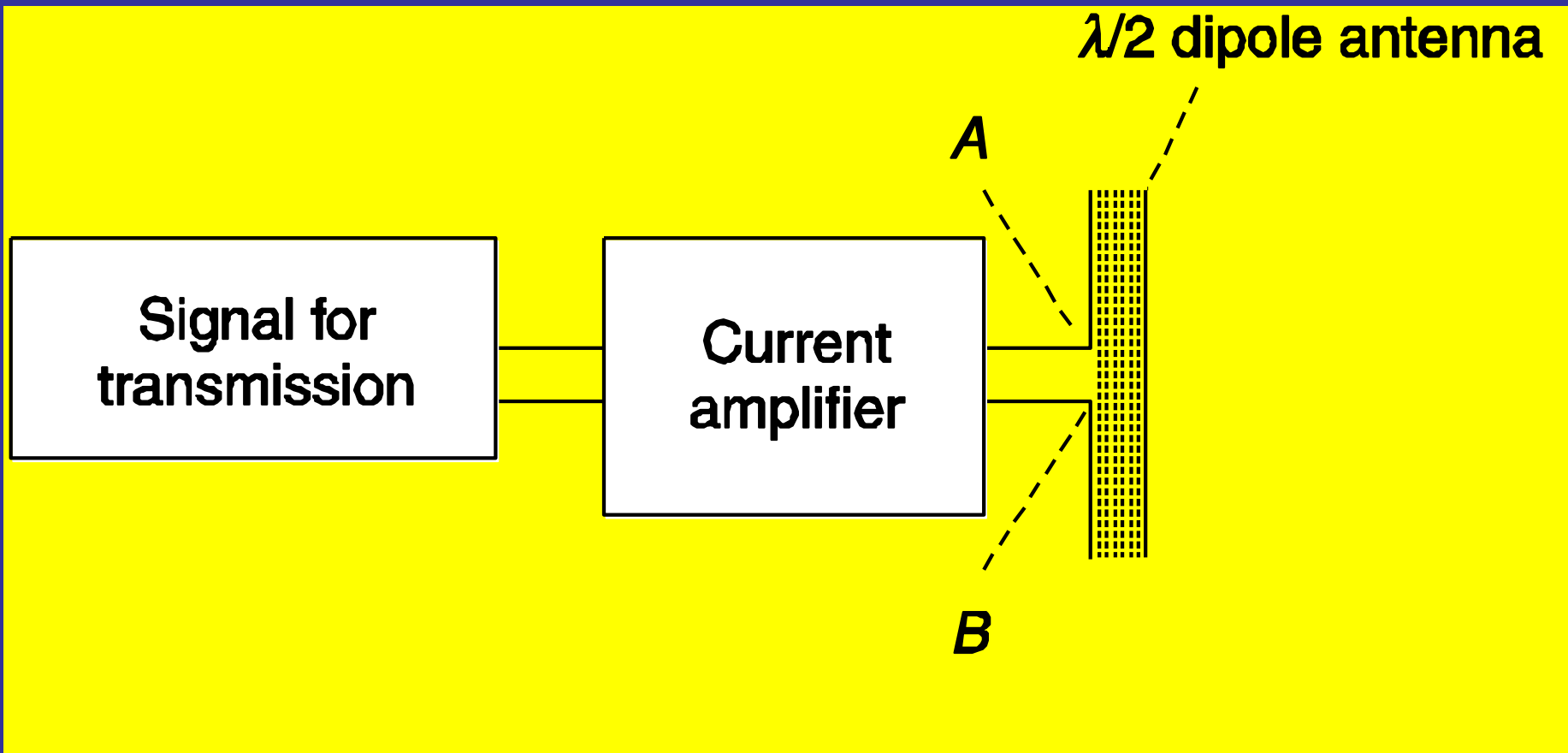
ANTENNAE

- If not properly tuned to the frequency band in which the transmitting system connected to it operates, the transmitted or received signals may be impaired

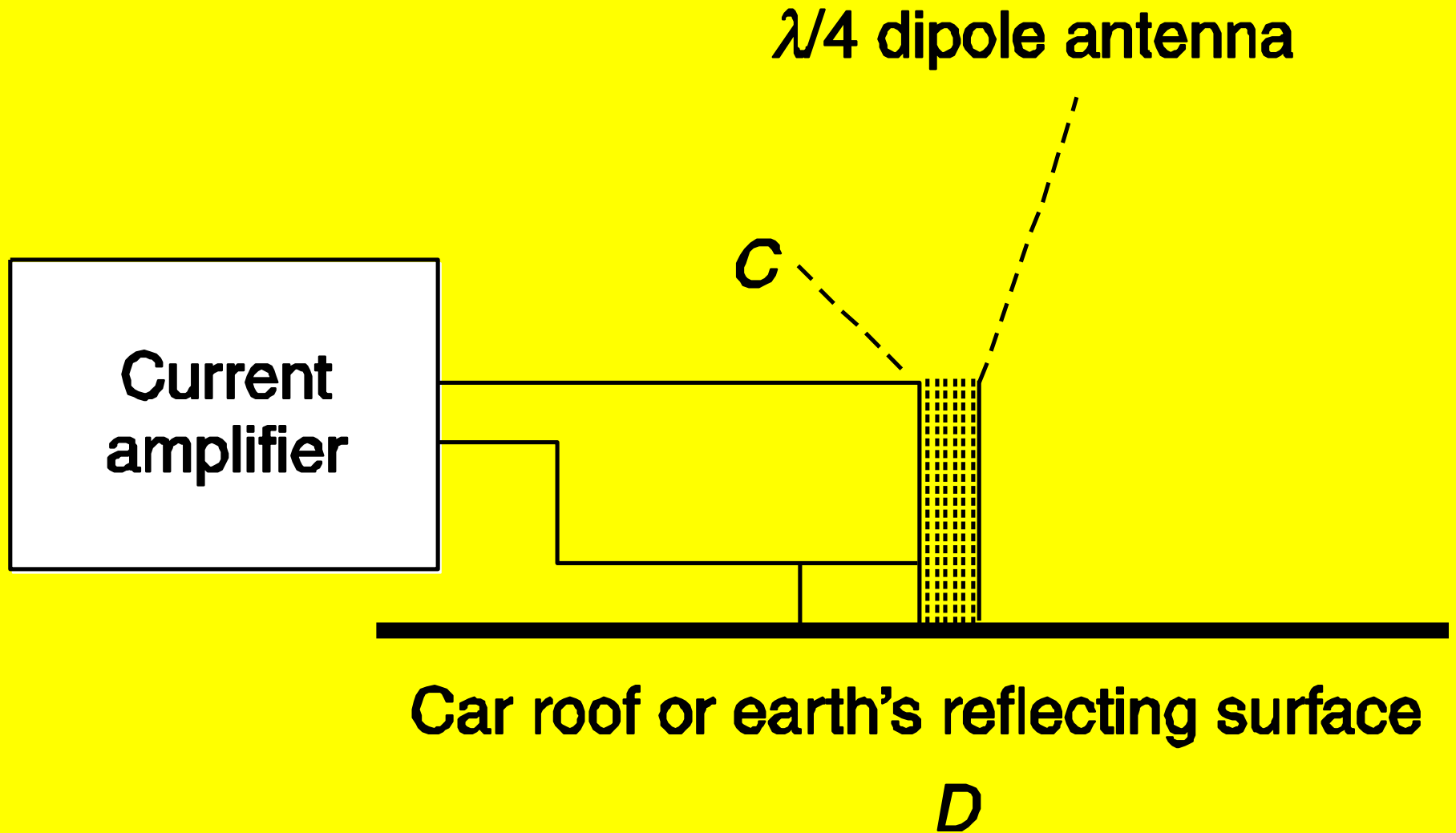
ANTENNAE FORMS

- Mostly determined by frequency ranges of operation
- Vary from a single piece of wire to a parabolic dish

$\lambda/2$ DIPOLE ANTENNA



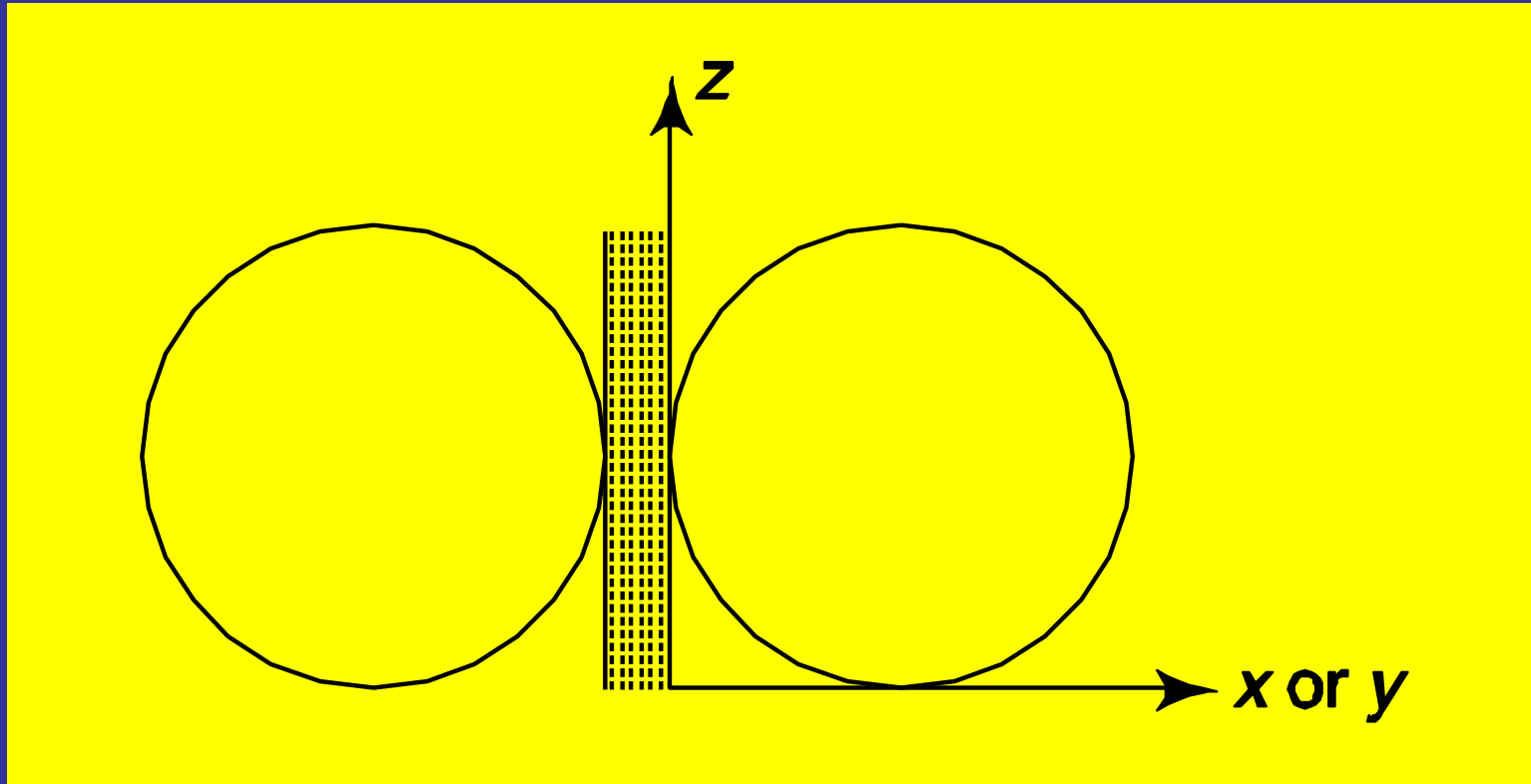
$\lambda/4$ DIPOLE ANTENNA



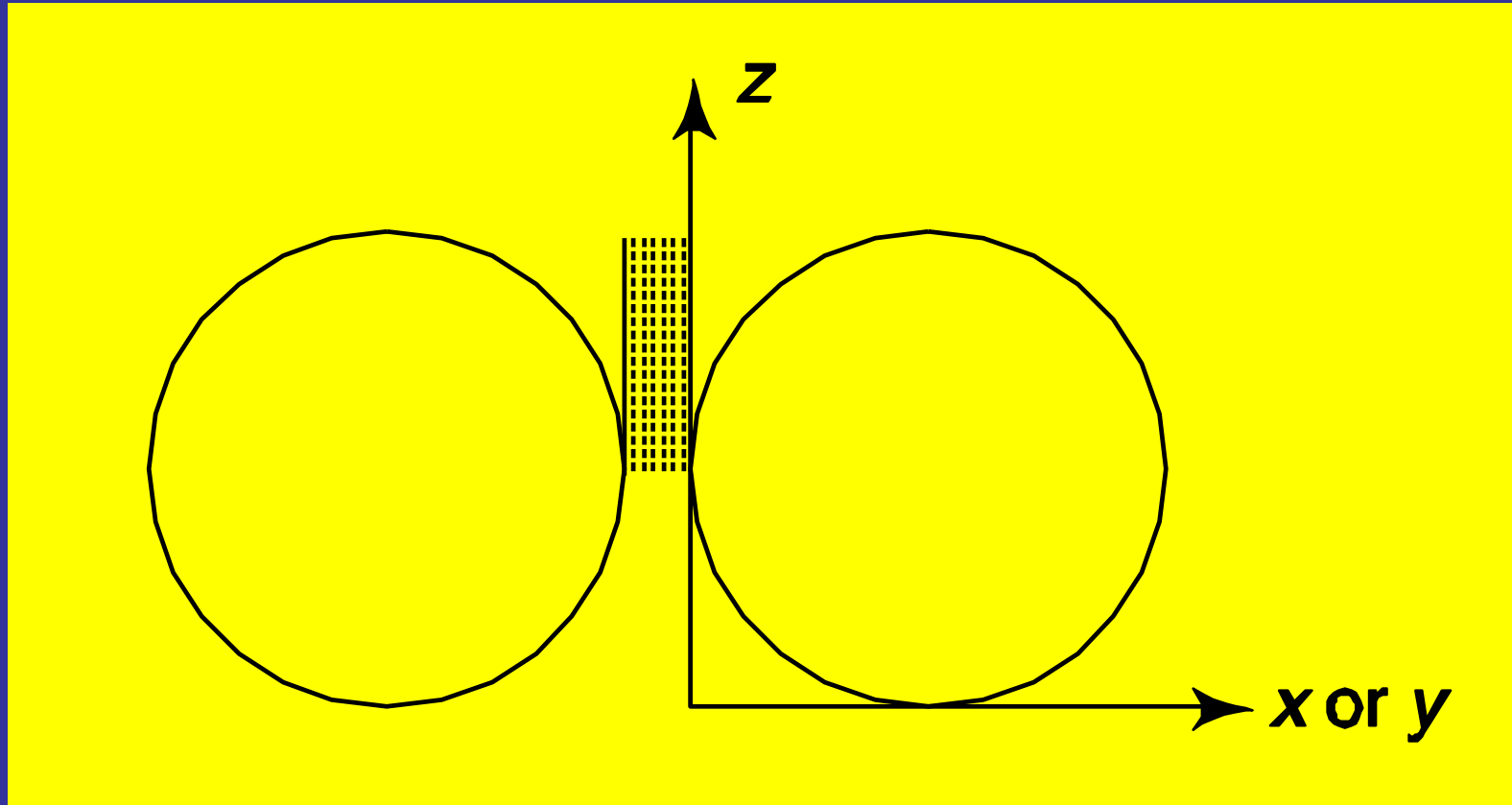
RADIATION PATTERN

- Important feature— signal amplitude at an instant is identical along the pattern
- Circular pattern means that radiated energy, and thus signal strength, is equally distributed in all directions in the plane
- Directed pattern— The signal strength is enforced along a specific direction in the plane

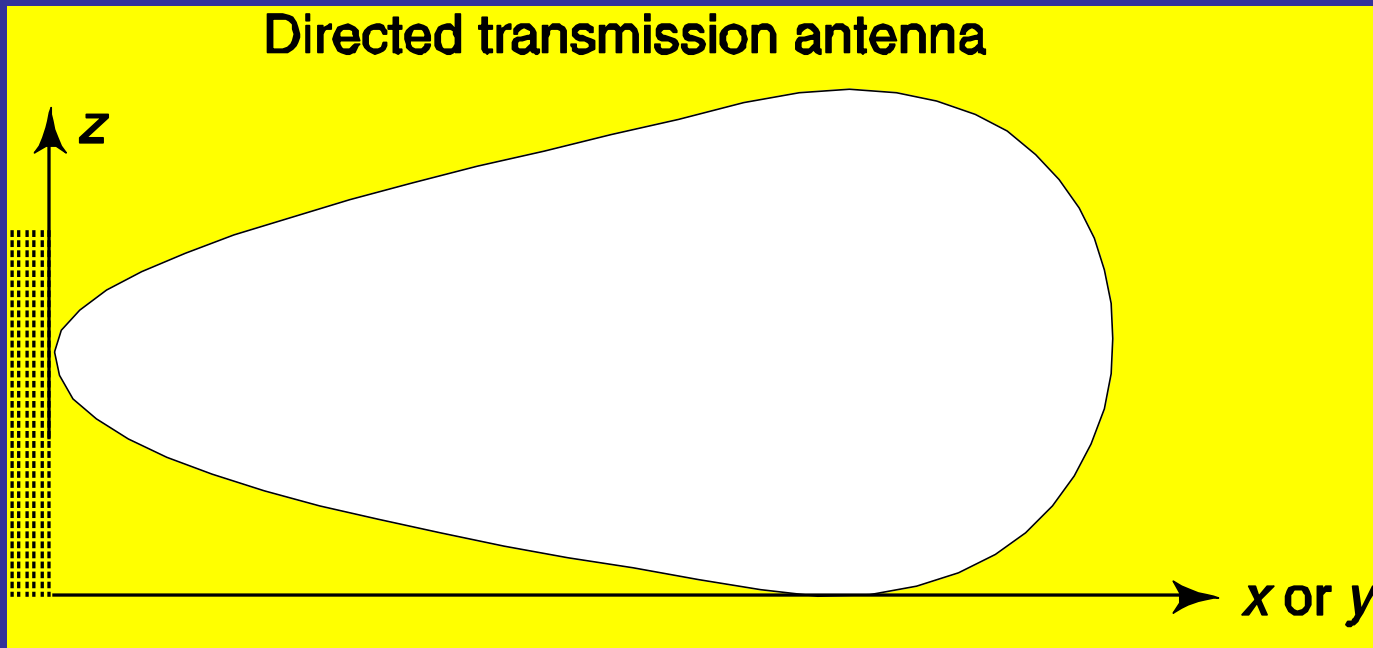
$\lambda/2$ RADIATION PATTERN IN Z-Y AND X-Z PLANES- IDENTICAL SIGNAL AMPLITUDE ALONG CIRCLES



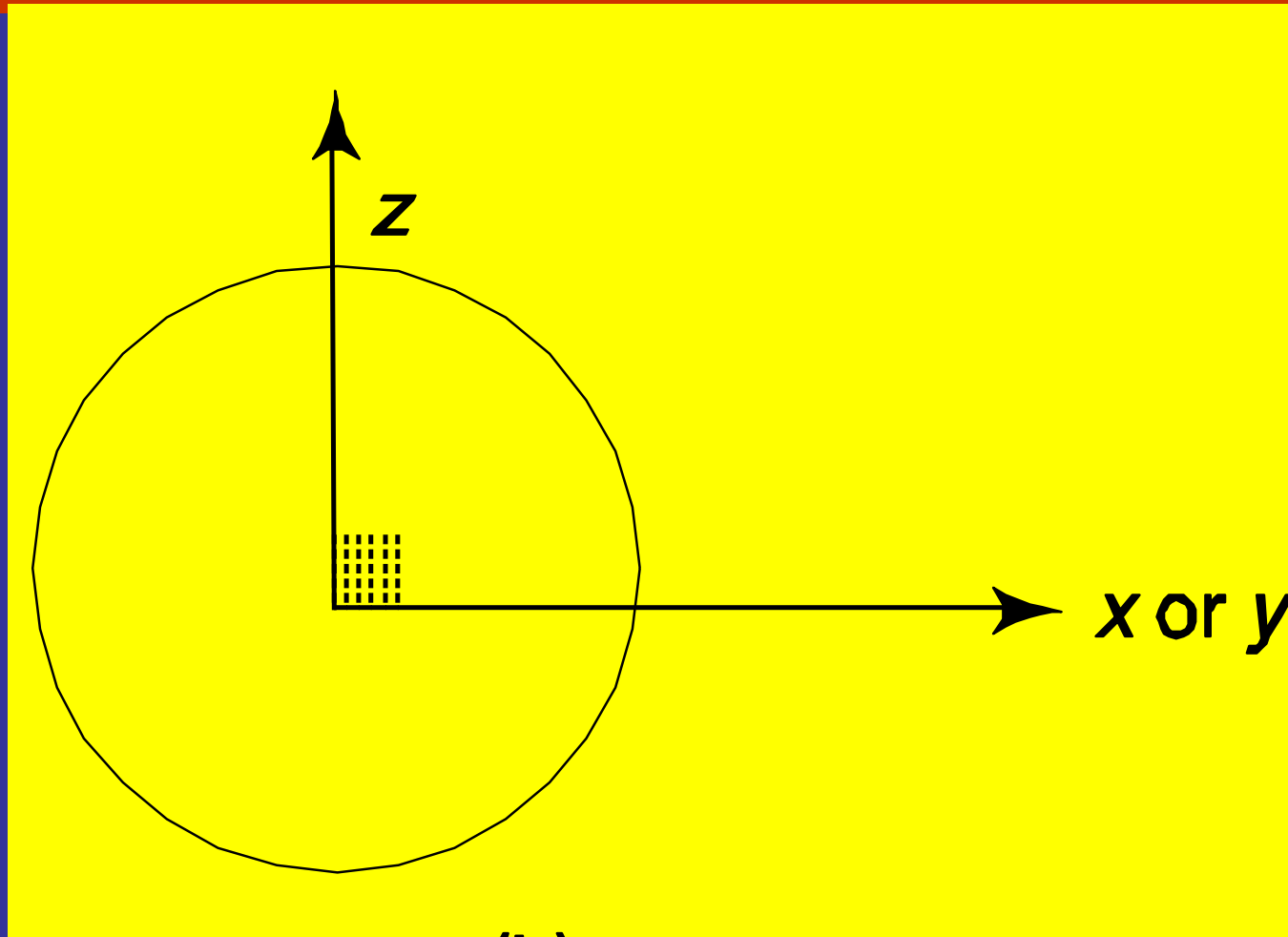
$\lambda/4$ RADIATION PATTERN IN Y-Z AND X-Z PLANES RADIATION PATTERN



DIRECTED TRANSMISSION ANTENNA RADIATION PATTERN IN Z-Y AND Z-Z PLANES RADIATION PATTERN



SAME ANTENNA RADIATION PATTERN IN X-Y PLANES RADIATION PATTERN



SUMMARY

- Mobile communication— location of the device can vary either locally or globally
- Communication takes place through a wireless, distributed, or diversified network
- Two ways of signals transmission — Guided or unguided

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... SUMMARY

- Guided through wires and optical-fibres
- Unguided through wireless
- VHF and UHF Frequency bands
- Microwave and Infrared bands
- Antenna
- Undirected and directed antennae

End of Lesson 01
**Guided Transmission and Unguided
Wireless Transmission**