Chapter 1

INTRODUCTION

Adapted from class notes by
Prof. Leszek T. Lilien, CS, Western Michigan University
and
Prof. Dharma P. Agrawal & Qing-An Zeng, University of Cincinnati

Most slides based on publisher's slides for 3rd and 4th edition of:
Introduction to Wireless and Mobile Systems by Agrawal & Zeng

Telecommunication

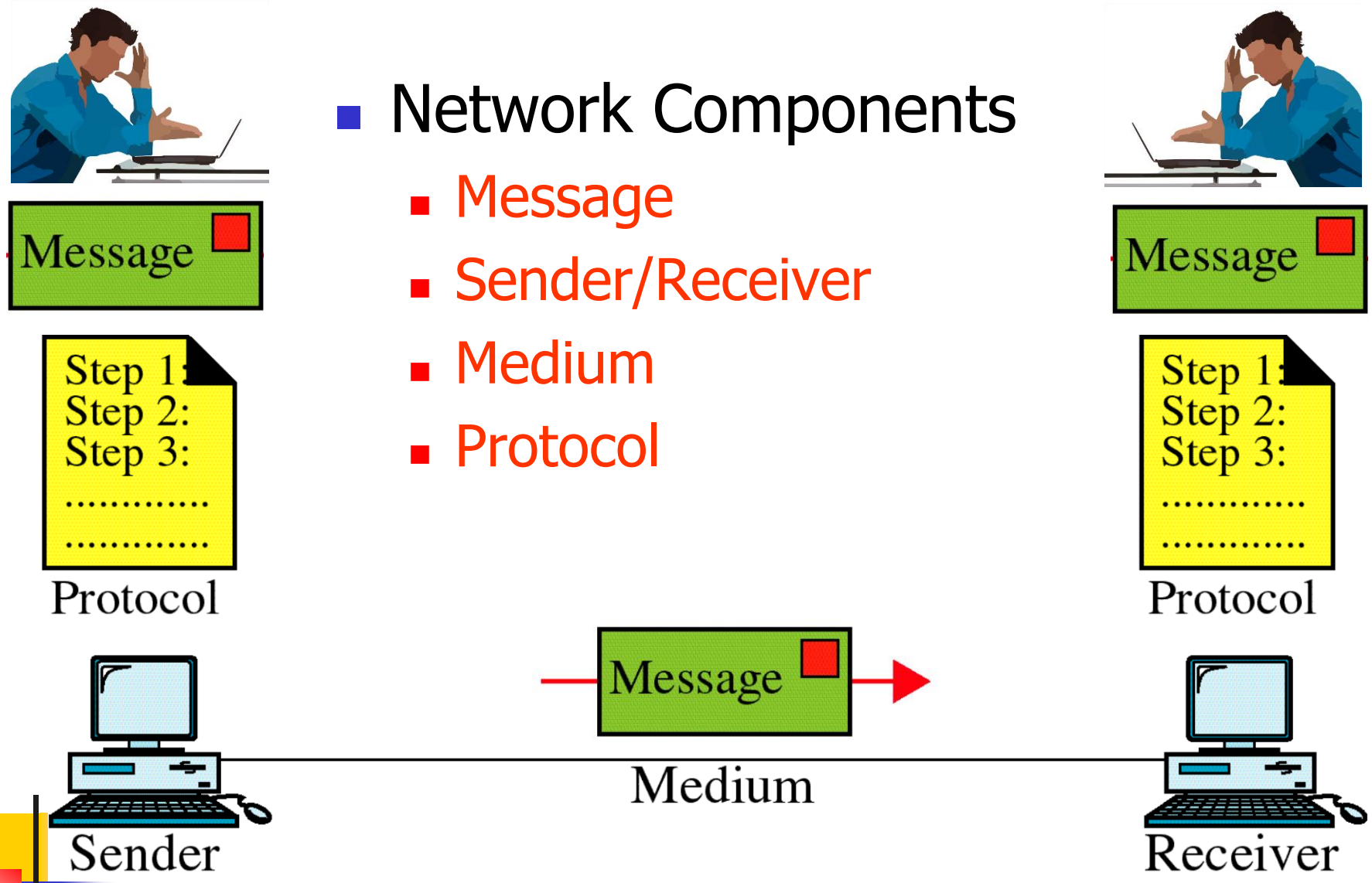
Telegraph

Facsimile

Telephone

Data Communication System Components

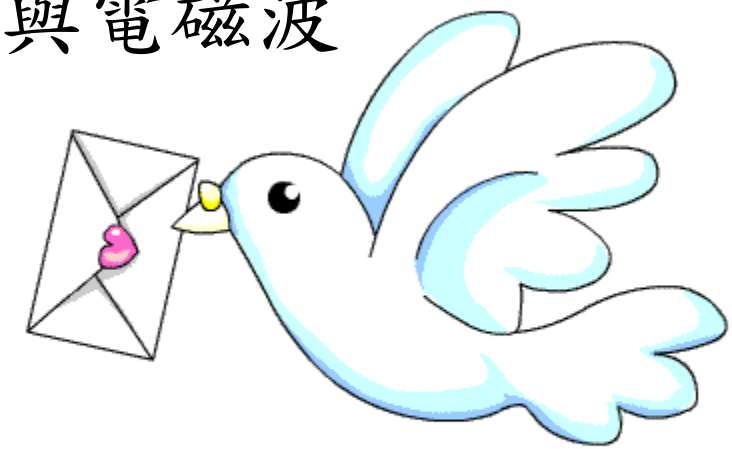
- Network Components
  - Message
  - Sender/Receiver
  - Medium
  - Protocol



 Source: *WCB/McGraw-Hill* &https://cc0.wfublog.com/ & http://photopin.com/

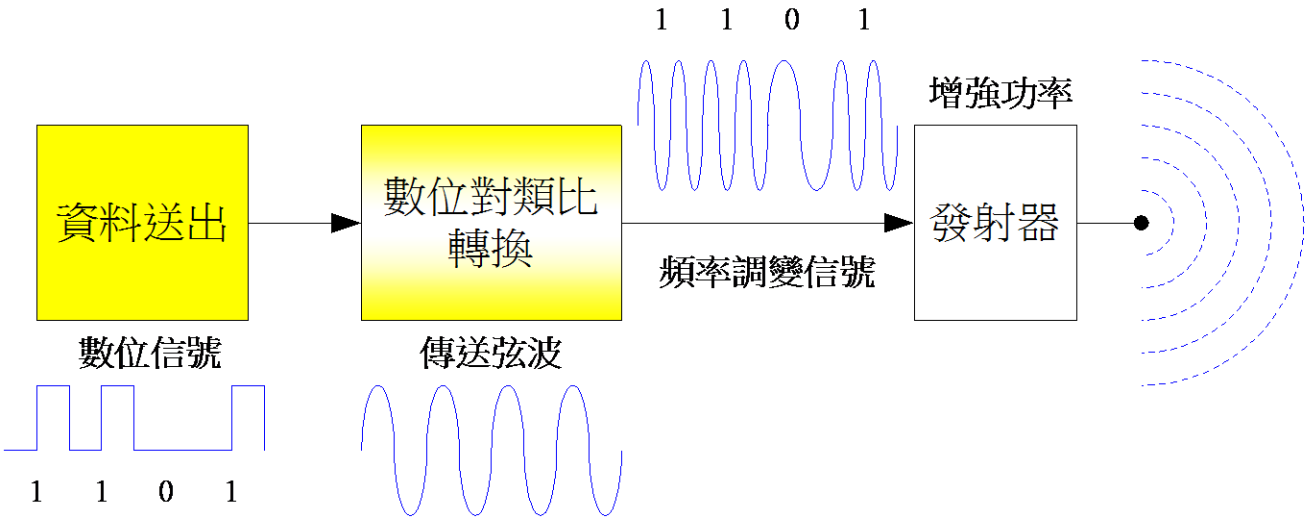
從有線到無線

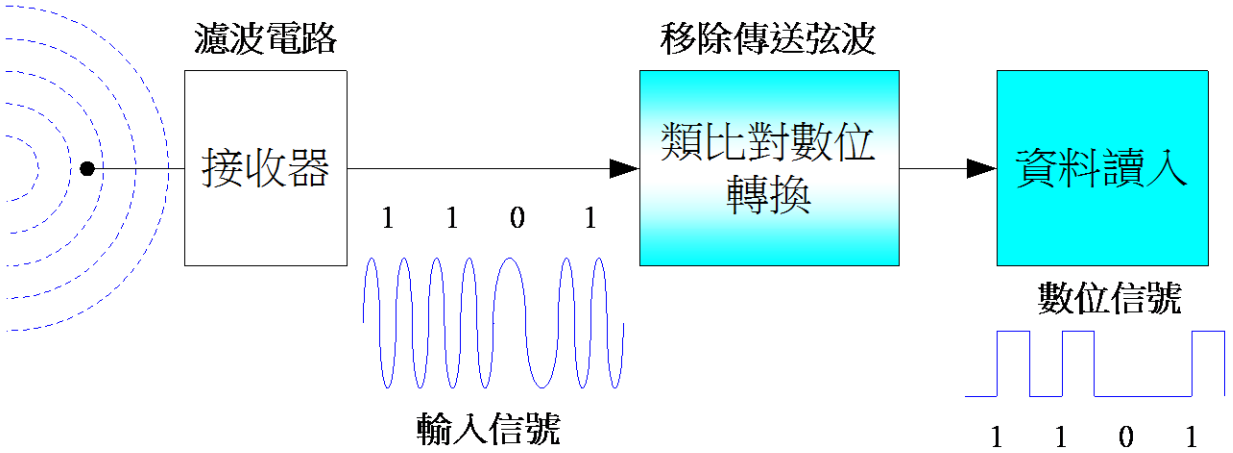
- 狼煙報訊
- 飛鴿傳書(carrier pigeons)
- 無形的力量：大氣壓力與電磁波
- 人類需求的變更



https://luonou.wordpress.com/2016/12/13/ubuntu下的信鴿

Source: 顏春煌，行動與無線通訊，金禾。



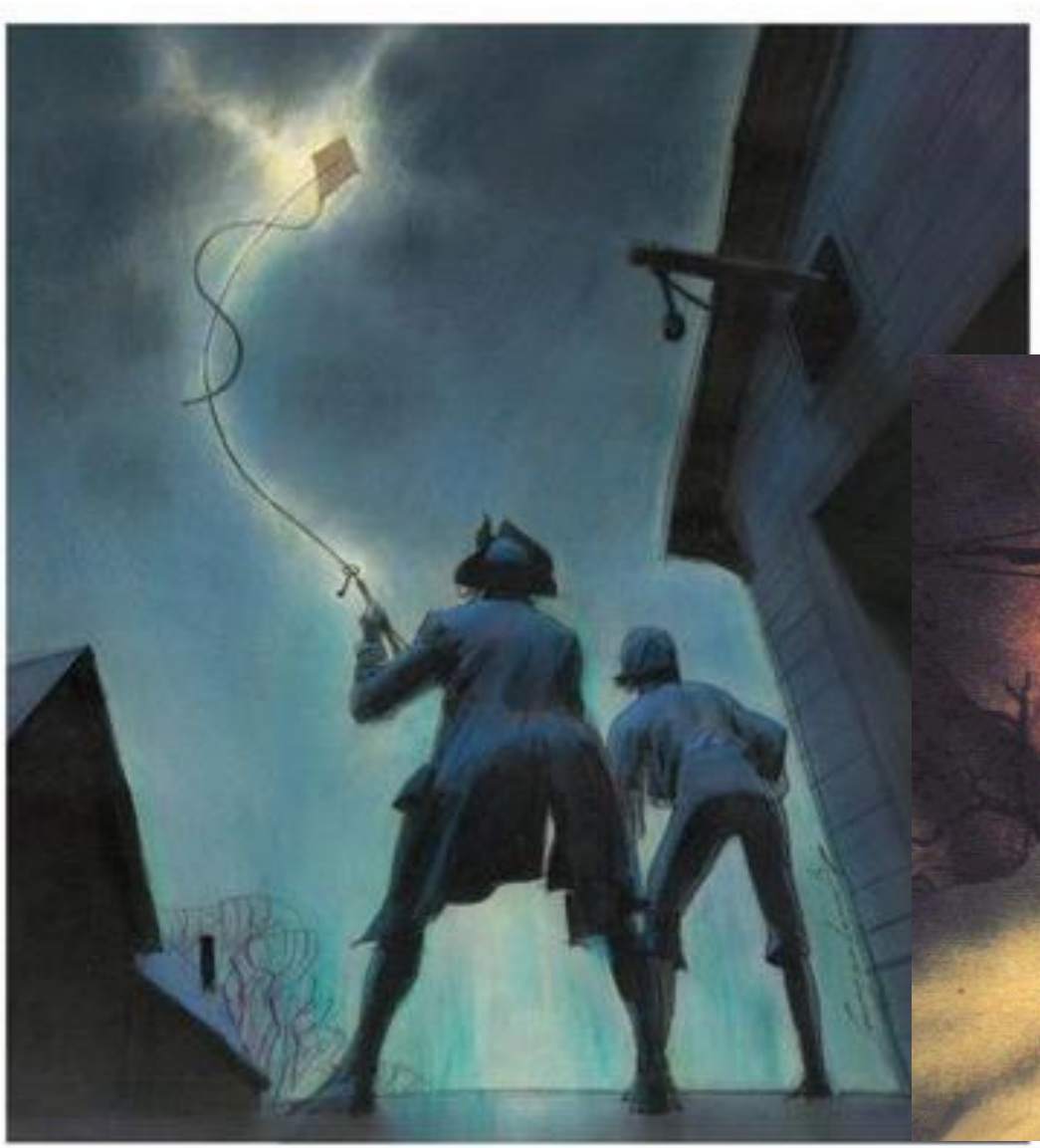


Source: D052最新計算機組織與結構, 新文京

Review

Picture source: 新知識-電和磁,錦繡,2001

Franklin and His Kite



??

http://3.bp.blogspot.com/_qMl1lpqXVEo/SmXfGyE4dOI/AAAAAAAAAbI/-axeq6oTXTU/s400/Franklin+Kite.JPG

、銀、金、鋁
中相當自由
，所以用這
製成的電線等
為導體。食鹽
也是一種導
為其中有帶正
離子和負電的
，而這些離
在溶液內自
。人體和地
導體。
生閃電時，
部有大量負
白於地球是一
雲下方的地面就
近琥珀的一端那
電荷積聚起來。
底和地面之間形
的電場，使雲底
正負電荷互相接

病患接受心電圖的檢測，可得知心臟各時刻的活動狀況。（林修杰攝）

雲底的負電和地面的正電荷有多時，它們之間的電場使空氣放電，這就是閃電。

臺灣大學總圖書館鐘樓頂的避雷針。（張騰憲攝）

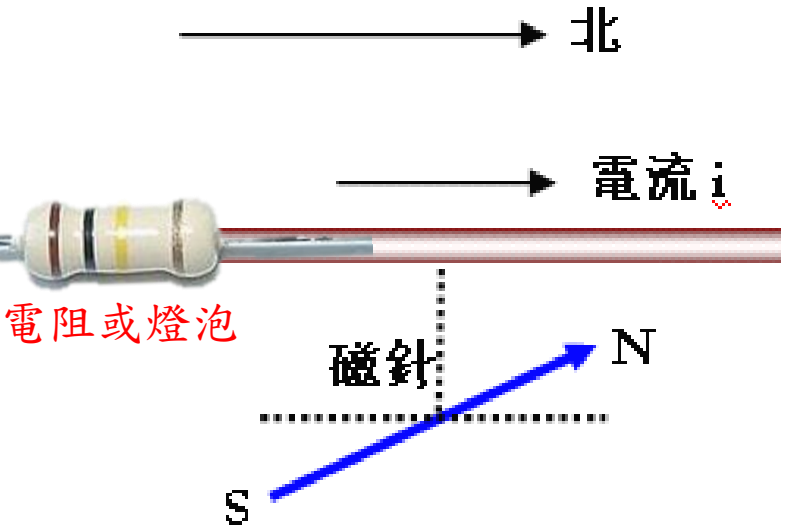
Picture source: 新知識-電和磁,錦繡,2001

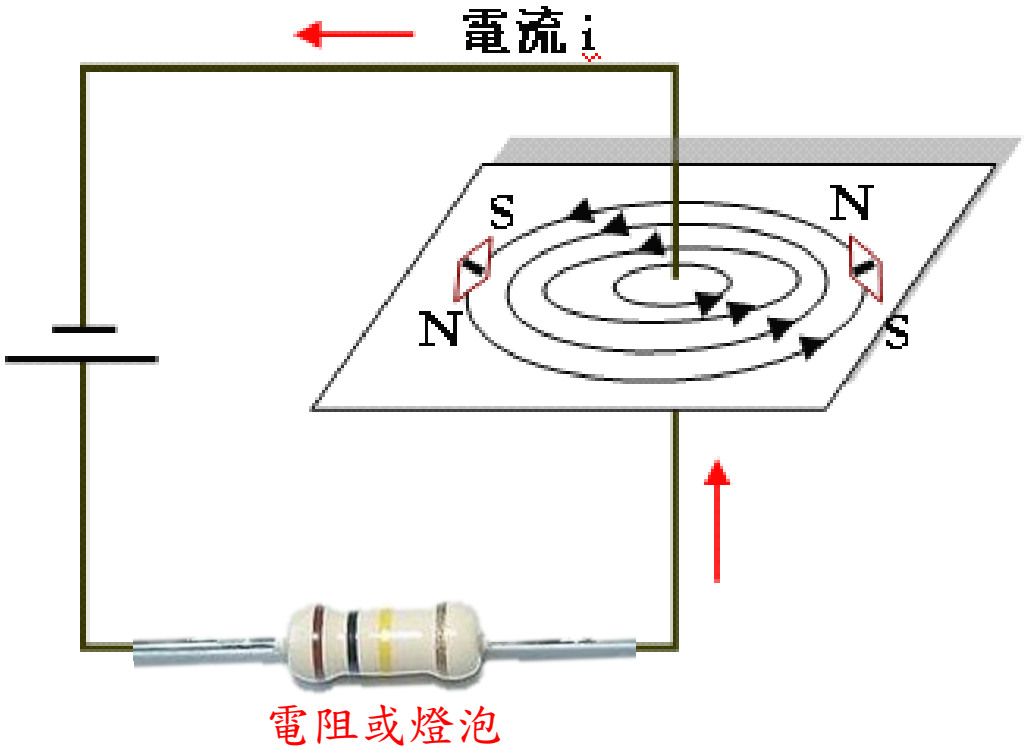
Ampere's Law

$$V = I \times R$$

$$1.5 = I \times 0.0003$$

$$I = ?$$

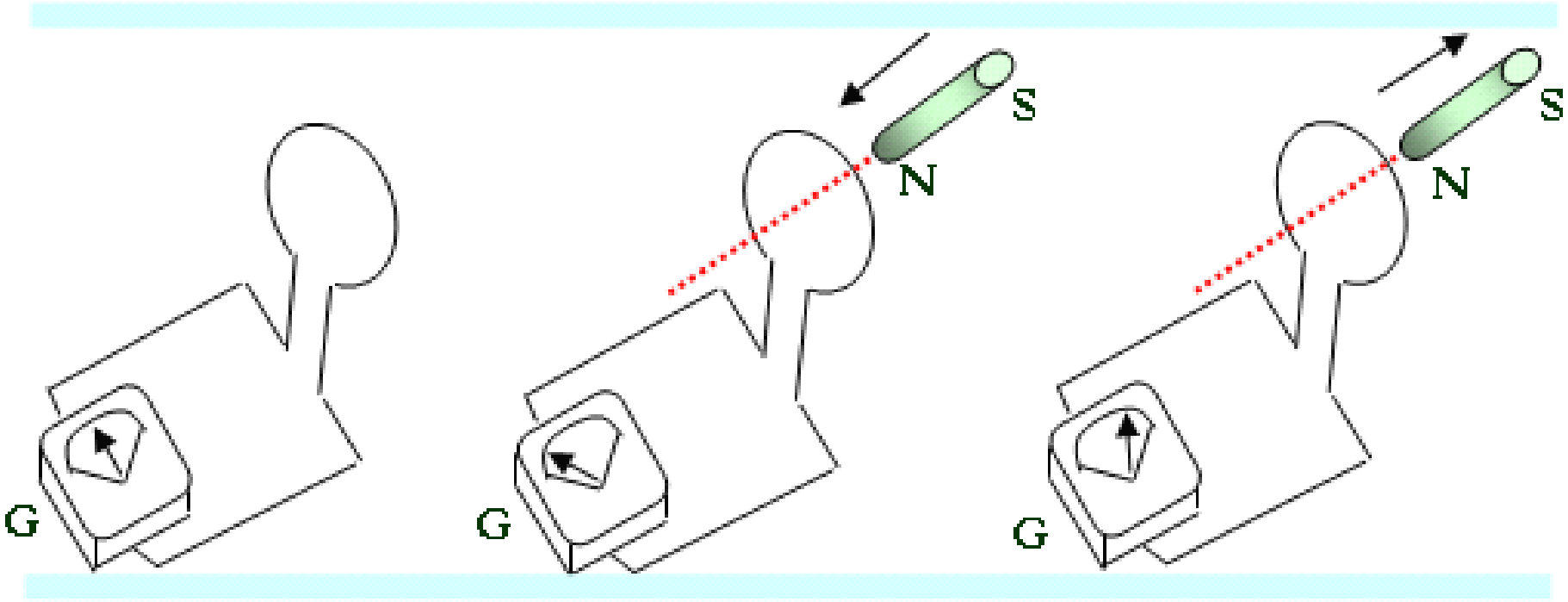




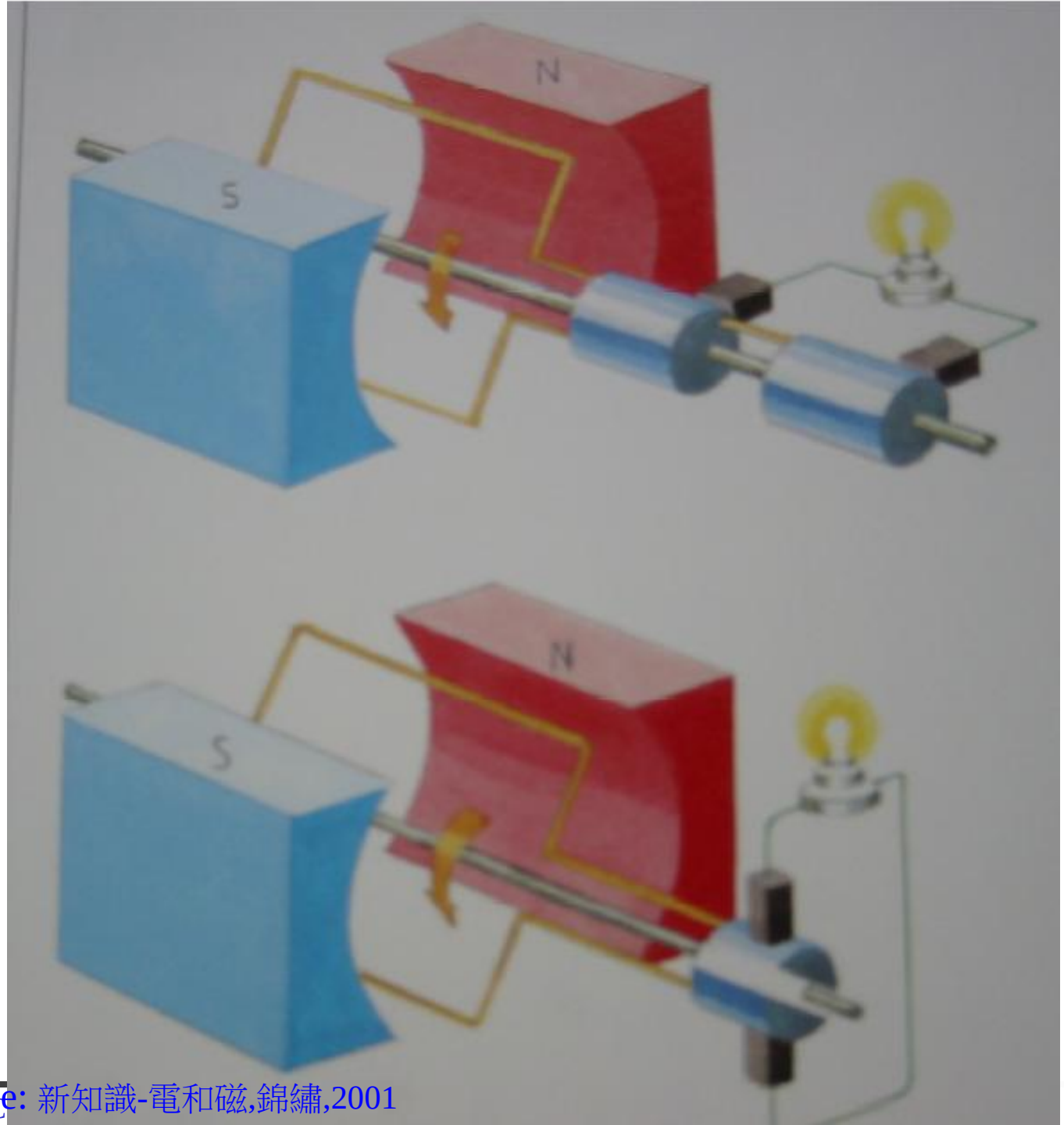
Source: 顏春煌，行動與無線通訊，金禾。

Picture source: 新知識-電和磁,錦繡,2001

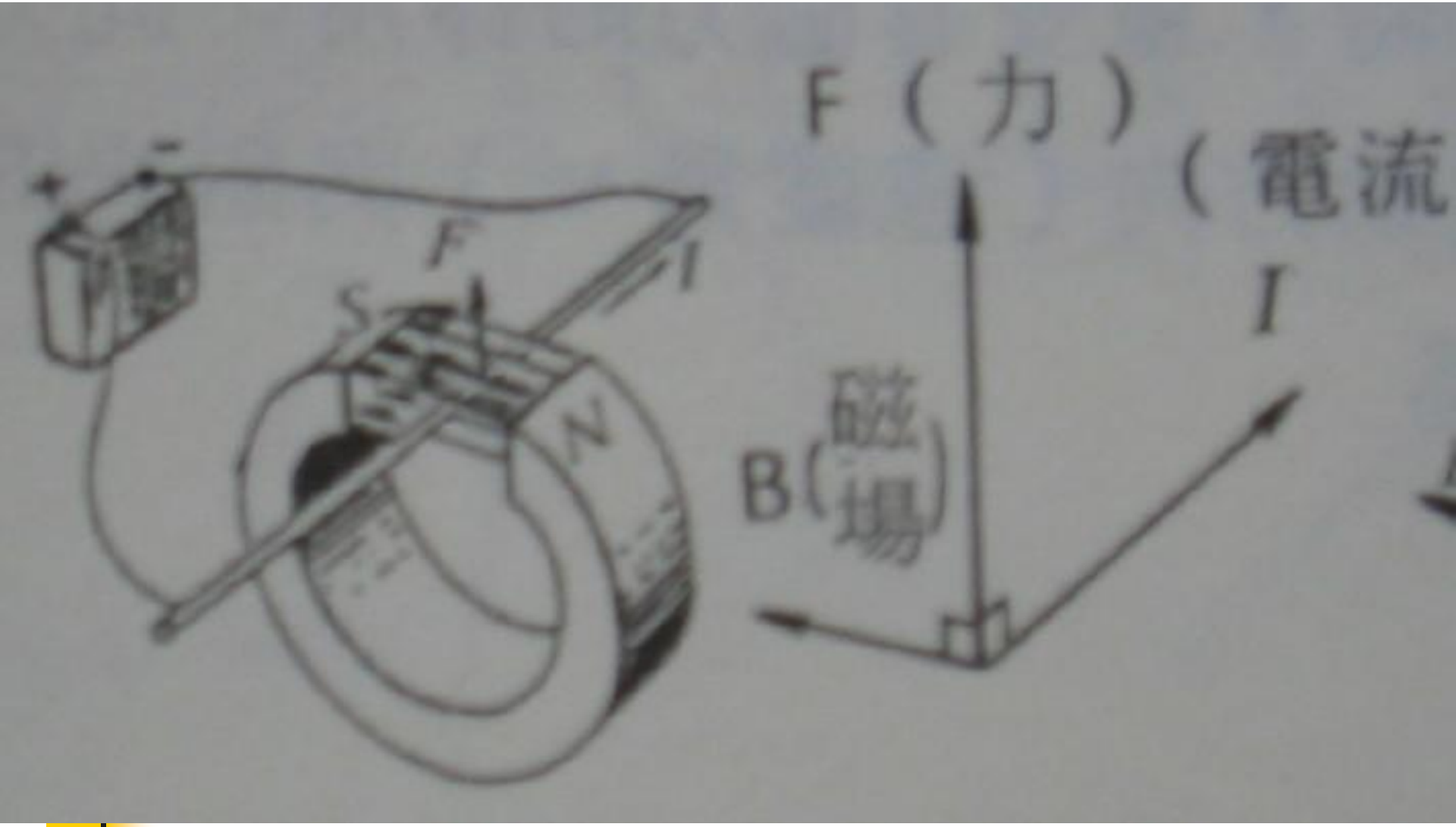
Electromagnetic Experiment



Source: 顏春煌，行動與無線通訊，金禾。



Picture source: 新知識-電和磁,錦繡,2001

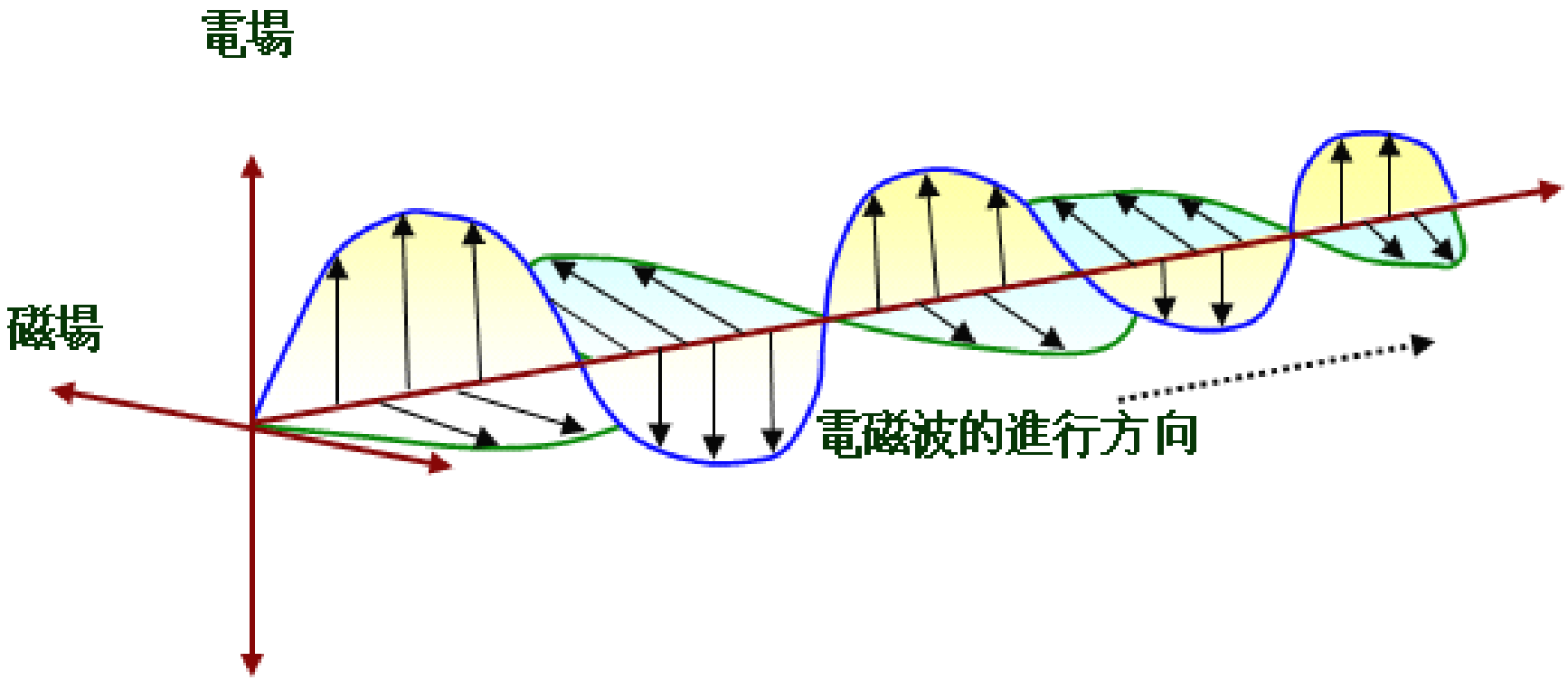


Picture source: 高中物理課本

Picture source: 新知識-電和磁,錦繡,2001

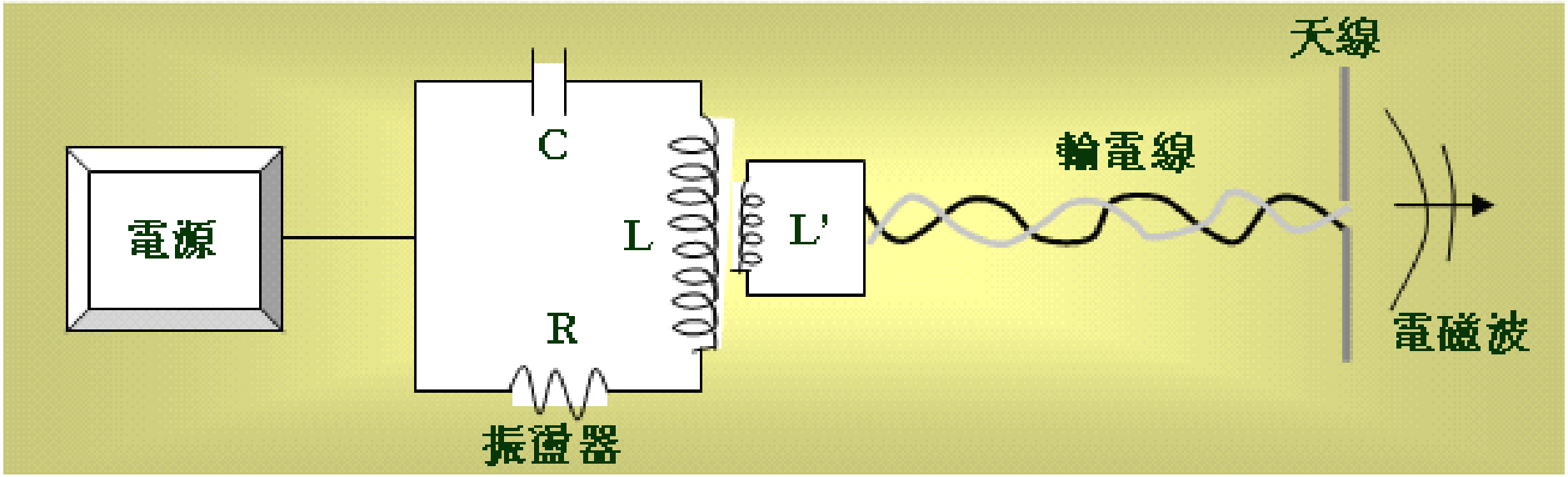
Electromagnetic Wave(電磁波)

電波? 無線電波? 電磁波?



Source: 顏春煌，行動與無線通訊，金禾。

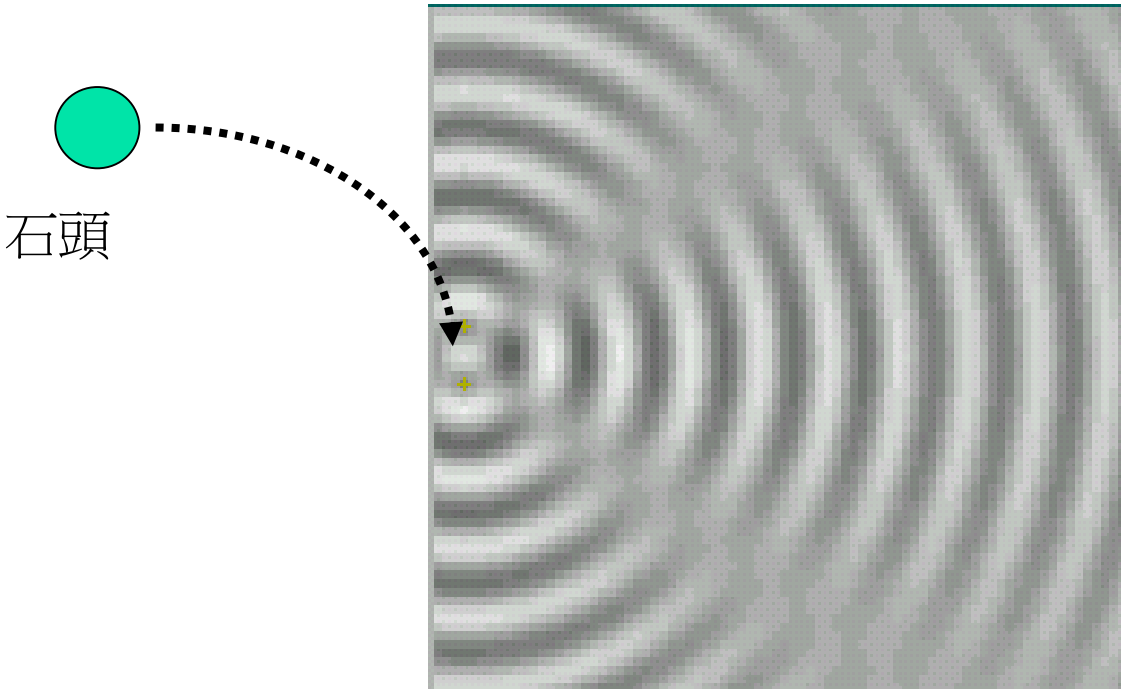
Electromagnetic Wave (cont.)



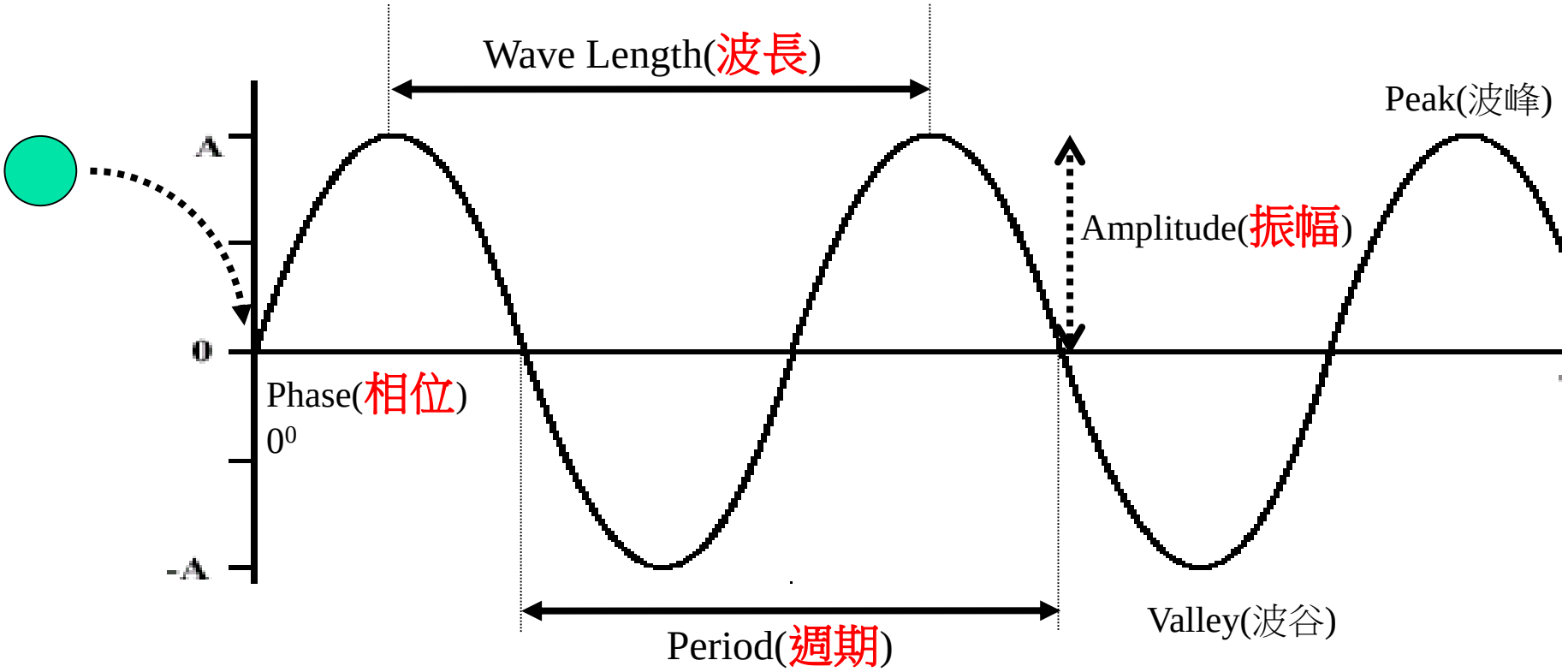
Source: 顏春煌，行動與無線通訊，金禾。

波(wave)的性質

- 水波、聲波、光波、電磁波、、、
- 水波



波的性質(cont.)

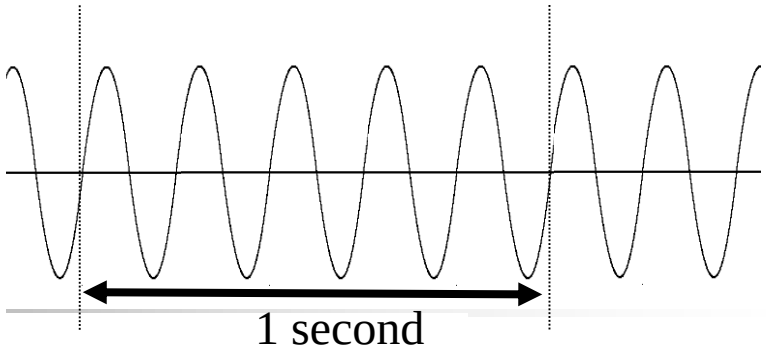


週期 = 1/5 = 0.2秒

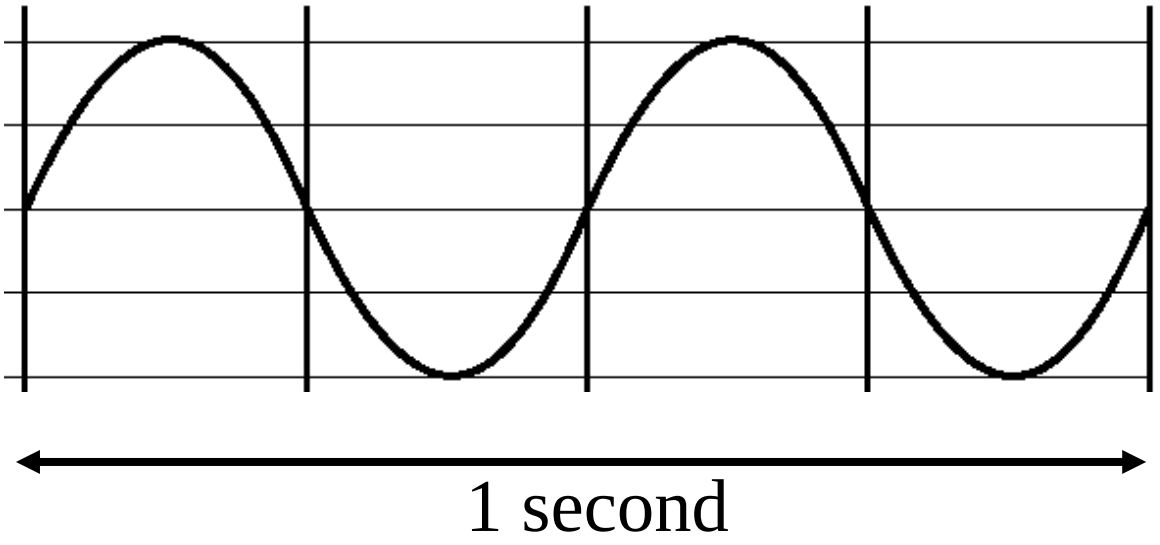
Frequency(頻率) = 5次/秒 = 5 Hz

頻率 = 1/週期

波速 = 波長/週期 = 波長* 頻率



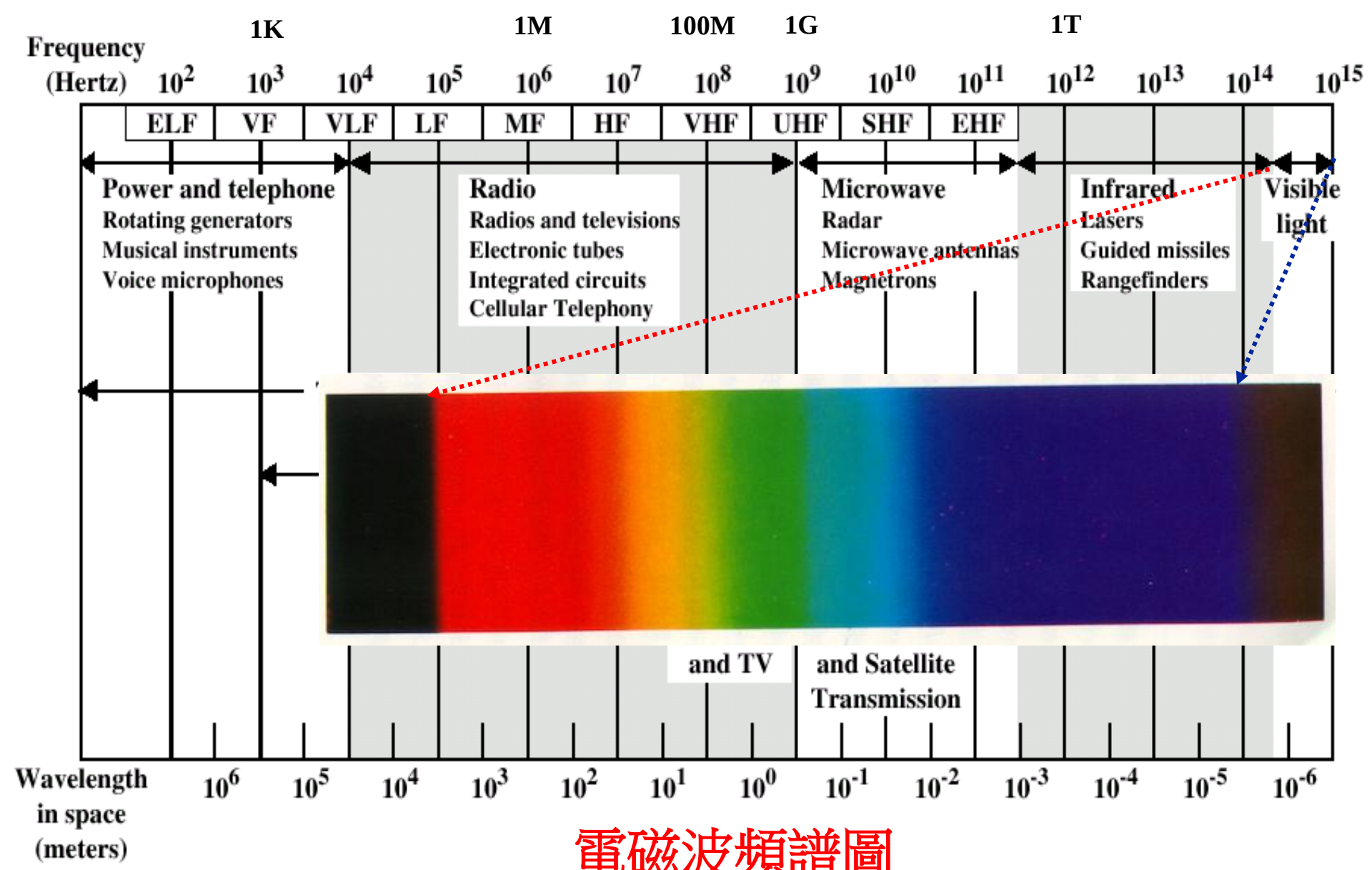
Frequency = ? Hz



波的性質(cont.)

- 頻率：每單位時間內的振動次數
  - 常用單位：赫茲(Hz) = 次/秒
  - 例子：鐘擺1Hz，市電60Hz
- 電磁波：
  電磁場的一種運動形態，這種運動以有限速度(即光速)在空間行進。具有波之一般性質。
- 頻帶(band)：一段連續之頻率範圍
- CATV:

  54MHz ~ 750 MHz – 1000MHz (102 CH.s)



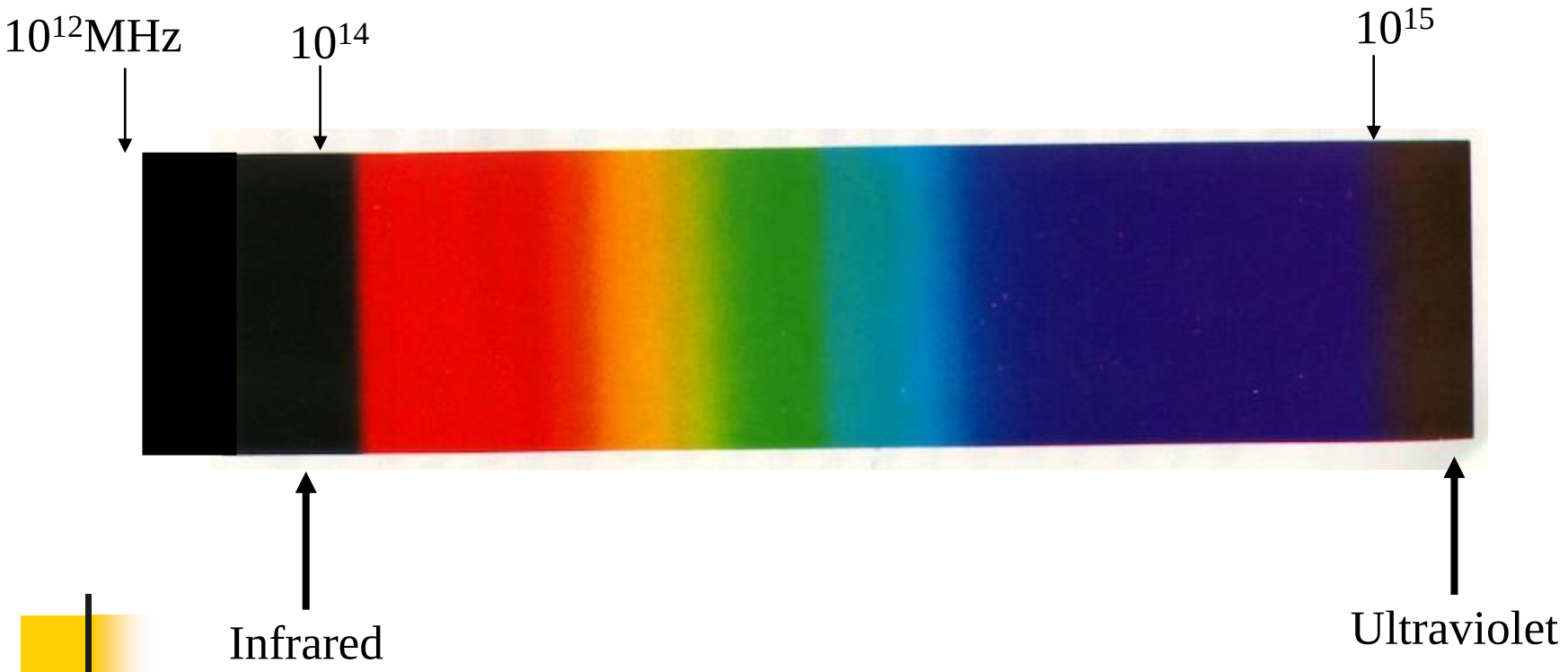
電磁波頻譜圖

ELF = Extremely low frequency
VF = Voice frequency
VLF = Very low frequency
LF = Low frequency
MF = Medium frequency
HF = High frequency
VHF = Very high frequency
UHF = Ultrahigh frequency
SHF = Superhigh frequency
EHF = Extremely high frequency

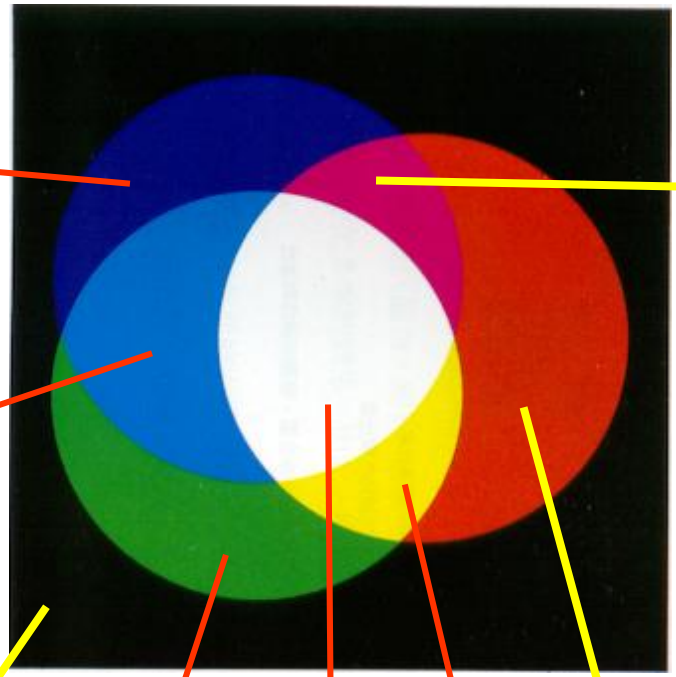
$$v = \lambda f$$

Visible light

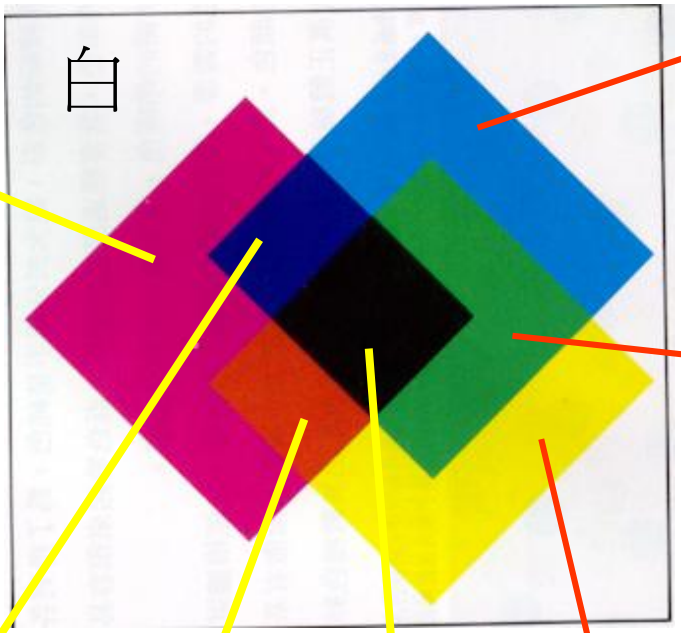
- 光譜



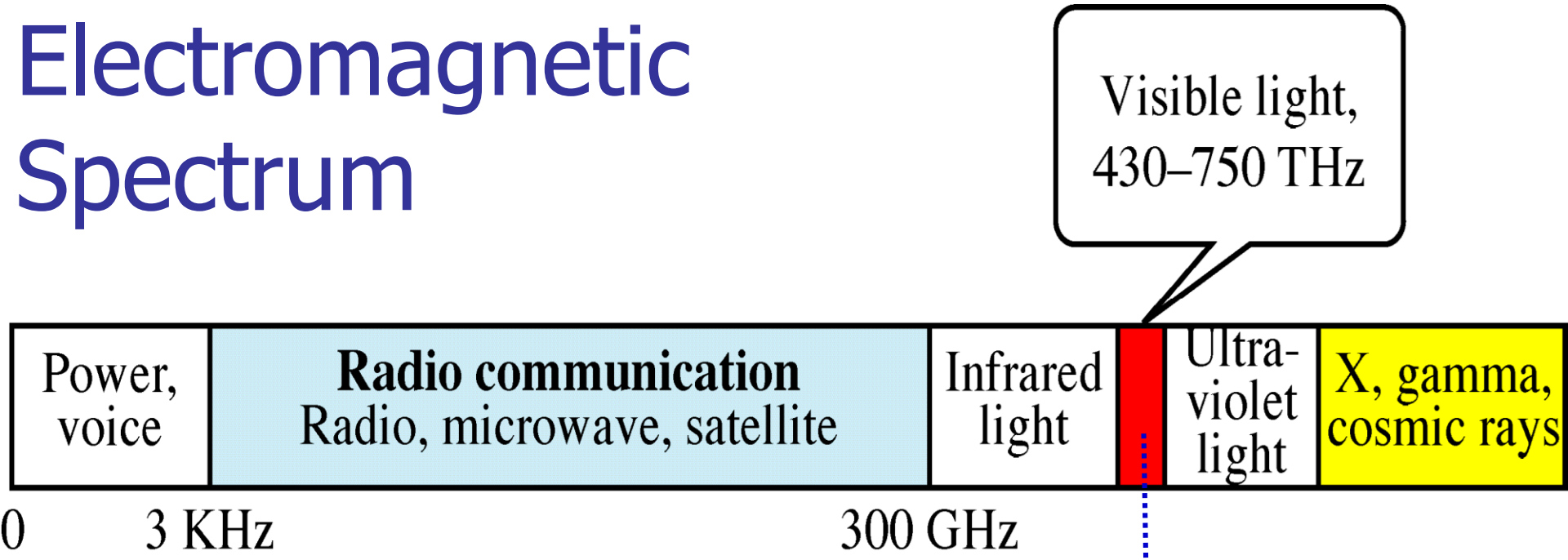
色光三原色RGB

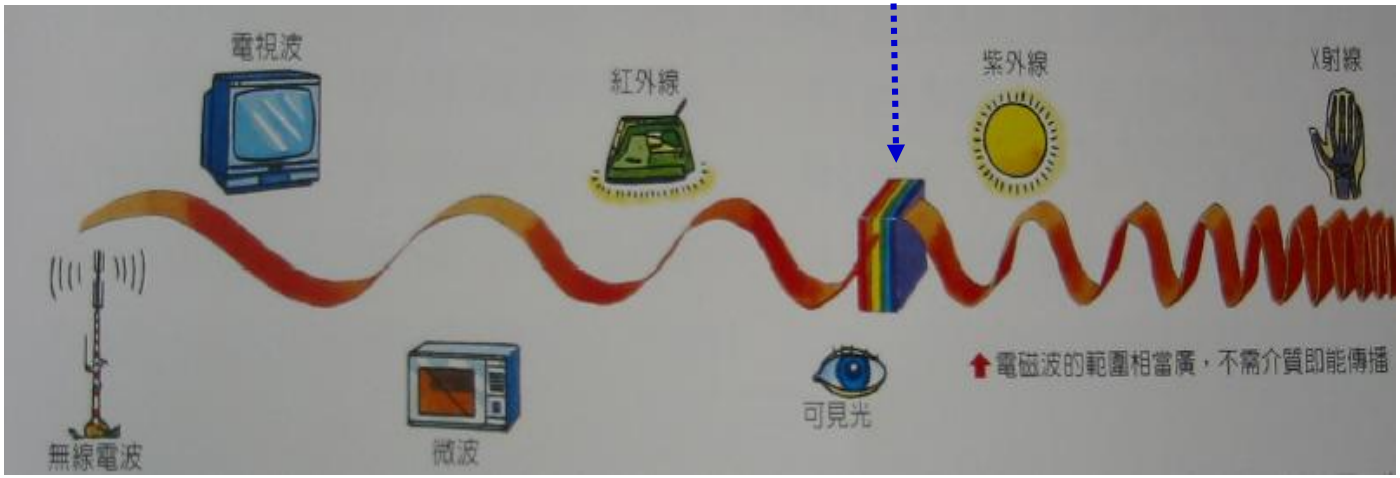


色料原色CMYK



Electromagnetic Spectrum





馬克士威建構完整的電磁學理論，並推測電磁波的存在。（張耀仁翻拍）

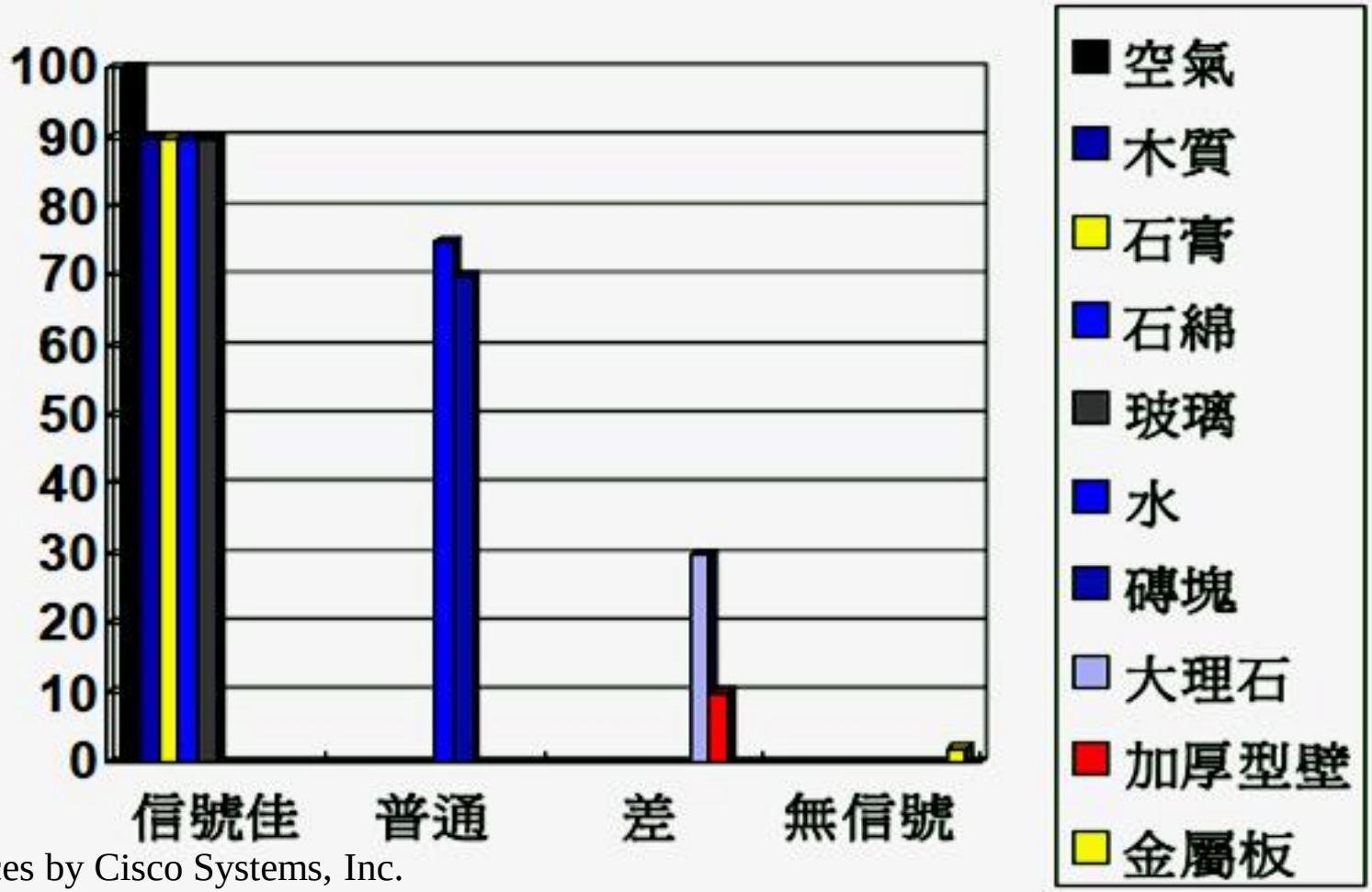
電場發生變化時，它的周圍會產生一個感應磁場。例如，一組天線上的電流隨時間變化，它產生的電場

電磁爐的交流電產生磁場，使鍋底產生感應電流而產生熱。（梁又千攝）

Picture source: 新知識-電和磁,錦繡,2001

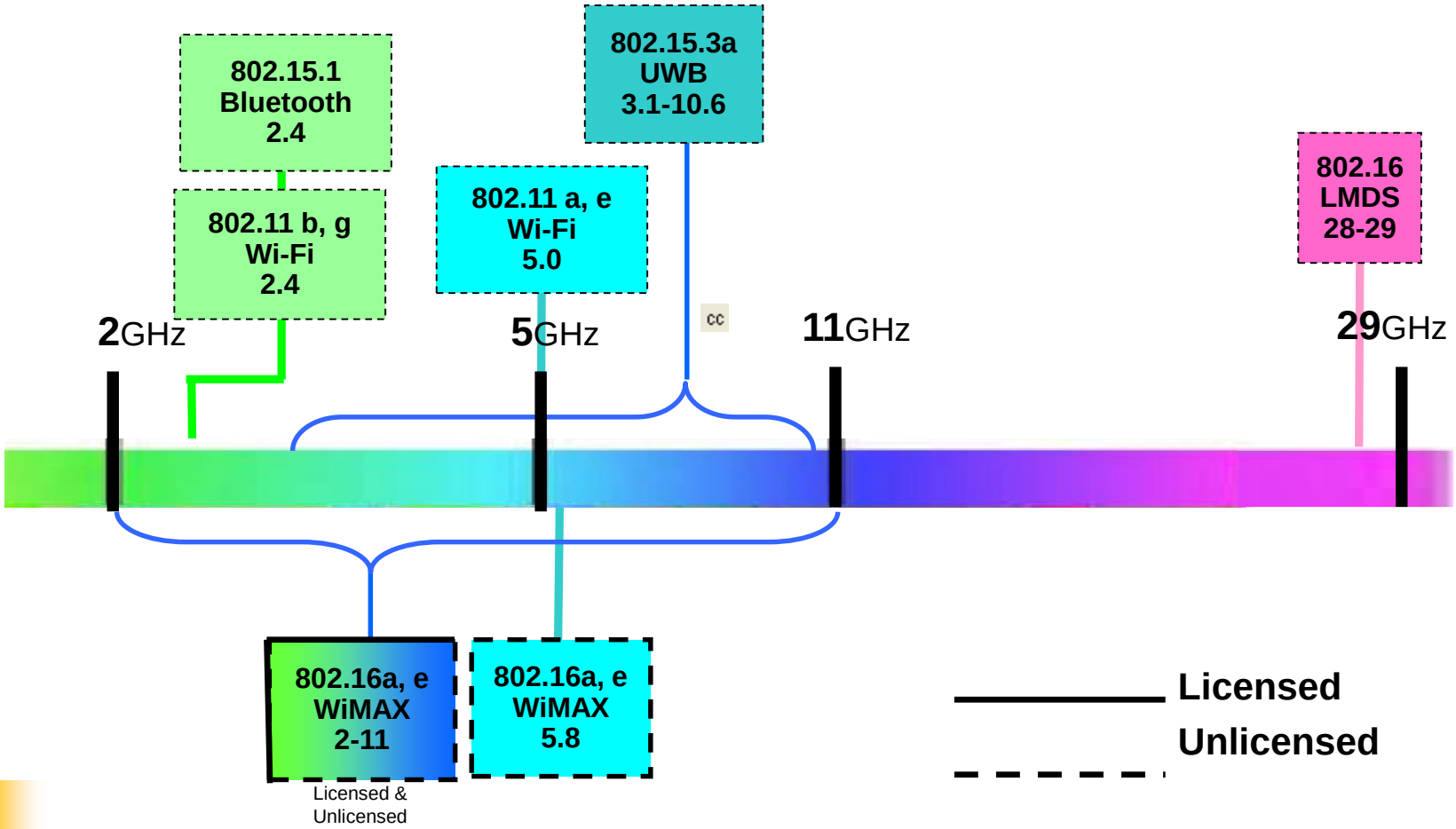
D-Link
Building Networks for People

無線網路對物質的穿透能力?



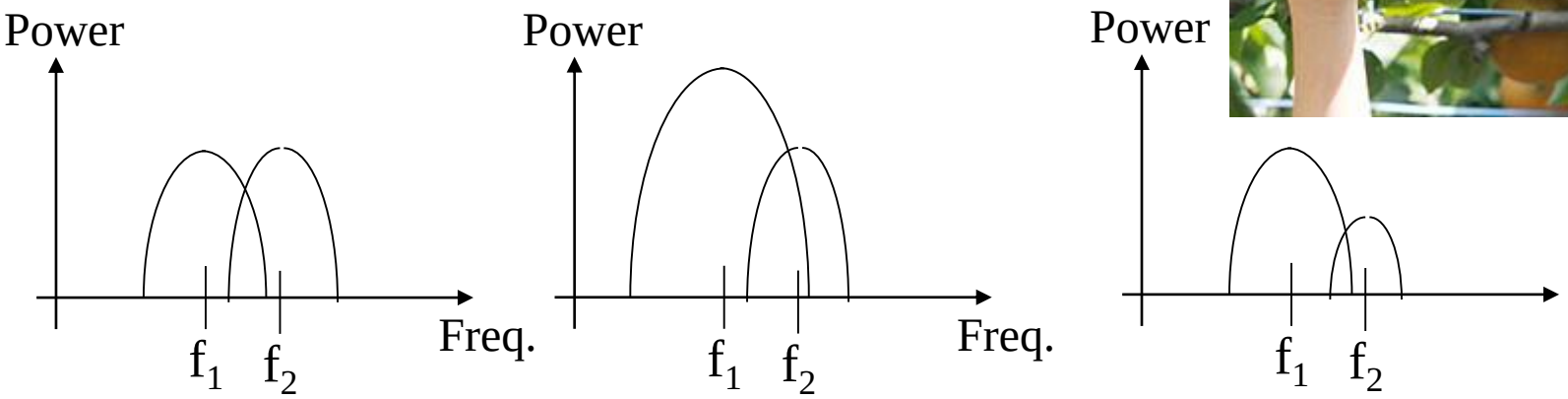
Picture sources by Cisco Systems, Inc.

無線寬頻網路頻譜分配


802.15.1
Bluetooth
2.4
802.11 b, g
Wi-Fi
2.4
802.15.3a
UWB
3.1-10.6
802.11 a, e
Wi-Fi
5.0
802.16
LMDS
28-29
2GHz
5GHz
11GHz
29GHz
802.16a, e
WiMAX
2-11
Licensed &
Unlicensed
802.16a, e
WiMAX
5.8
Licensed
Unlicensed

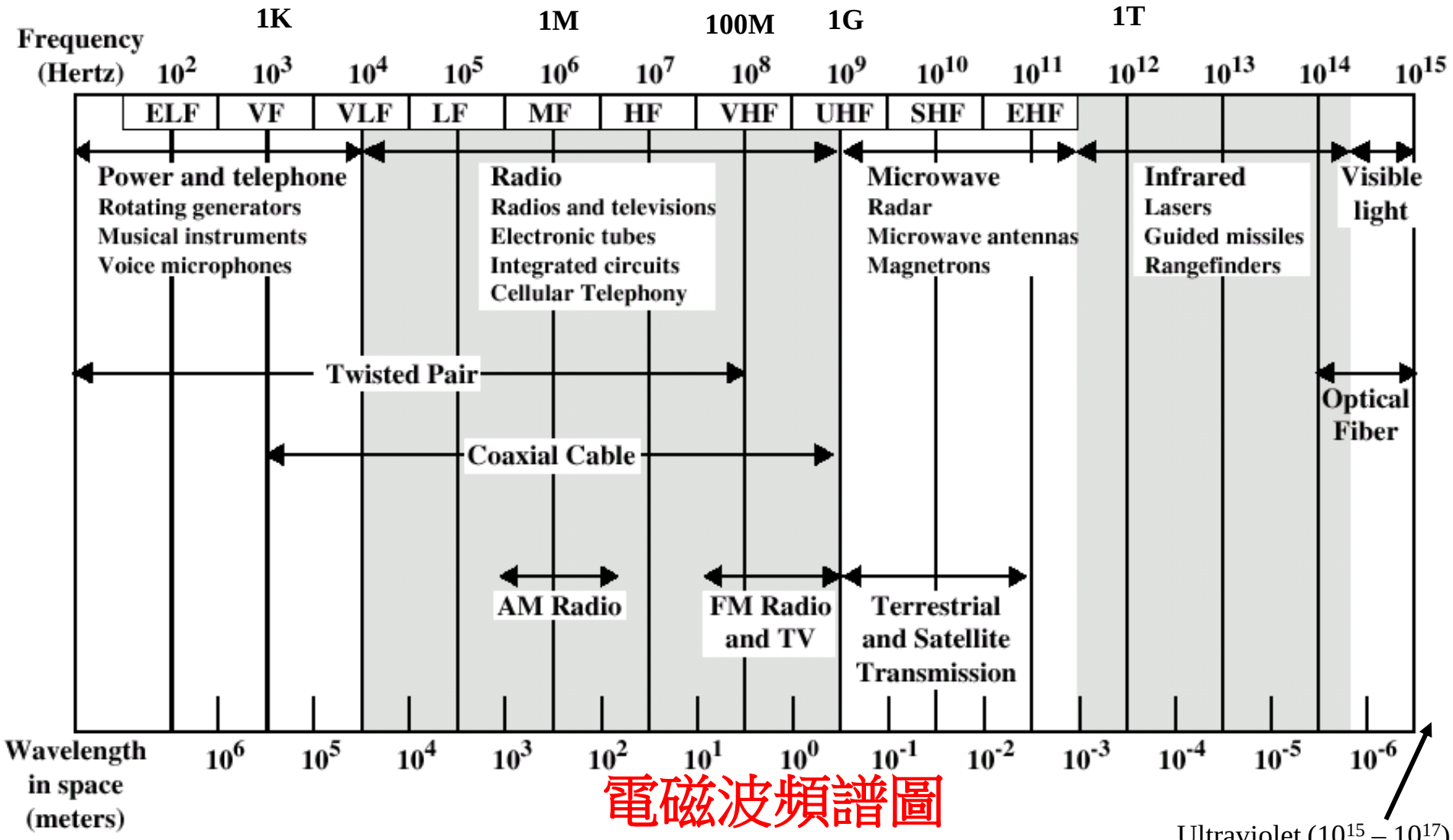
頻譜為什麼需要分配?

- 水波有反射、折射、干擾 ➔ 電磁波？
  - 電台、基地台之頻率分配及功率規定
  - 電磁波安全規範與公共財的概念



- 國際頻率登記委員會(IFRB)：在日內瓦，宗旨是幫助所有成員合理地使用無線電通信頻道。

Electromagnetic Spectrum for Telecommunications



電磁波頻譜圖

Ultraviolet (10^{15} – 10^{17})
X-rays, Gamma rays
(10^{17} – 10^{22})

ELF = Extremely low frequency
VF = Voice frequency
VLF = Very low frequency
LF = Low frequency
MF = Medium frequency
HF = High frequency
VHF = Very high frequency
UHF = Ultrahigh frequency
SHF = Superhigh frequency
EHF = Extremely high frequency

- 第一章到此OK!
- Q&A ?

- Thanks!