

# **CAPABILITIES AND LIMITATIONS OF TELECOMMS TOOLS AVAILABLE FOR DISASTER RESPONSE**

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# Overview

## ***New Technology***

***Smartphones and Cellular Networks***

***Satellite***

***Social Media***

## ***Traditional Technology (after lunch)***

***VHF Radio***

***HF Radio***

***Broadcast Media (TV and Radio)***

# Matthew Lloyd

20 year's experience in communications  
where there is no infrastructure

10 years with New Zealand Red Cross:

Designed “disaster proof” field communications  
tools donated to Red Cross societies in the  
Pacific:

*Talking Briefcase* based on the Iridium phone

*Talking Suitcase* portable VHF repeater system

*Succinct Data* field data collection and transmission  
system using the Iridium short burst data module

# Matthew Lloyd

Created the NZRC IT &  
Telecommunications Emergency  
Response Unit:

A tool of IFRC based in Geneva

Only 5 in the world

A team of trained technical problem solvers ready for instant, global, deployment (with telecoms hardware), to support IFRC disaster response

# *Smartphones and Cellular Networks*

## **Description**

The smartphone is a modern miracle combining in one small package a:

telephone,

computer,

camera,

navigation system.

Supporting the handset is a sophisticated infrastructure of cell towers and backhaul communication links.

# Smartphones and Cellular Networks

## Capabilities 1/2

A wireless telephone connected to the global telephone system

A camera

Positional Information (GPS and compass)

A computer with, an almost infinite variety of associated apps, some of which are of great value to disaster response:

- Data collection (e.g. Magpi)

- Social media

- Maps and simple GIS

# Smartphones and Cellular Networks

## Capabilities 2/2

Users can supply their own communications tools (cell phones) for disaster response.

Users do not require special training except in the use of unfamiliar apps

Cell phones *can* operate independent of cellular infrastructure, using Wi Fi and Bluetooth, *if* alternative hardware and software (e.g. Serval Mesh and Mesh Extender) are available

# Smartphones and Cellular Networks

## Limitations

Cell phones cannot function if they do not have a communication medium:

Infrastructure (cell towers) can physically fail because of the disaster

The system can be overloaded because too many subscribers urgently wish to contact family members or share pictures

The power supply to maintain the system fails. Batteries will run out and it may be impossible to transport generators or fuel to where they are needed



# Satellite

## **Description:**

Satellites are radio stations circling around the centre of the earth. Their speed is set so that the pull of gravity is exactly opposed by centripetal force, so that they don't fall to earth or fly off into space

Satellites are used where:

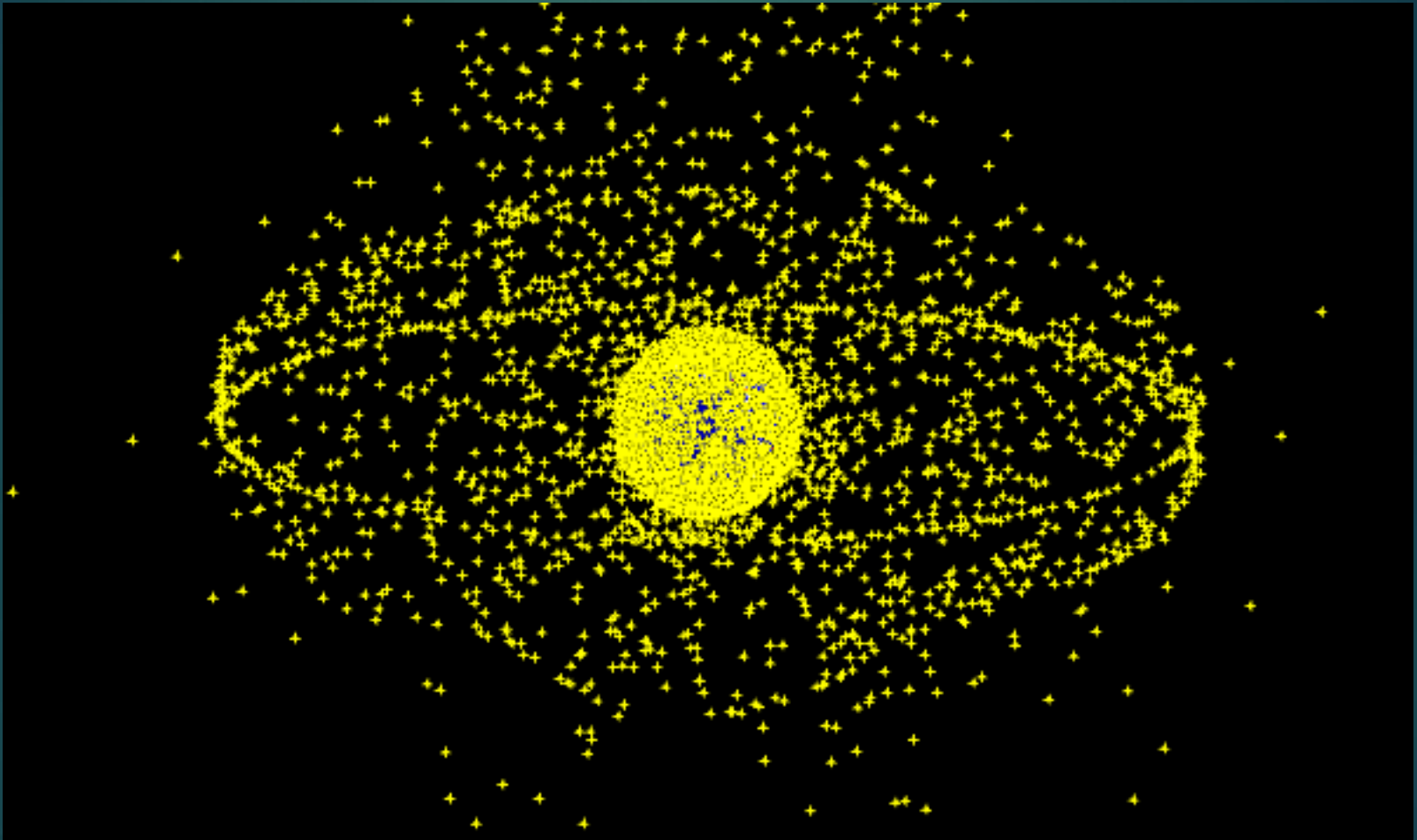
- global communication is required

- high bandwidth data communication is required

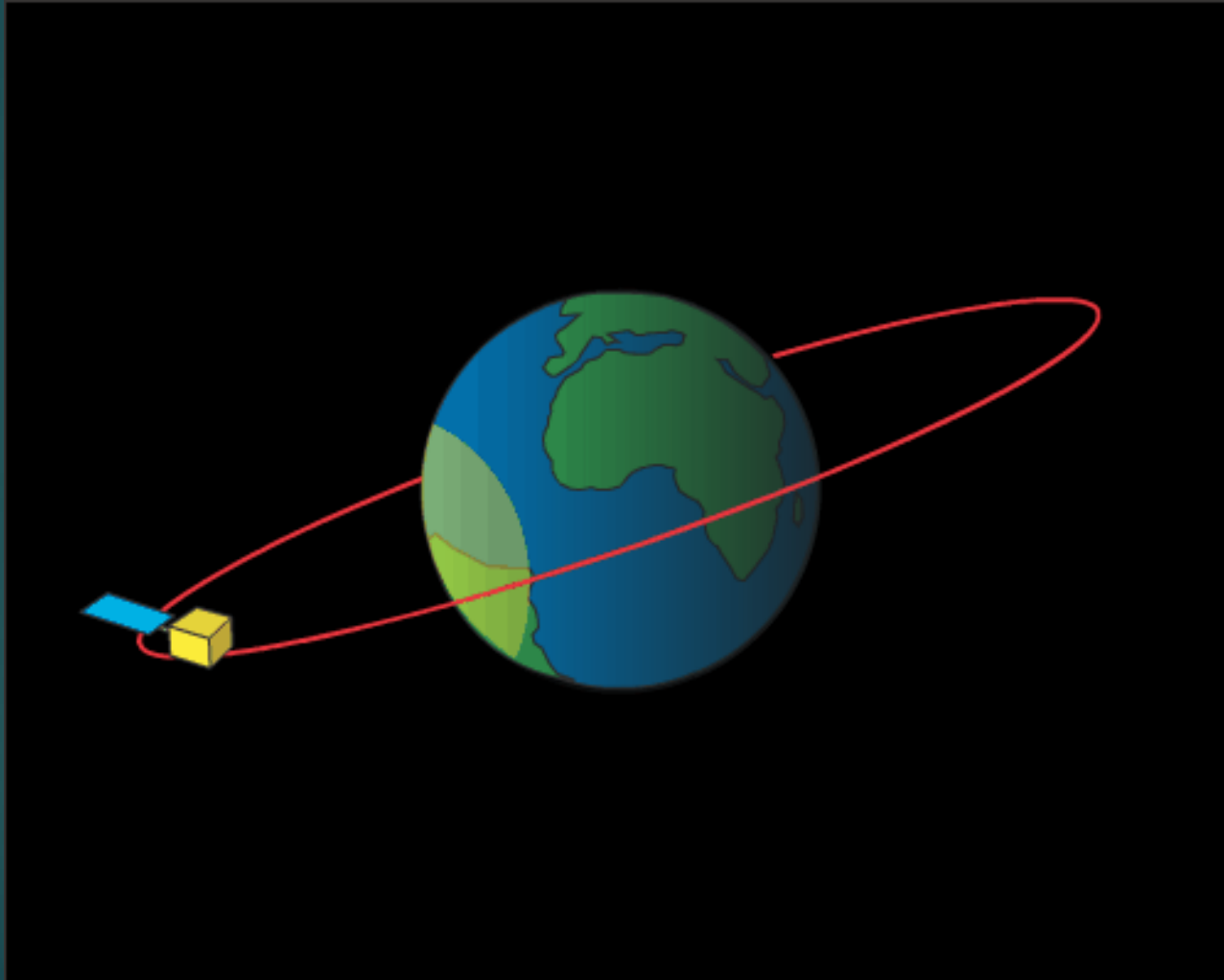
- where local conditions (e.g. hills, trees, or distance) prevent the use of radio.

# **SIMPLE SATELLITE THEORY**

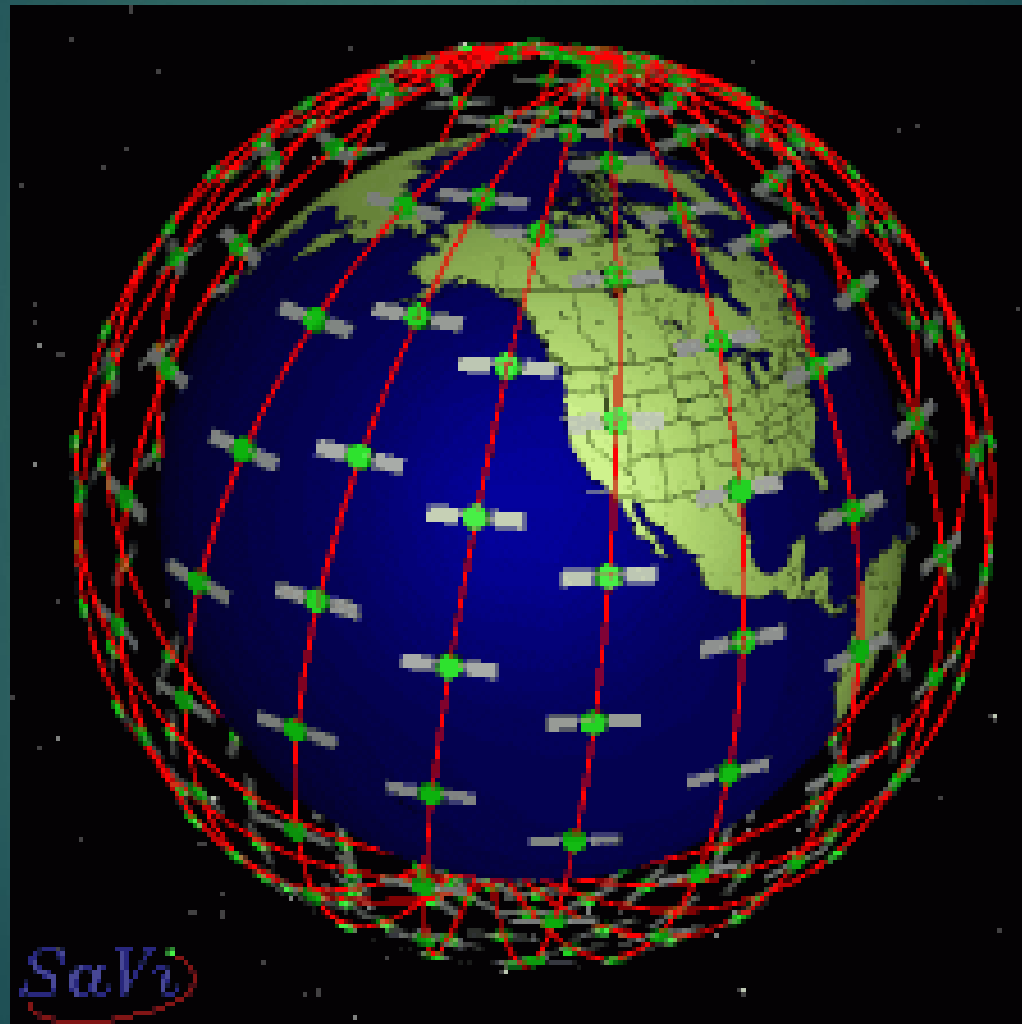
# Satellites in Earth Orbit



# Geostationary Orbit (GEO)



# Low Earth Orbit (LEO)



# Satellite

1

## Capabilities of Geostationary satellites

Three satellites can cover the surface of the globe (except the north and south poles)

Aerials on fixed installations (e.g. satellite TV) only need to be aligned once

Tend to be high bandwidth and good for computer data

# *Satellite*

## **Limitations of Geostationary satellites**

Require a dish or directional antenna to focus a weak signal

The dish/antenna will need to be realigned every time it changes location

Fixed installations will be damaged by the disaster or run out of battery power

# Satellite

## Capabilities of LEO satellites:

Are closer to the earth:

- Need less power so the handsets and batteries are smaller

- Have smaller, nondirectional, antennae

Move across the sky so, if one is obscured it will shortly be replaced by another one

Have truly global coverage, although satellites are farthest apart at the equator

Easy to carry around and use like a telephone



# *Satellite*

## **Limitations of LEO satellites:**

Can lose connection as a satellite is obscured or moves out of range

Tend to be low bandwidth, designed for voice with only a limited data capability

# *Social Media*

## **Description:**

Social media are a relatively new communication system that emerged when the World Wide Web (WWW) and cell phones became available to the general public.

They are designed to create virtual communities by making informal communication (chat) very easy, as well as the sharing of ideas, opinions and images.

# *Social Media*

## **Capabilities**

Available to the general public and widely adopted by smartphone users

Promulgates information faster than official channels

Provides data from areas where “official” data sources may not be available

Crowdsourced data validates data from other sources (corrects fake news or alternative “facts”)

# *Social Media*

## **Limitations 1/2**

Only available where telecoms infrastructure is functioning

Only available to smartphone users

Data may be unreliable and need verification

Promulgates information faster than official channels (official channels look inefficient)

# Social Media

## Limitations 2/2:

It is a community:

Creating that community must start long before the disaster

The public need to learn to trust & be part of it

Maintaining the community requires constant effort:

During business as usual:

Use information that is interesting to keep the customers visiting your site

share information and sources as a matter of habit.

In time of disaster:

Official information transmitted via Social Media must be available *as soon as possible* and continue 24/7.

Incorrect rumours and memes are very hard to eradicate (Fake news, alternative “facts”)

***ANY QUESTIONS?***

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# **CAPABILITIES AND LIMITATIONS OF TELECOMMUNICATIONS TOOLS AVAILABLE FOR DISASTER RESPONSE**

## **PART 2**

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# *VHF Radio*

## **Description**

VHF radio is used where portability is required, because the wavelengths used have an aerial of a convenient size, and the power used requires relatively small batteries. VHF radio is ideal for managing teams of personnel in the field and coordinating teams with a common task



# **SIMPLE VHF RADIO THEORY**

# Overview

Radio transmits information using the electromagnetic spectrum

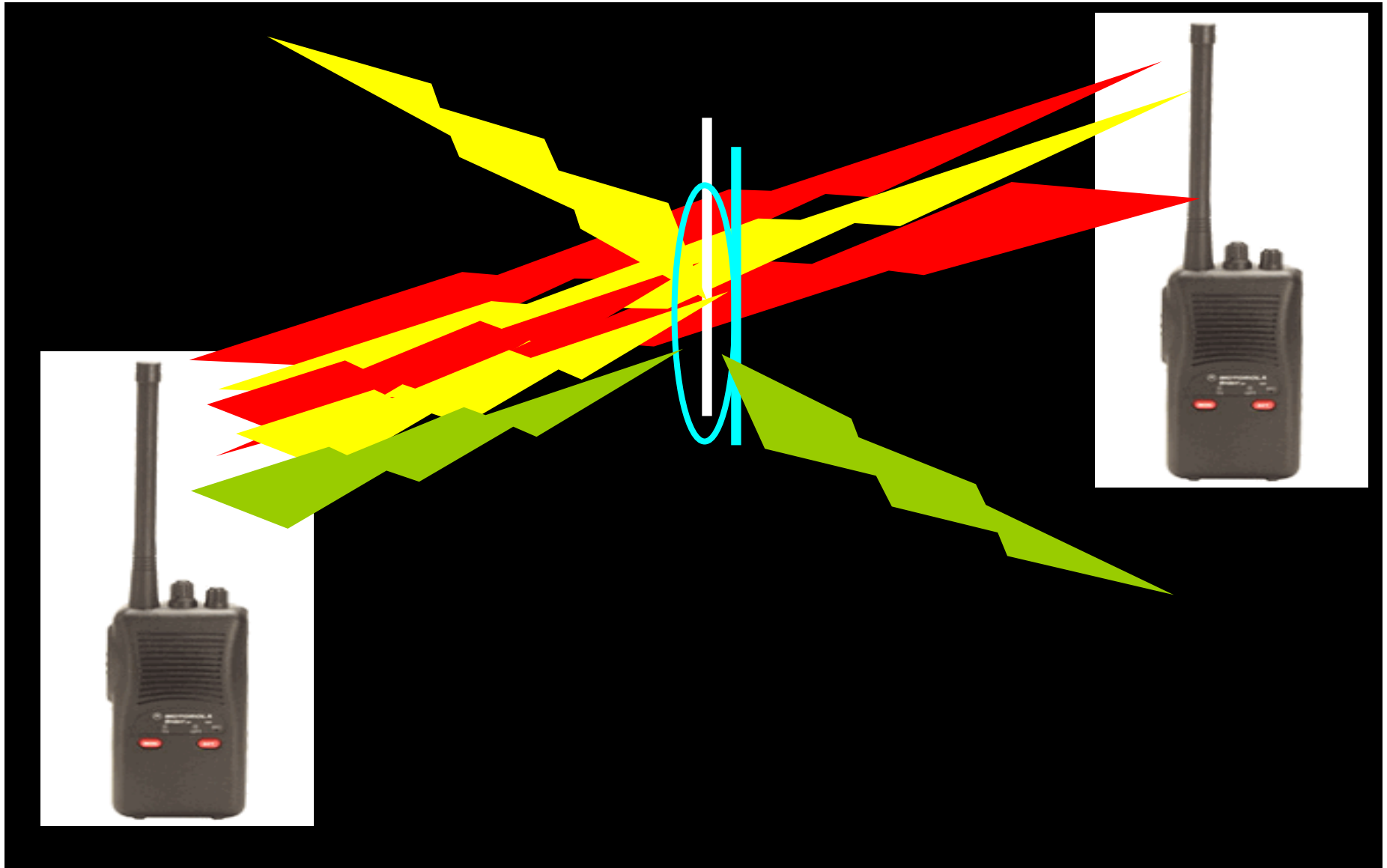
Our eyes use the electromagnetic spectrum

The difference is wavelength:

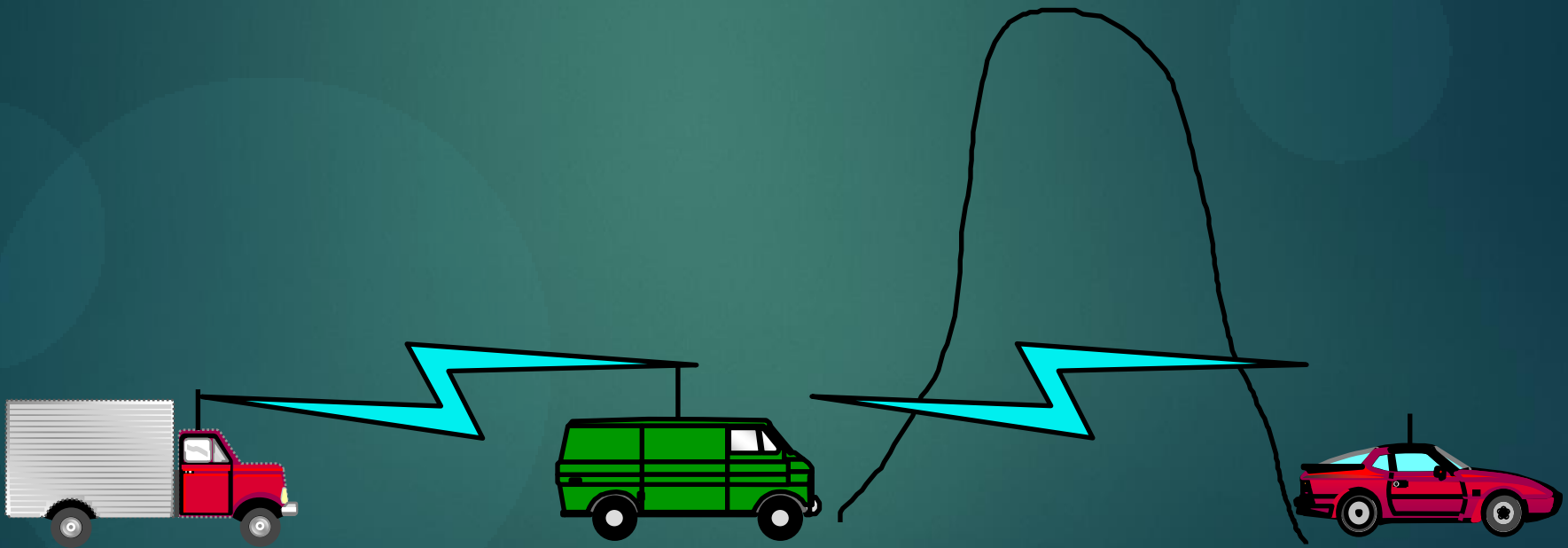
Very short for light using the rods and cones in our eyes

Longer for radio using antennas

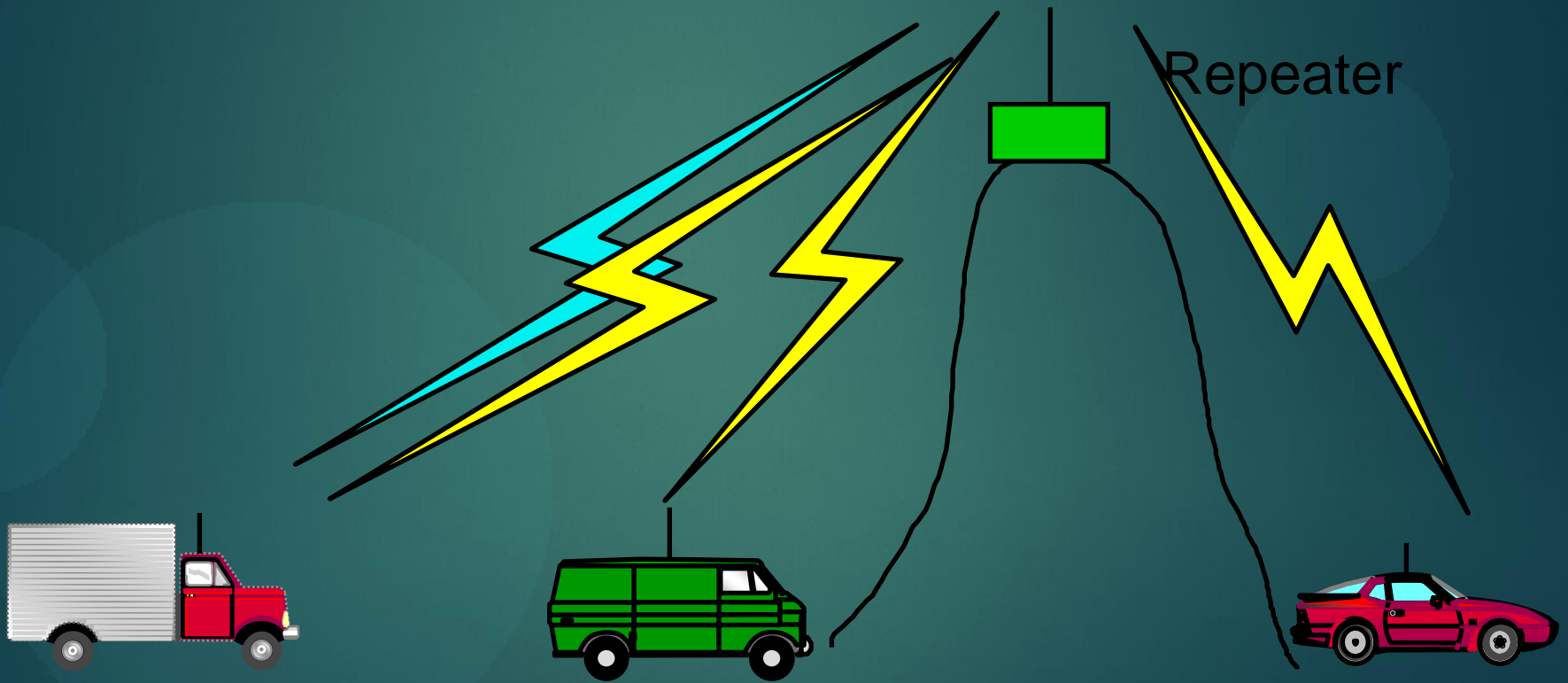
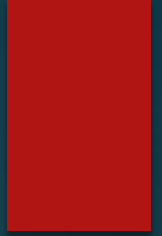
# How does radio work?



# Point to point communication in VHF



# VHF Repeater



# VHF Radio

## Capabilities

Convenient to carry around (but just too big for a pocket)

Can be simple to use (beware, can also be complicated)

Performance is easily enhanced with a repeater

Portable repeaters create a communication footprint when and where needed

Low maintenance costs (the equipment can be taken to the engineer)

# VHF Radio

## Limitations

Fixed installations (masts and nonportable repeater sites) can be damaged in the disaster

Line of sight communications (limited by the horizon)

Batteries are specific to that handset and are expensive to replace

VHF radio does not work well when surrounded by trees and jungle (attenuation)

Radio equipment is difficult to transport across international borders due to national spectrum management issues and equipment type approval

# *HF Radio*

## **Description:**

HF radio is used where a longer range is required (beyond the VHF radio horizon). Due to the size of the aerials, and the power required, HF radio is not easily portable but it can be carried in vehicles with some loss of performance (because the aerial needs to be shortened).

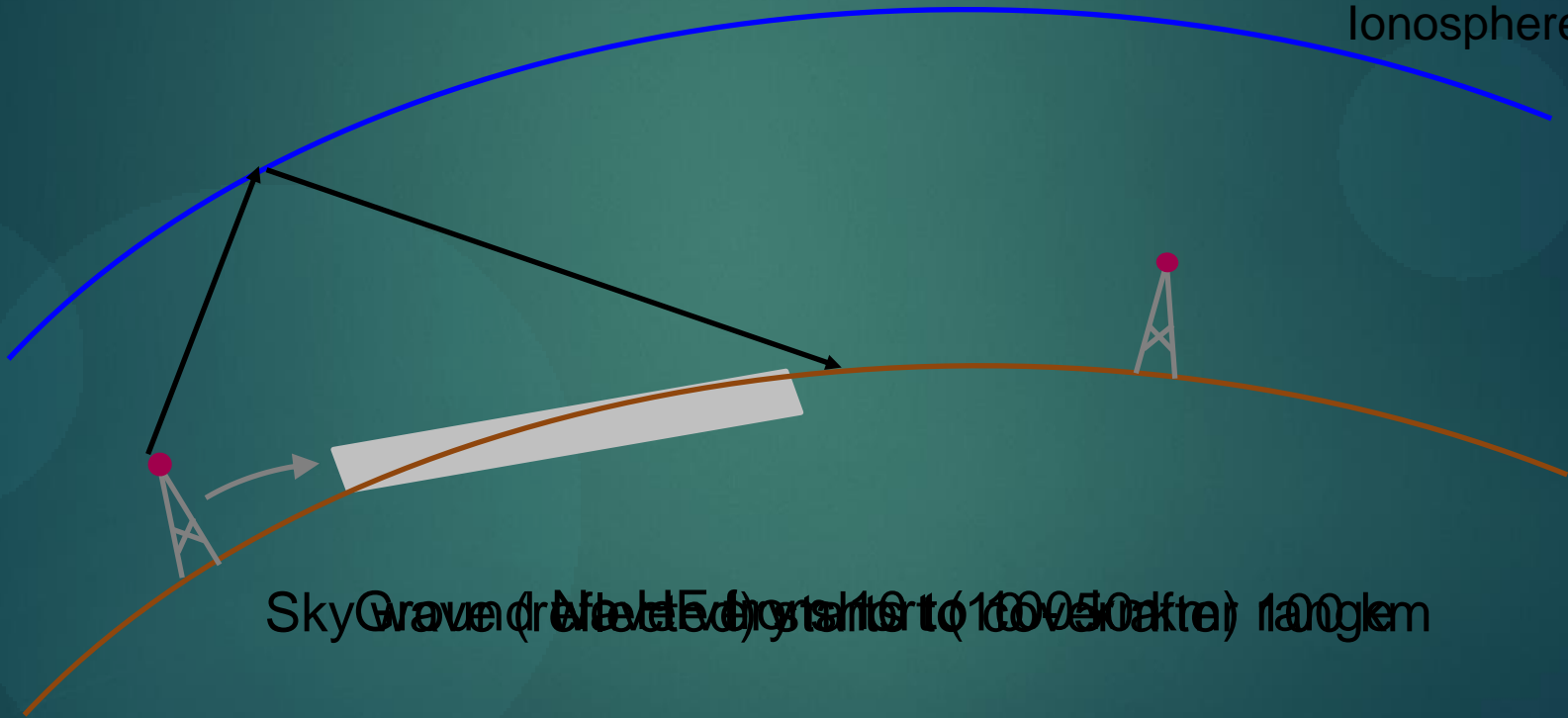


# **SIMPLE HF RADIO THEORY**

# HF Propagation

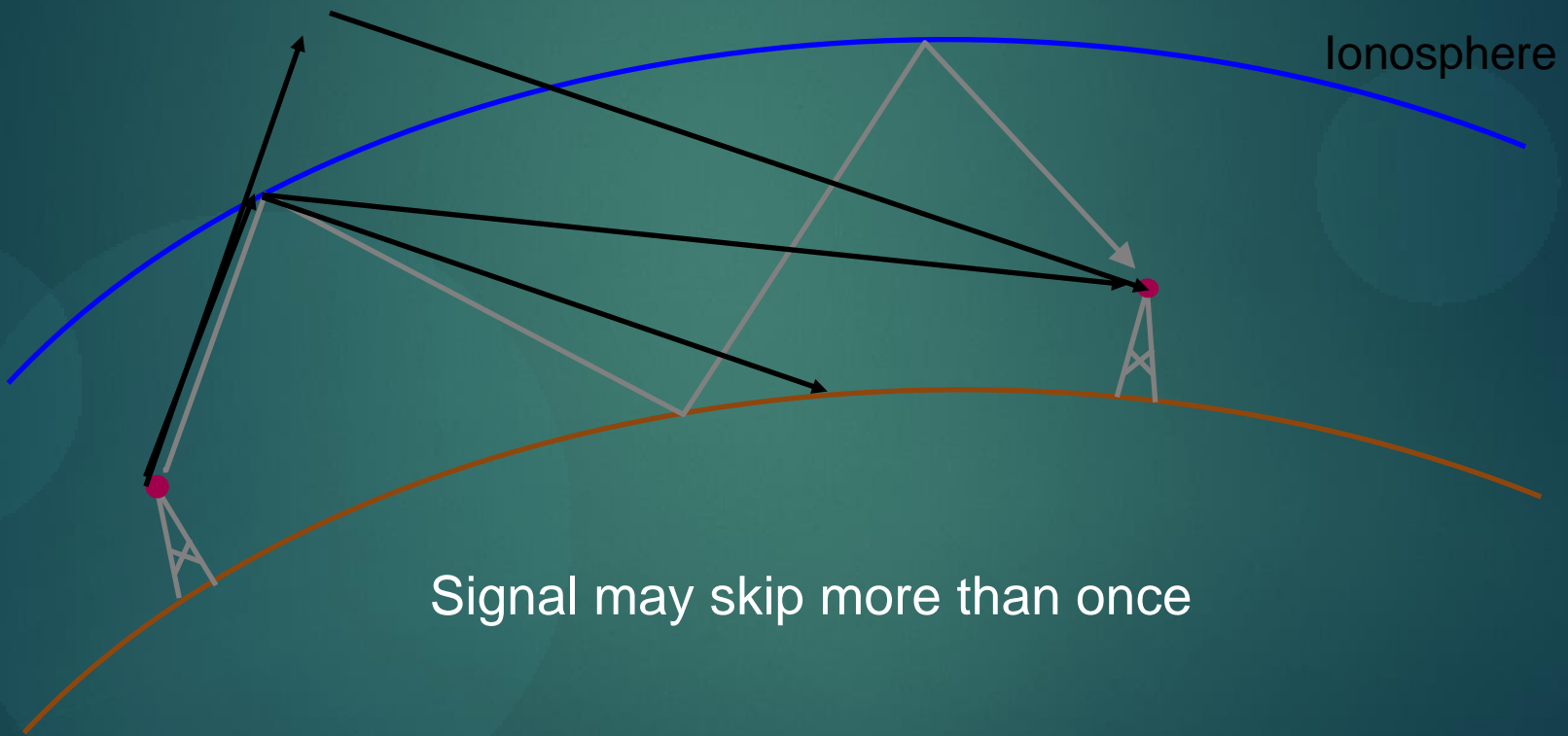
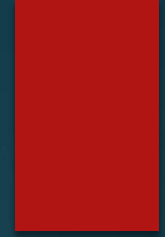


Ionosphere



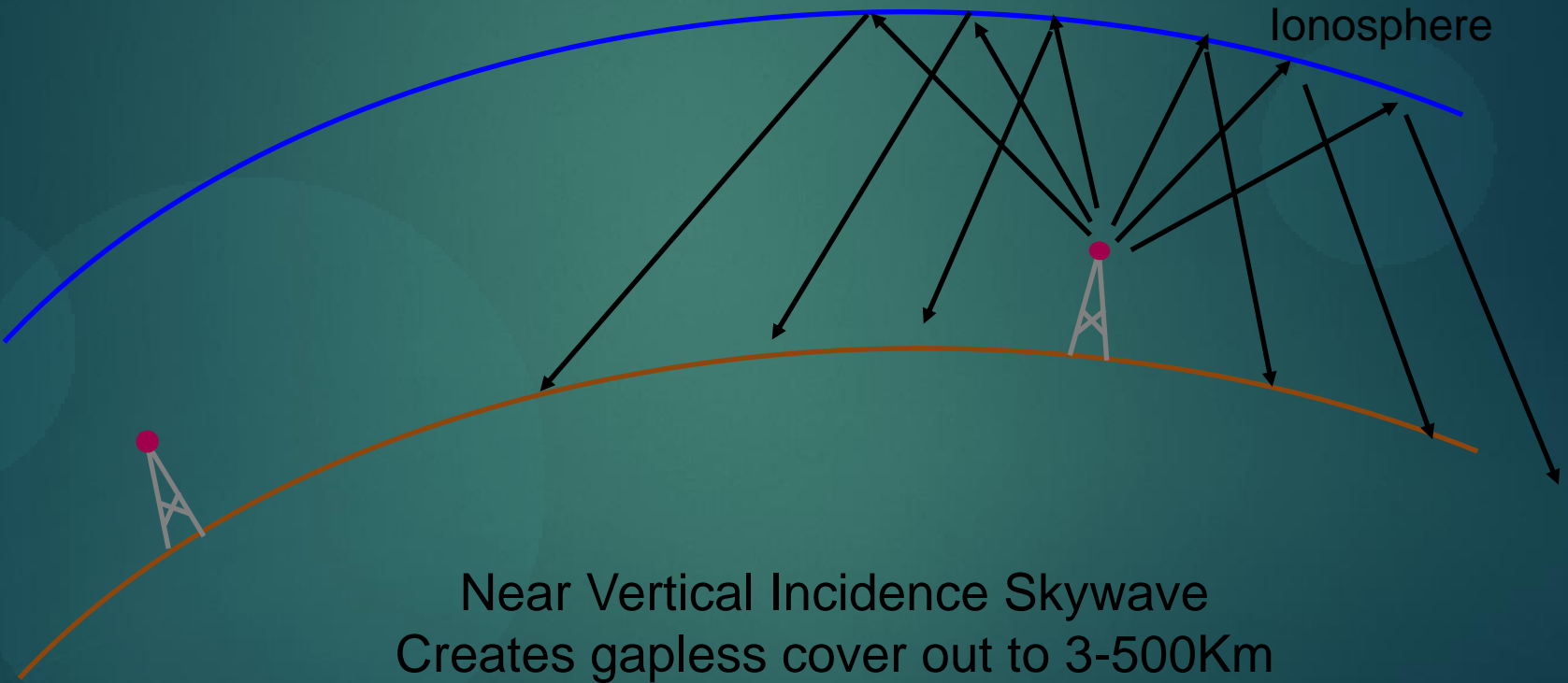
SkyWave (HF) starts to (100% after) 100km  
Ground Wave (HF) starts to (100% after) 100km

# HF Propagation



Angle of reflection and therefore range also depends on time of day  
Angle of reflection and therefore range depends on frequency used

# HF Propagation



# *HF Radio*

## Capabilities

Long range, if given enough power it can reach around the globe (think of the BBC World Service).

# *HF Radio*

## **Limitations 1/2**

Large size antennas need masts and land to put them on

Fixed installations can be damaged in the disaster

High maintenance costs (the engineer has to travel to the equipment)

High transmit power needs large batteries and a large power supply (or many solar panels)

# HF Radio

## Limitations 2/2

Radio equipment is difficult to transport across international borders due to national spectrum management issues and equipment type approval

Prone to electrical interference and therefore needs an electrically quiet receive site

requires trained operators:

- Poor speech quality

- Variable propagation conditions, due to day and night variations and the 10 year sun spot cycle

# ***Broadcast Media (TV and Radio)***

## **Description**

The Broadcast media, television and radio, are mature and well established tools. People welcome them into their homes and workplaces for their entertainment value and they are frequently “always on” in the background.



# ***Broadcast Media (TV and Radio)***

## **Capabilities**

Widely available to the general public. Where signal is available, even people with low income will buy a radio or TV set.

High probability that the radio/TV will be turned on even if not being actively listened to (how often do you hear a radio playing in the background at a work place?)

Very rapid transmission of alerts and warnings

# ***Broadcast Media (TV and Radio)***

## **Limitations 1/2:**

One way transmission only. Cannot receive information from affected people

Limited by the availability of broadcast transmitters. It may not be cost effective to communicate with remote communities.

# ***Broadcast Media (TV and Radio)***

## **Limitations 2/2:**

Terrestrial broadcasts are limited by the radio horizon range:

VHF 10s of Km

MF 100s of Km

HF (shortwave radio) 1000s of Km

Satellite broadcasts have global reach but are unlikely to contain local information

***ANY QUESTIONS?***

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