Non-Ionizing Radiation from Cellular Phones and Cell Sites

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Food and Drug Administration
PHILIPPINES

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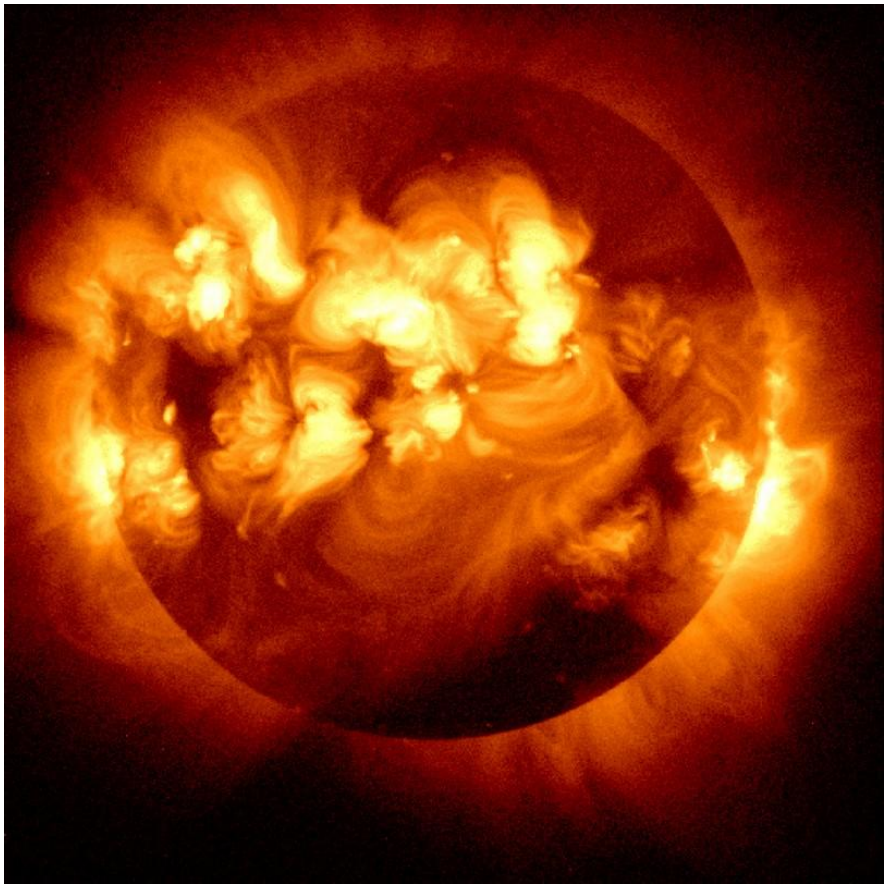
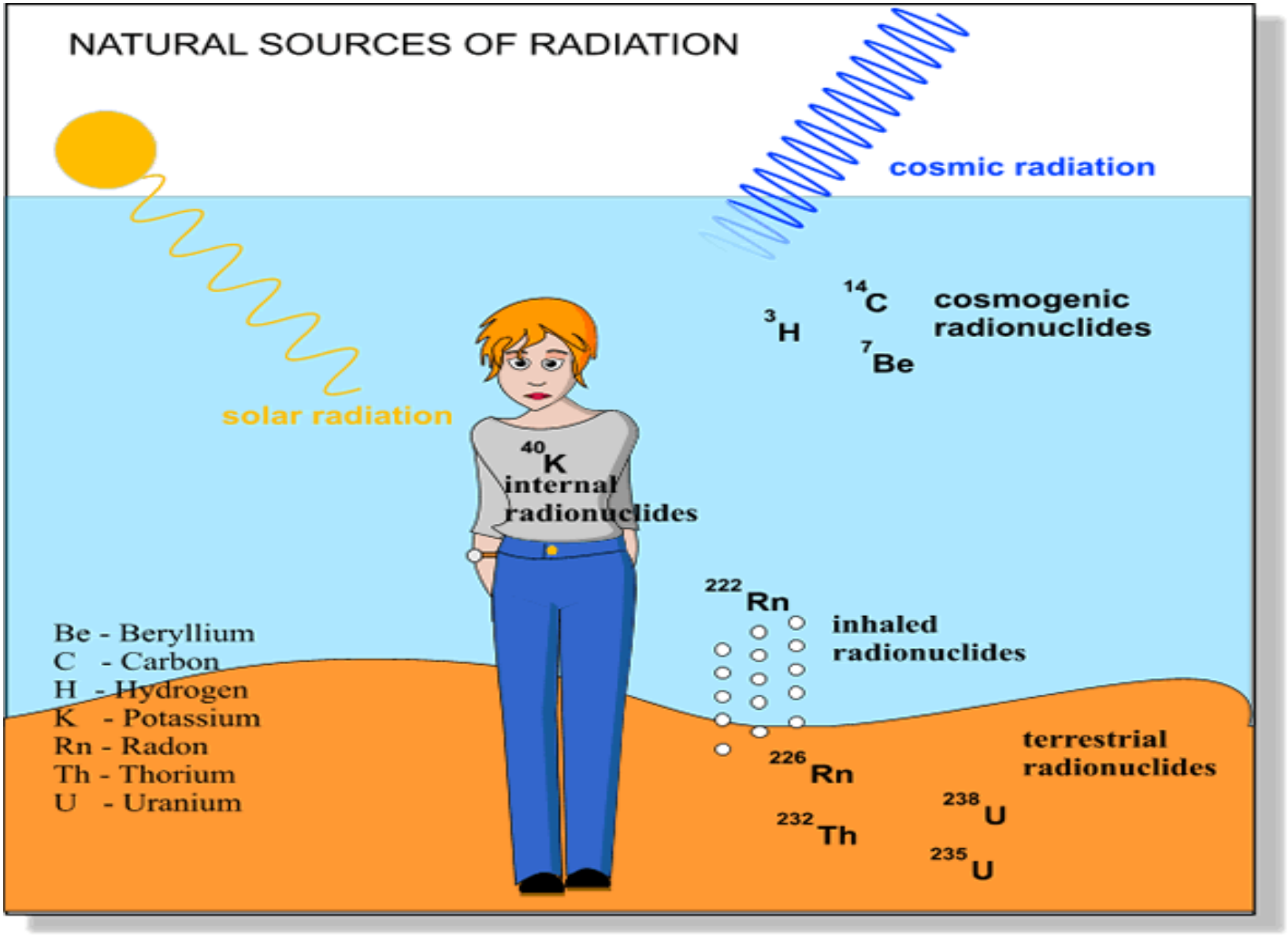
1. What is Non-Ionizing Radiation (NIR)?
2. Types/Classes
3. Measurement of NIR
4. Hazards and Risks
5. Measuring NIR Output from Cellphones

What is Radiation?

- Radiation describes any process in which energy travels through vacuum or through space, ultimately to be absorbed by another body.



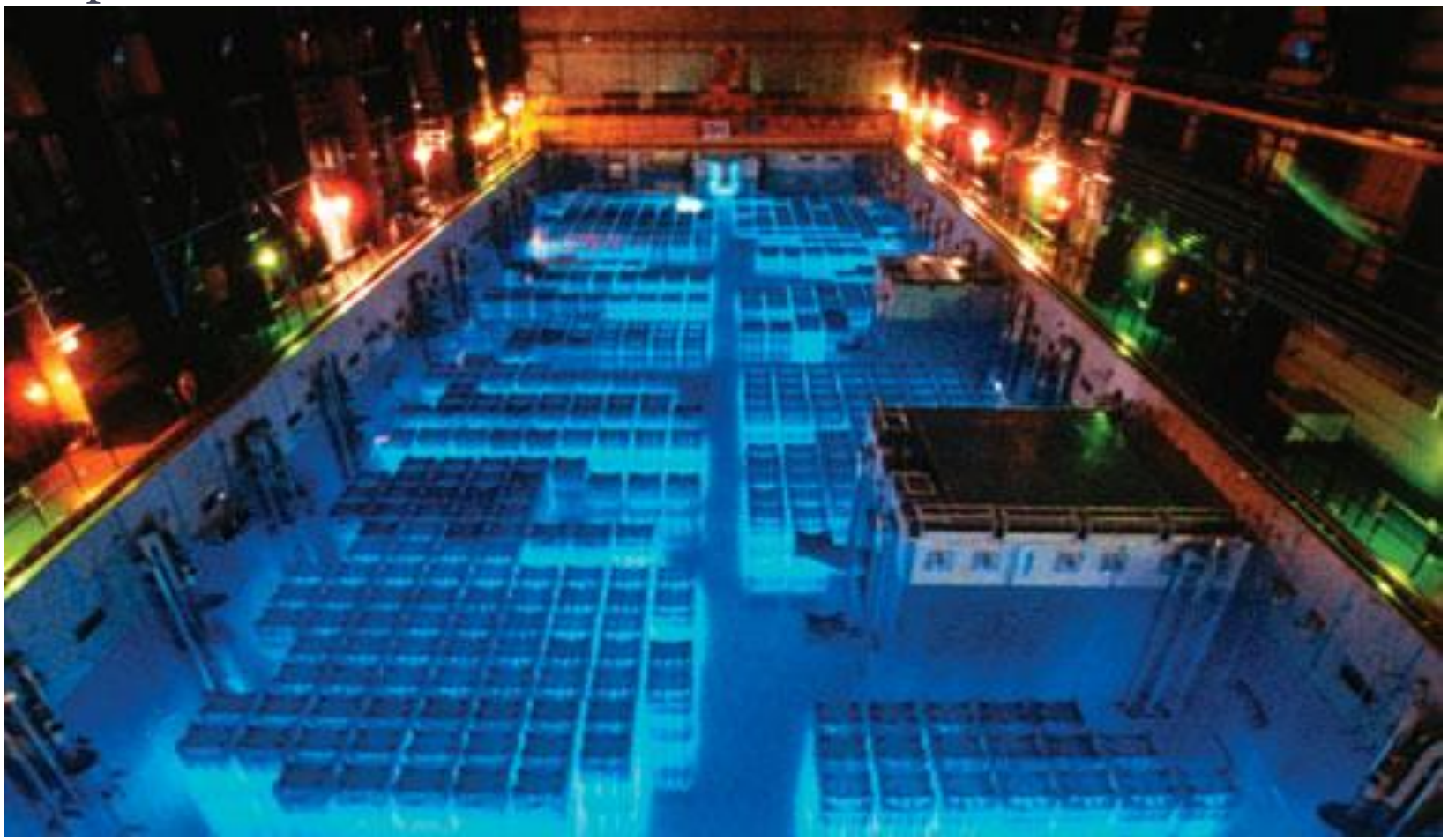
Natural Sources of Radiation



Ionizing and Non-Ionizing Radiation

What Is Ionizing Radiation?

Chapter One:



Ionizing Radiation

- Ionizing radiation consists of subatomic particles or electromagnetic waves that are energetic enough to detach electrons from atoms or molecules

What Is Non-Ionizing Radiation?

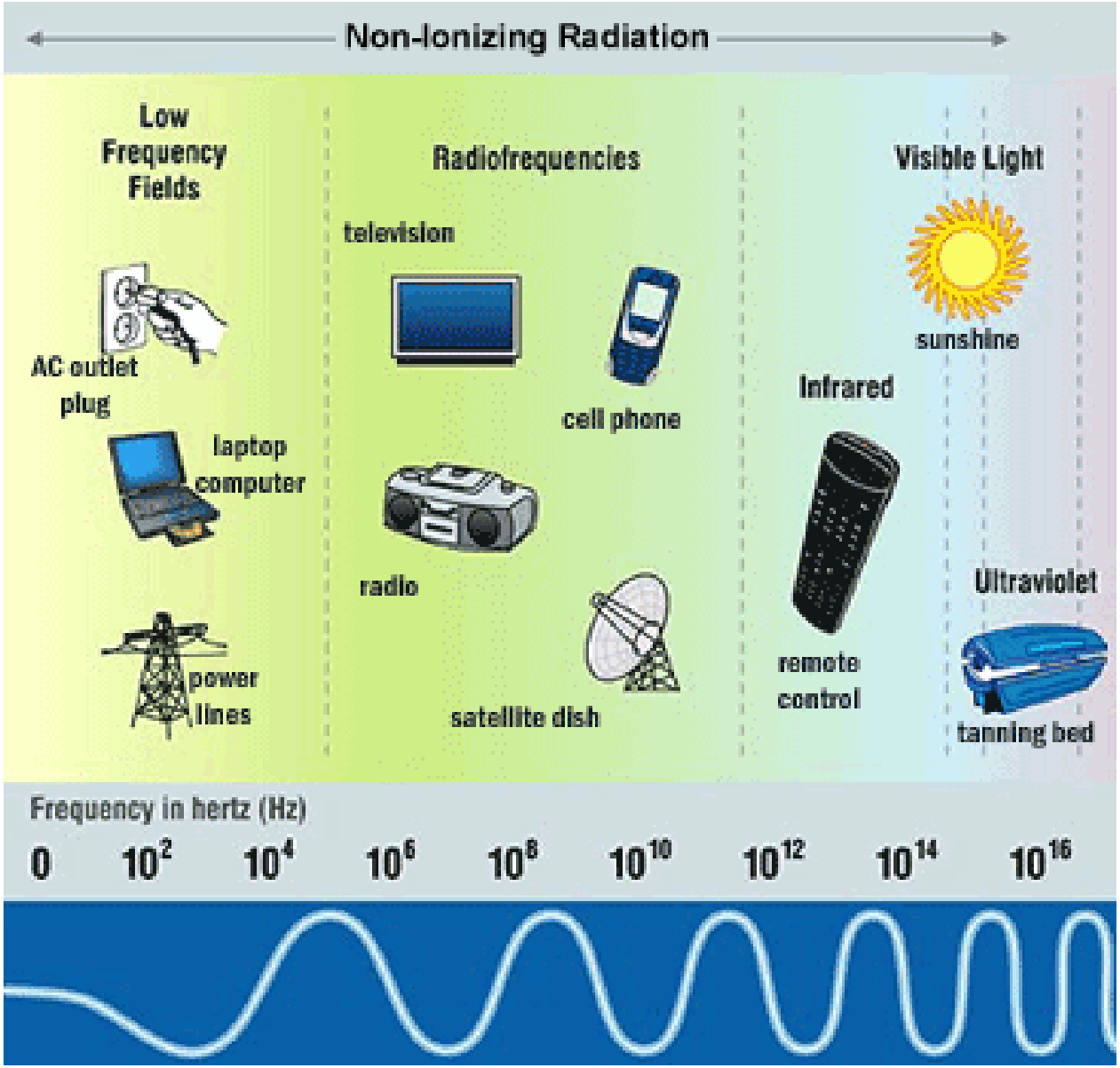
Chapter Two:

Non-Ionizing Radiation

- Non-ionizing radiation or non-ionising radiation refers to any type of electromagnetic radiation that does not carry enough energy to remove an electron from an atom or molecule.

NIR Sources: Artificial

- Cellphones
- Wi-Fi
- Radio stations
- Microwave ovens
- Ultrasound machines
- MRI
- Radar stations
- Electric power lines



NIR and Its Risks

- The main effect of exposure to NIR is an increase in temperature.
- The temperature increase is dependent on the power (in Watts) of the source

International Agency for Research on Cancer (IARC)

Lyons, France

WHAT IS IARC?

THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER IS A SCIENTIFIC AGENCY OF THE WORLD HEALTH ORGANIZATION. " ITS ROLE IS TO CONDUCT AND COORDINATE RESEARCH INTO THE CAUSES OF CANCER. "

Scientific Studies Assessed by IARC[1]

- **Studies of Cancer in Humans (All pertinent epidemiologic studies)**
- **Studies of Cancer in Experimental Animals**
- **Mechanistic and Other Relevant Data**

  (studies on absorption, distribution, metabolism and elimination of agents in humans, animals, cellular systems; on physiological changes in cells, tissues, organs; on functional changes at the cellular level; on changes at the molecular level)

Classification is based on " the weight of the evidence".[1]

1. **Sufficient evidence:** " A casual relationship has been established between **exposure** to the agent and human cancer: a positive relationship has been observed between exposure to the agent and cancer in studies in which chance, bias and confounding could be ruled out with reasonable confidence. "

Classification According to IARC

2. **Limited evidence:** " A positive association has been observed between exposure to the agent and cancer for which a casual interpretation is considered to be credible, but chance, bias or confounding could not be ruled out with reasonable confidence. "

Classification According to IARC

3. **Inadequate evidence**: "The studies cannot be interpreted as showing either the presence or absence of a carcinogenic effect because of major qualitative or quantitative limitations, or no data on cancer in humans are available."

Classification According to IARC

4. **Evidence suggesting lack of carcinogenicity:** " There are several adequate studies covering the full range of doses to which human beings are known to be **exposed,** which are mutually consistent in not showing a positive association between exposure to the agent and any studied cancer at any observed level of exposure…"

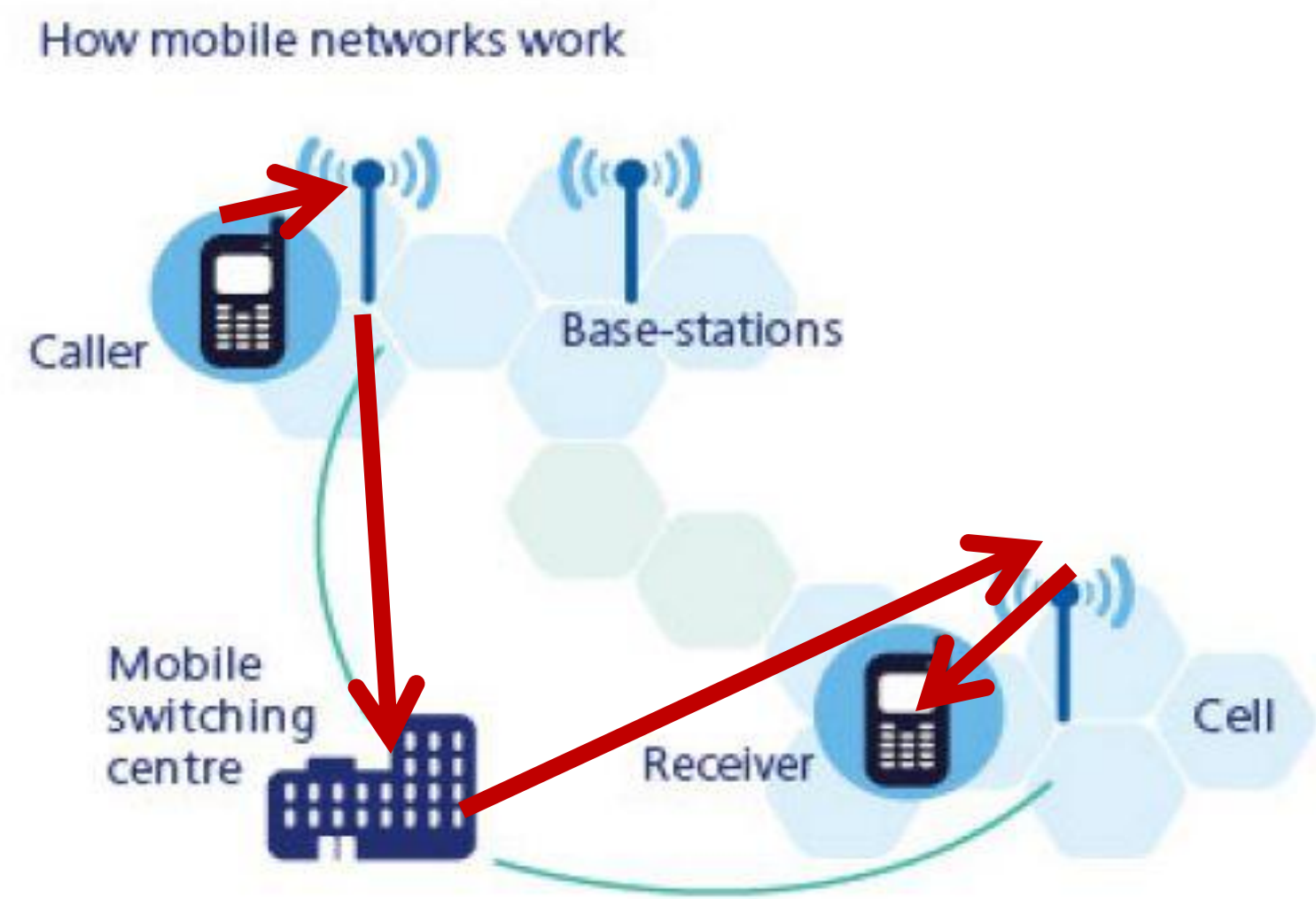
Classification According to IARC

5. **Overall evaluation:** "Categorization is a matter of scientific judgment, reflecting the strength of the evidence derived from the studies in humans and in experimental animals and from other relevant data."

Classification of Carcinogenicity According to IARC[1]

- **Group 1 : The agent is carcinogenic to humans**
- **Group 2A: The agent is probably carcinogenic to humans**
- **Group 2B: The agent is possibly carcinogenic to humans.**
- **Group 3: The agent is not classifiable as to its carcinogenicity to humans.**
- **Group 4: The agent is probably not carcinogenic to humans.**

Cellphones:How They Work



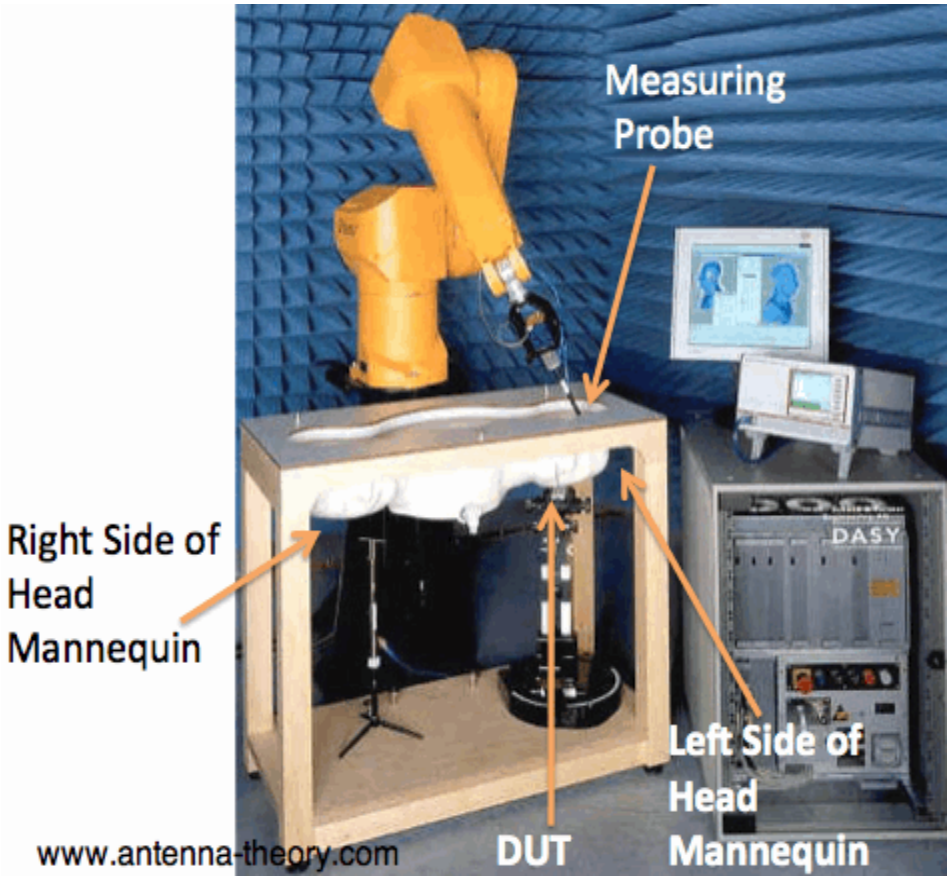
How is NIR from Cellphones Assessed?

- A quantity called the Specific Absorption Ratio (SAR) is used to assess the amount of energy delivered to the body part of interest. It is measured in Watts/kg

- For a phone to receive FCC certification and be sold in the United States, its maximum SAR level must be 1.6 watts per kilogram. In Europe, the level is capped at 2 watts per kilogram, while Canada allows a maximum of 1.6 watts per kilogram.

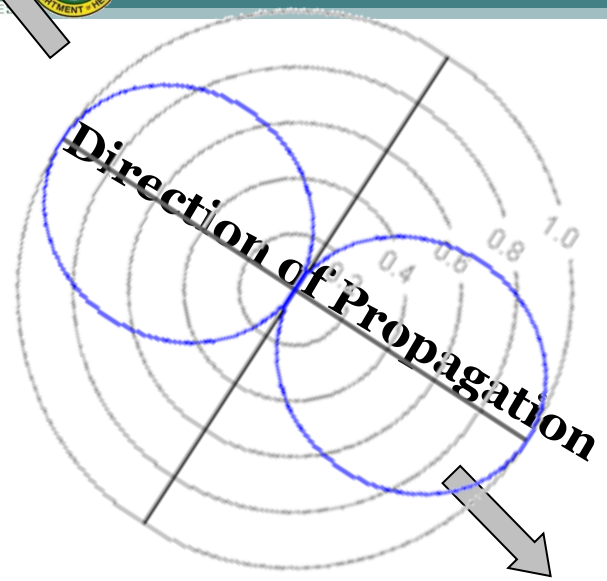
How is NIR from Cellphones Measured?

- There is a hollow tub that the yellow robot moves the measuring probe into. The tub is formed in standardized shapes, which replicate the shape of the human head. The tub that the probe is measuring simulates the left side of the human head.
- The DUT is the device-under-test (the mobile phone) is placed directly on the edge of the tub, and transmits at maximum power continuously. The probe is moved through the head region by the yellow robot arm,
- To simulate the conductivity and density correctly, the tub is filled with a fluid that has similar properties to human tissue.
- The SAR must be measured on both the left and right side of the head as shown. Even though geometrically the measurements are fairly similar, the results can be very different due to the chaotic nature of the near field. The SAR values quoted for a mobile phone are the highest value of SAR measured for any frequency the phone operates in, from both the left and right side of the head.

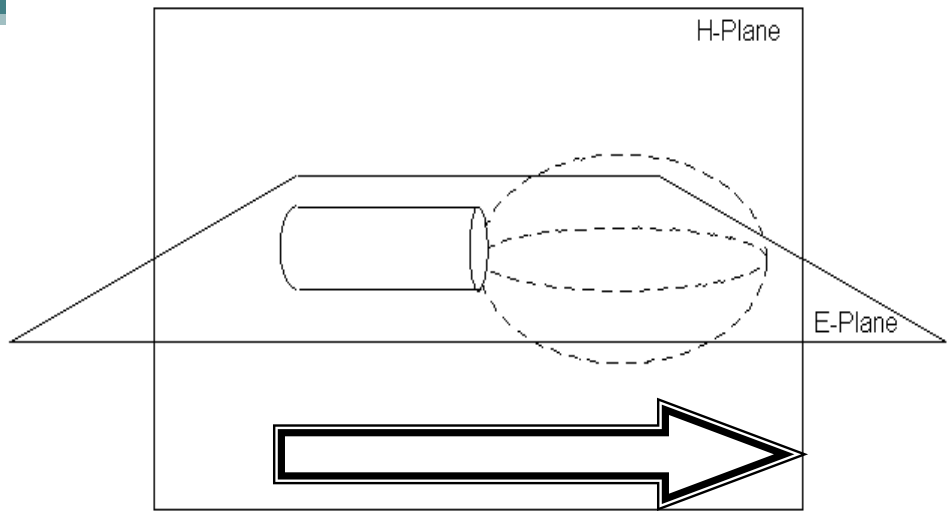


How is NIR from Cellsites Measured?

- An EMF meter is placed in the location where the field strength is to be measured.



Direction of Propagation



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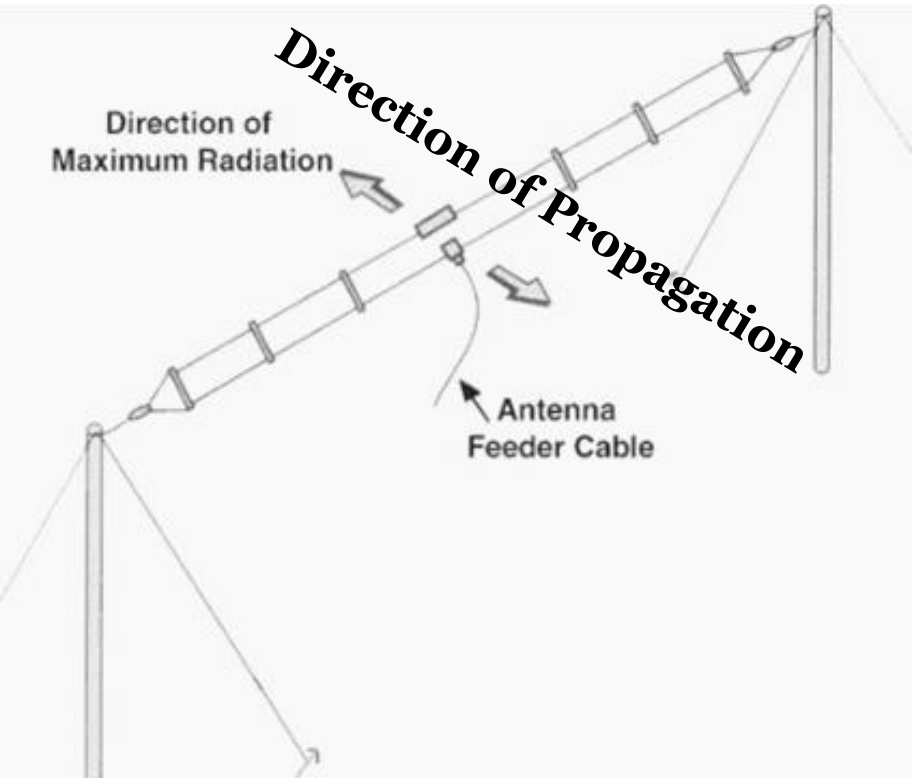

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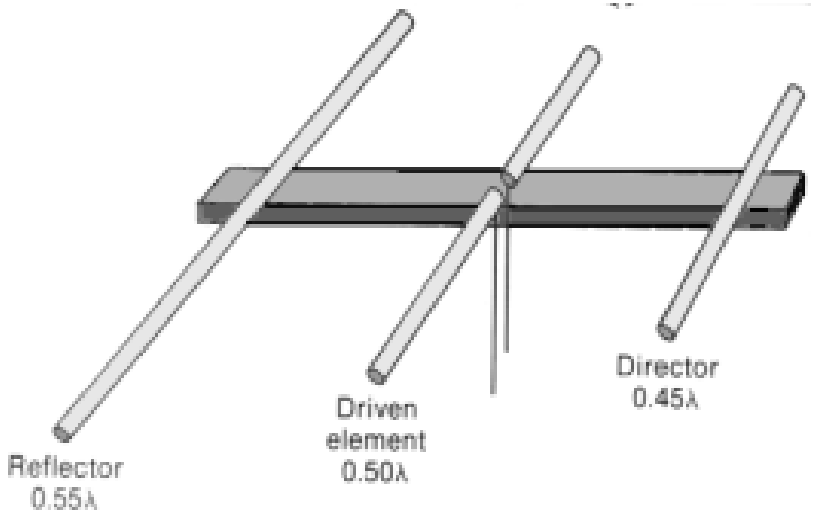

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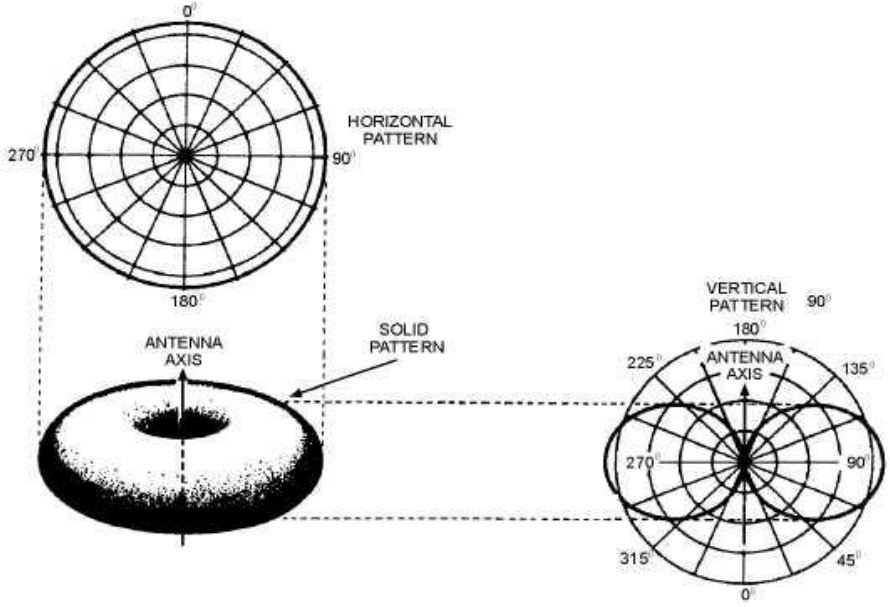
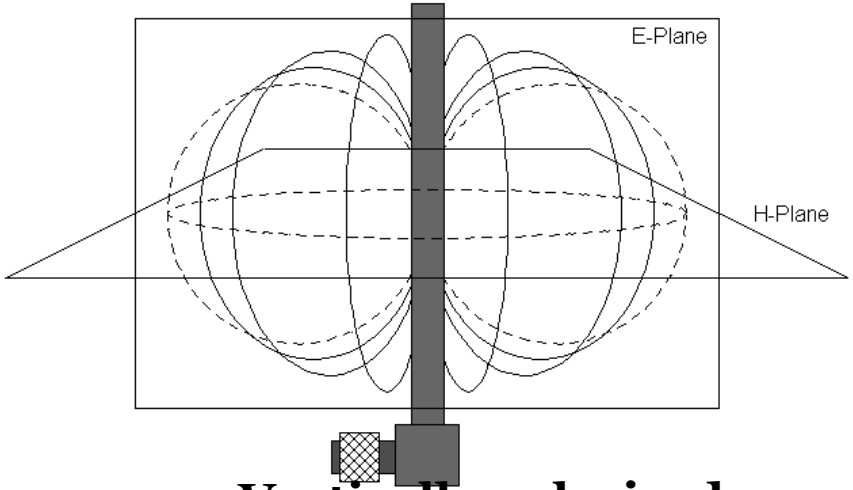
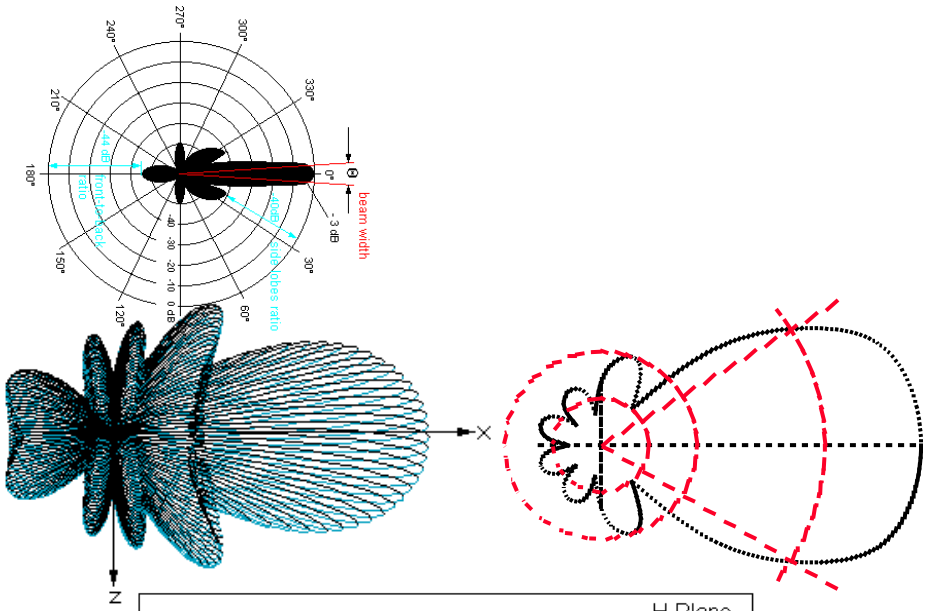
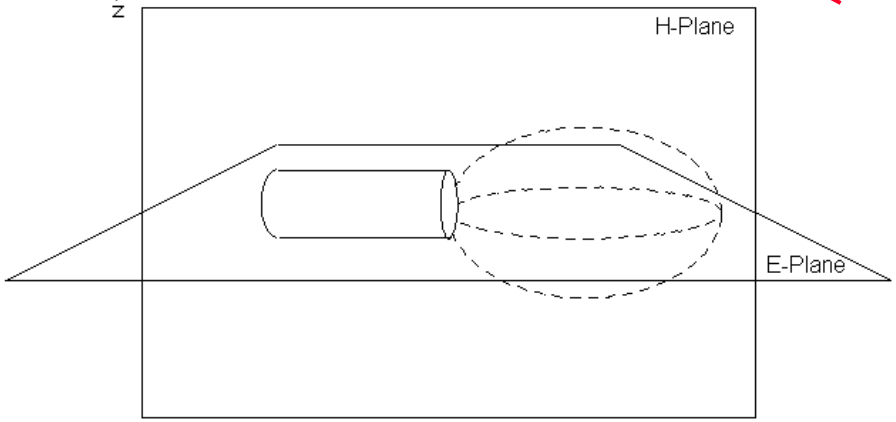




<u>Vertically polarized</u> omnidirectional dipole antenna





<u>Horizontally polarized</u> directional yagi antenna

Who Determines the Limits?

- In the US:
  1. IEEE (C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to RF Electromagnetic Fields 3 kHz to 300 GHz)

- In Europe:
  1. CENELEC (ENV 50166-2: Human Exposure to Electromagnetic Fields High Frequency : (10 kHz to 300 GHz))

20 Highest SARs

Rank	Model	SAR (digital)
1	Motorola Bravo	1.59
2	Motorola Droid 2 Global	1.58
3	Sony Ericsson Xperia X10 Mini Pro	1.55
4	Nokia Astound	1.53
5	Motorola Defy	1.52
5a	Motorola Grasp	1.52
5b	ZTE Salute	1.52
8	RIM BlackBerry Curve 9350	1.5
9	Motorola Droid 2	1.49
10	HTC Desire	1.48
10a	HTC Trophy	1.48
12	Motorola Atrix 4G	1.47
12a	RIM BlackBerry Curve 9360	1.47
14	ZTE Score	1.45
14a	Motorola Droid Razr	1.45
14b	Motorola Droid Razr Maxx	1.45
17	RIM BlackBerry Torch 9810	1.44
18	Sony Ericsson Xperia X10	1.43
18a	RIM BlackBerry Bold 9650	1.43
20	RIM BlackBerry Bold 9930	1.38

20 Lowest SARS

Rank	Model	SAR (digital)
1	Samsung Infuse 4G	0.2
2	Pantech Breeze III	0.281
3	Samsung Acclaim	0.29
4	Samsung Galaxy S II Skyrocket	0.3
4a	Samsung Replenish	0.3
6	Huawei Ideos X5	0.34
6a	Huawei Impulse 4G	0.34
6b	T-Mobile Sidekick 4G	0.34
9	LG Quantum	0.35
9a	Samsung Focus Flash	0.35
9b	Samsung Galaxy S II	0.35
12	Samsung Galaxy S II	0.36
13	Samsung Epic 4G Touch	0.4
14	Samsung Evergreen	0.41
14a	Samsung Haven	0.41
16	LG Enlighten	0.42
16a	Samsung Captivate	0.42
16b	Samsung Conquer 4G	0.42
19	HTC Rezound	0.427
20	Samsung Epic 4G Touch	0.4

Specific Absorption Ratios: iPhone (W/kg)

- *Original iPhone: 0.974 (FCC ID: BCGA1203)*
  iPhone 3G: 1.38 (FCC ID: BCGA1241)
  iPhone 3GS: 0.79 (FCC ID: BCGA1303A)
  iPhone 4 GSM: 1.17 (FCC ID: BCG-E2380A)
  iPhone 4 CDMA: 1.18 (FCC ID: BCG-E2422A)
  iPhone 4S: 1.11 (FCC ID: BCG-E2430A)

So How Do We Determine If Everything is Within Limits?

We MEASURE.

And MEASUREMENTS must be TRACEABLE TO THE SAME **REFERENCE**.

METROLOGY is that branch of science which ensures that measurements our lives depend on are reliable.

Metrology

BIPM OIML

World Metrology Day
20 May 2012
www.worldmetrologyday.org