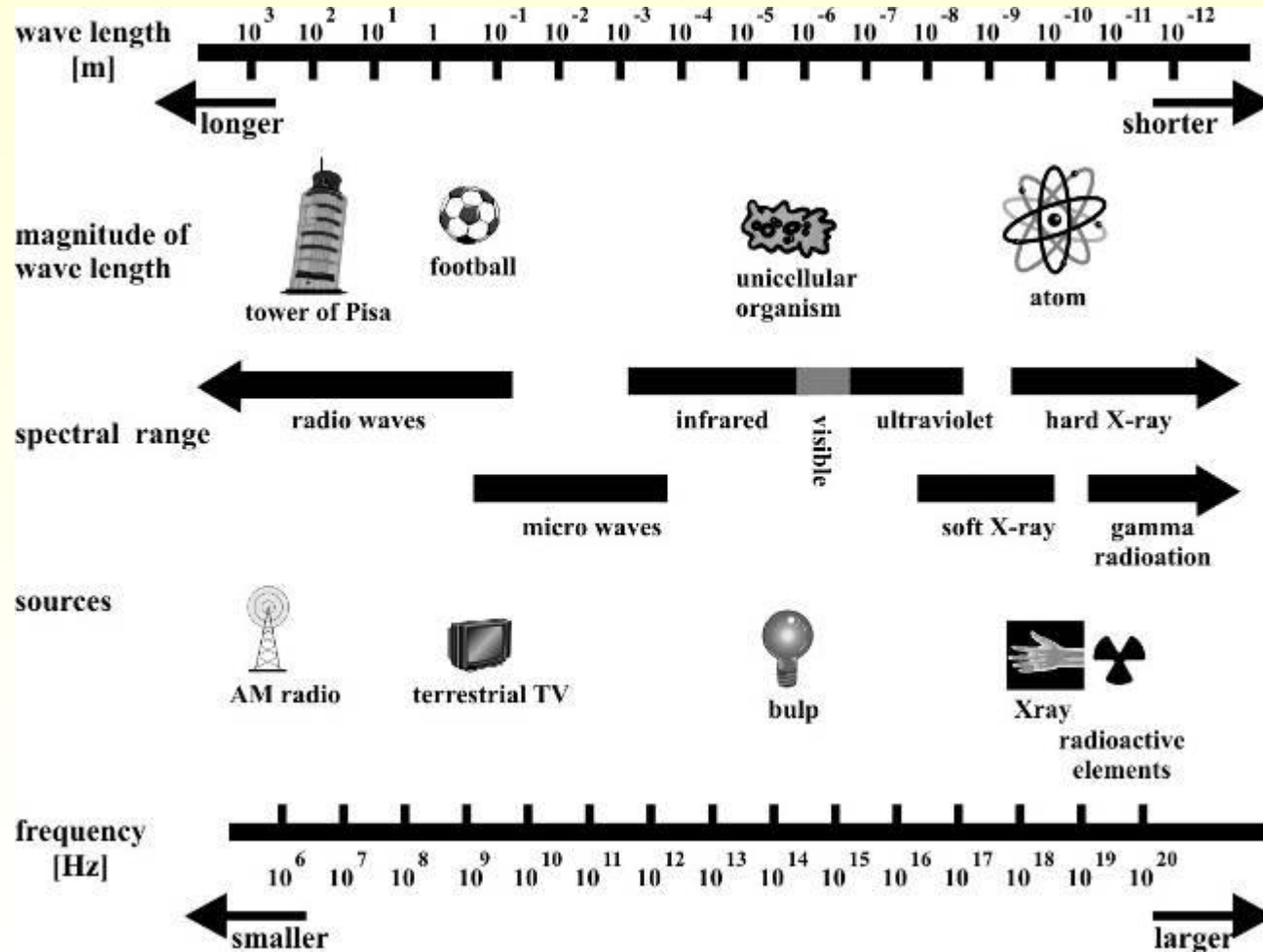




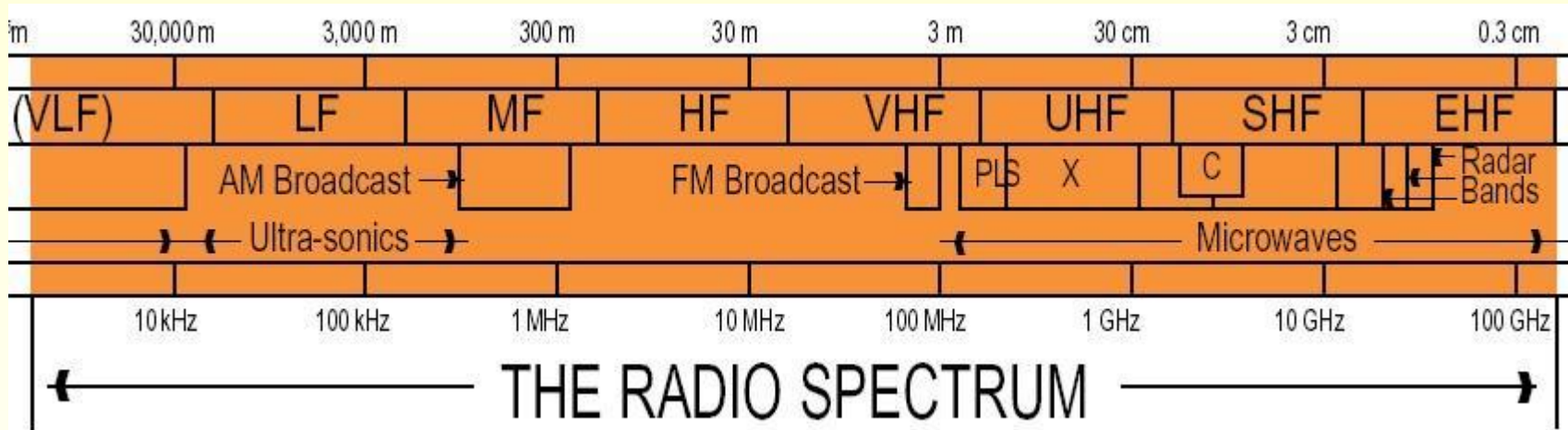
Dr. Haim Mazar

Regulation and Standardization of Wireless Communications in Israel, Europe and America

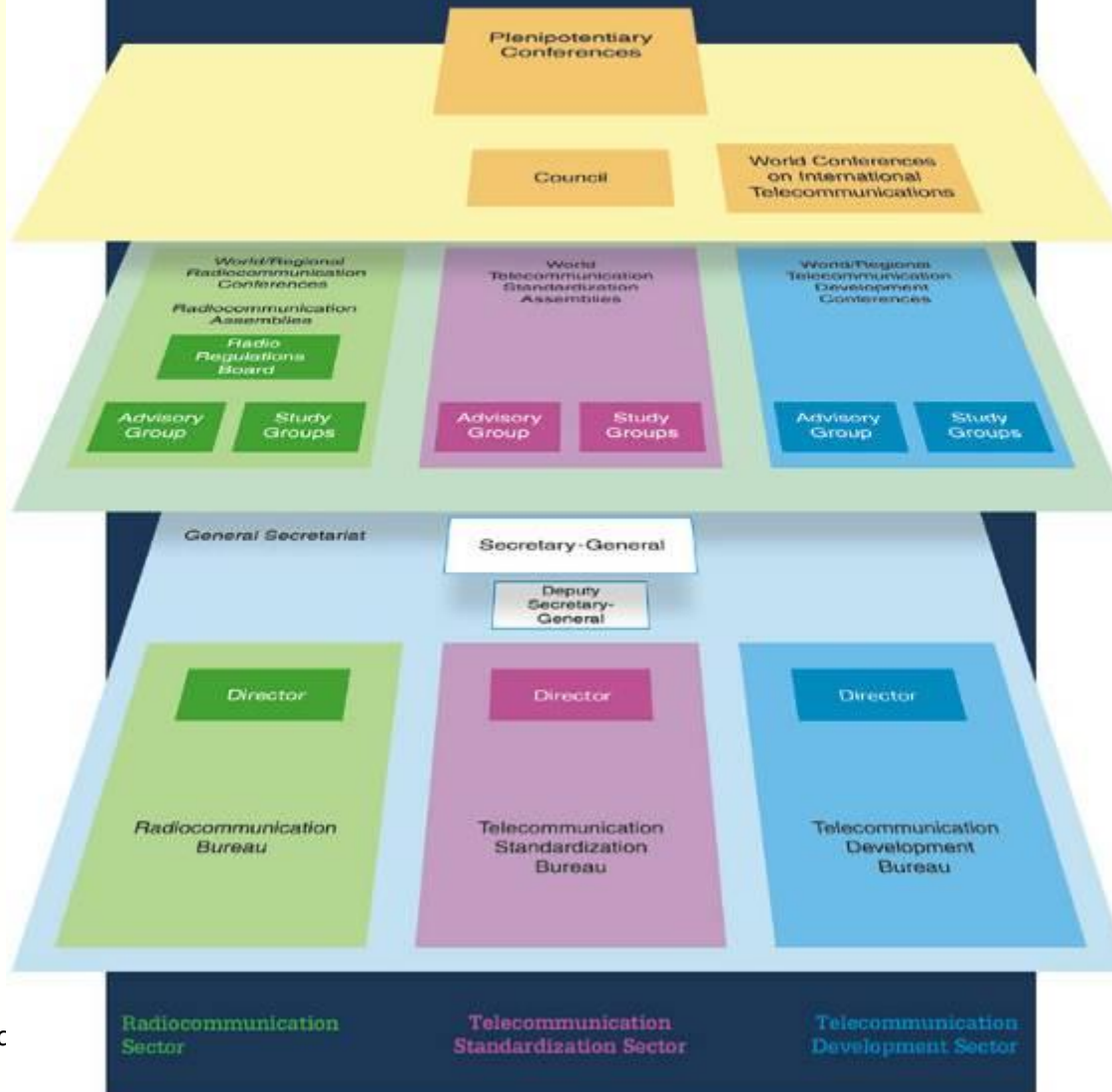
The RF Spectrum



The RF Spectrum



Structure



ITU Regions



US Chart, 2003

UNITED STATES FREQUENCY ALLOCATIONS THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

ASTRONOMICAL MOBILE	INTER-SATELLITE	RADIO ASTRONOMY
ASTRONOMICAL MOBILE SATELLITE	RADIO TERMINATION SATELLITE	LAND MOBILE
ASTRONOMICAL RADIO NAVIGATION	LAND MOBILE SATELLITE	RADIO LOCATION
MARITIME	MARITIME MOBILE	RADIO LOCATION SATELLITE
MARITIME SATELLITE	MARITIME MOBILE SATELLITE	RADIO NAVIGATION
BROADCASTING	MOBILE	RADIO NAVIGATION SATELLITE
BROADCASTING SATELLITE	MOBILE SATELLITE	SPACE OPERATION
FIXED	MOBILE SATELLITE	SPACE RESEARCH
FIXED SATELLITE	MOBILE SATELLITE	STANDARD-FREQUENCY AND TIME SIGNAL

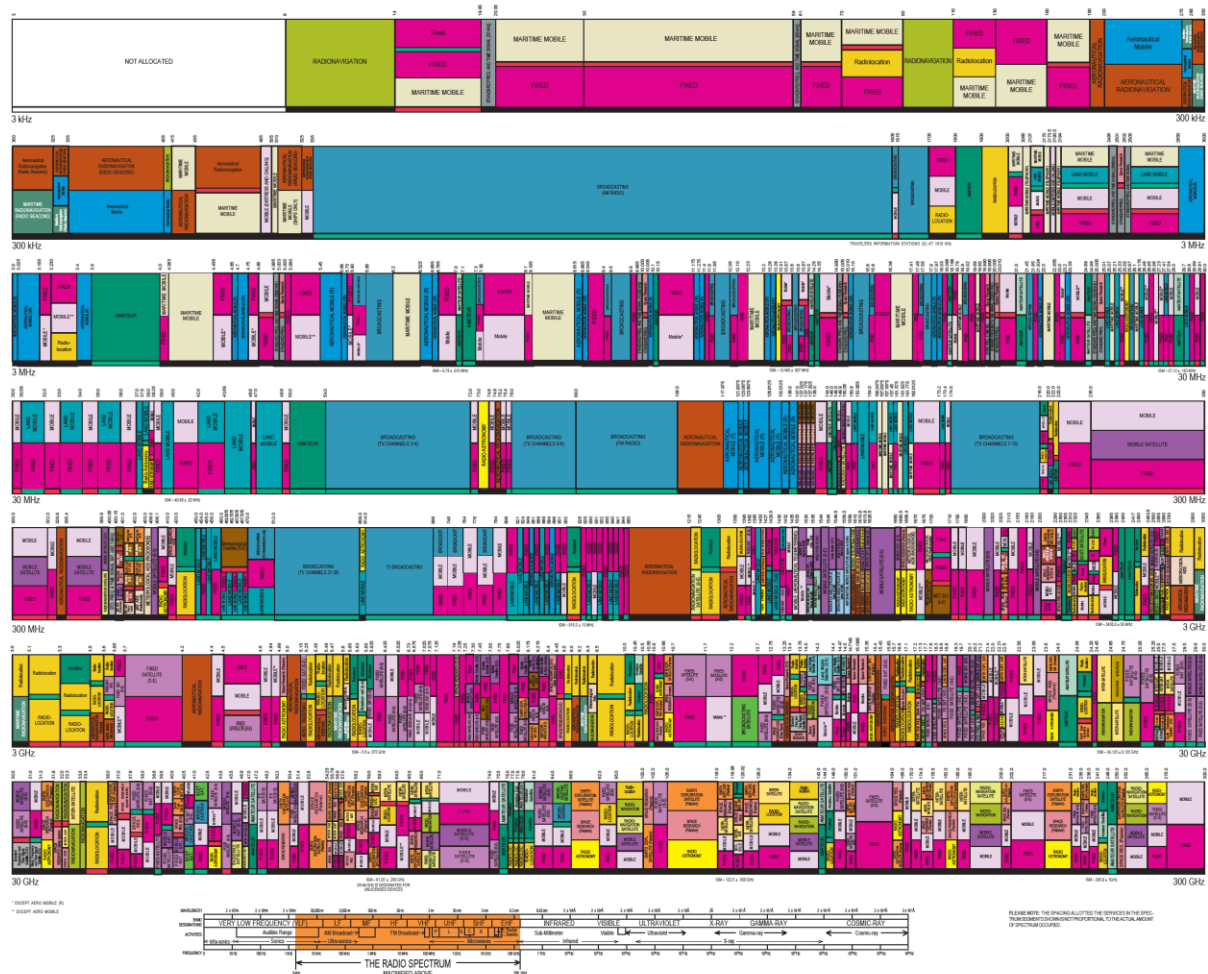
ACTIVITY CODE

GOVERNMENT EXCLUSIVE	GOVERNMENT NON-GOVERNMENT SHARED
NON-GOVERNMENT EXCLUSIVE	

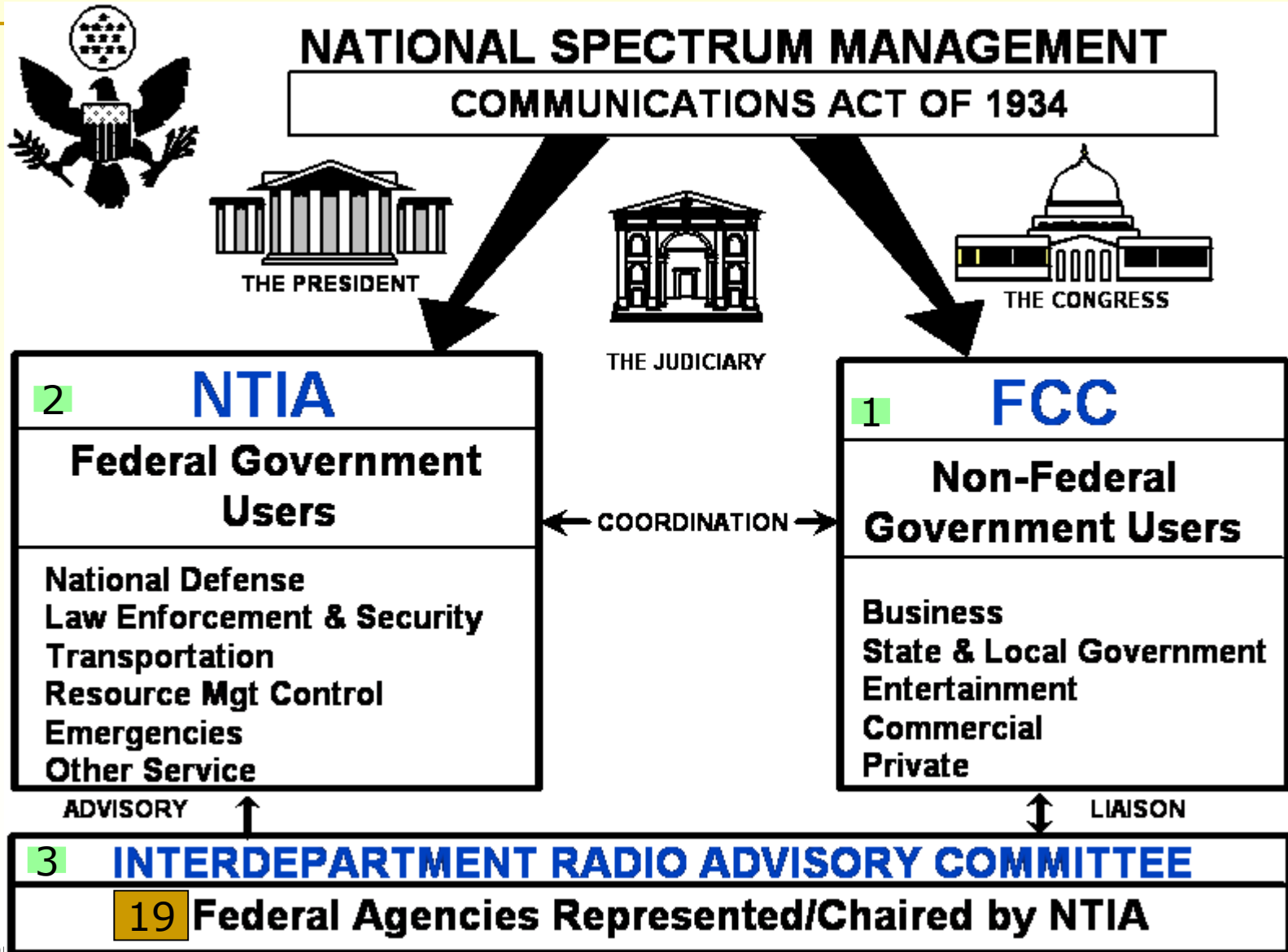
ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	DESCRIPTION
Primary	F	Fixed
Secondary	M	Mobile
	LA	Land Mobile with Other Code Letters

This is a graphic representation of the portion of the Table of Frequency Allocations used by the FCC and NTIA, as well as other not completely related agencies. It is intended as a visual guide to the radio spectrum. It does not constitute a legal document. For more information, please refer to the FCC and NTIA websites.



US National Spectrum Management, Bill



D

CFR 47, the Code of Federal Regulations



National Archives and
Records Administration



1. <http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199847>
2. http://www.access.gpo.gov/nara/cfr/waisidx_98/47cfr22_98.html
3. <http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi?TITLE=47&PART=22&SECTION=905&YEAR=1998&TYPE=PDF>
4. PP10Tables/get-cfr22_905Cellular.pdf

NTIA Manual of Regulations and Procedures for Federal Radio

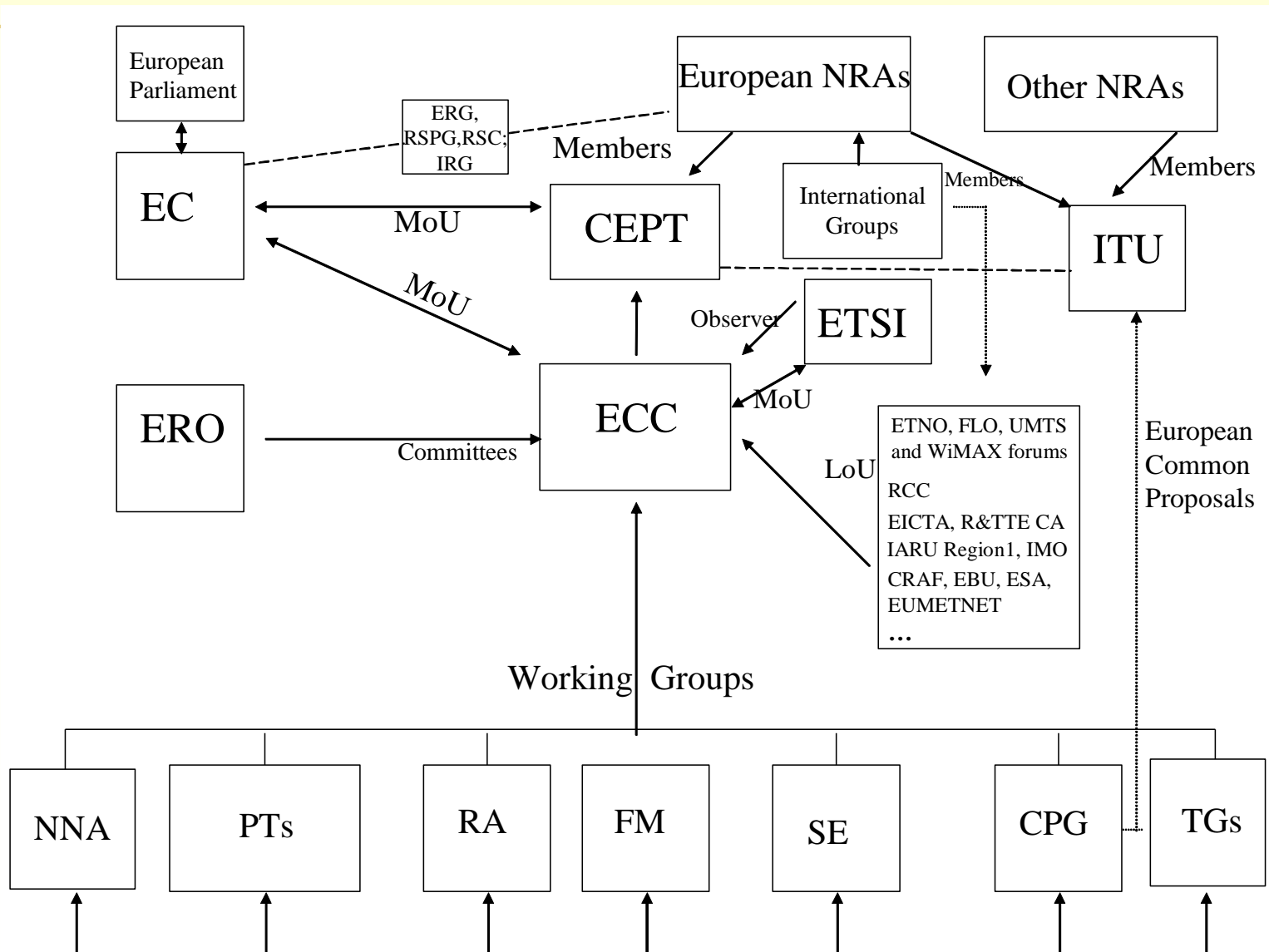
Frequency Management (Redbook)



National Telecommunications & Information Administration (NTIA)

<http://www.ntia.doc.gov/osmhome/redbook/redbook.html>

The Main Players in European RF regulation

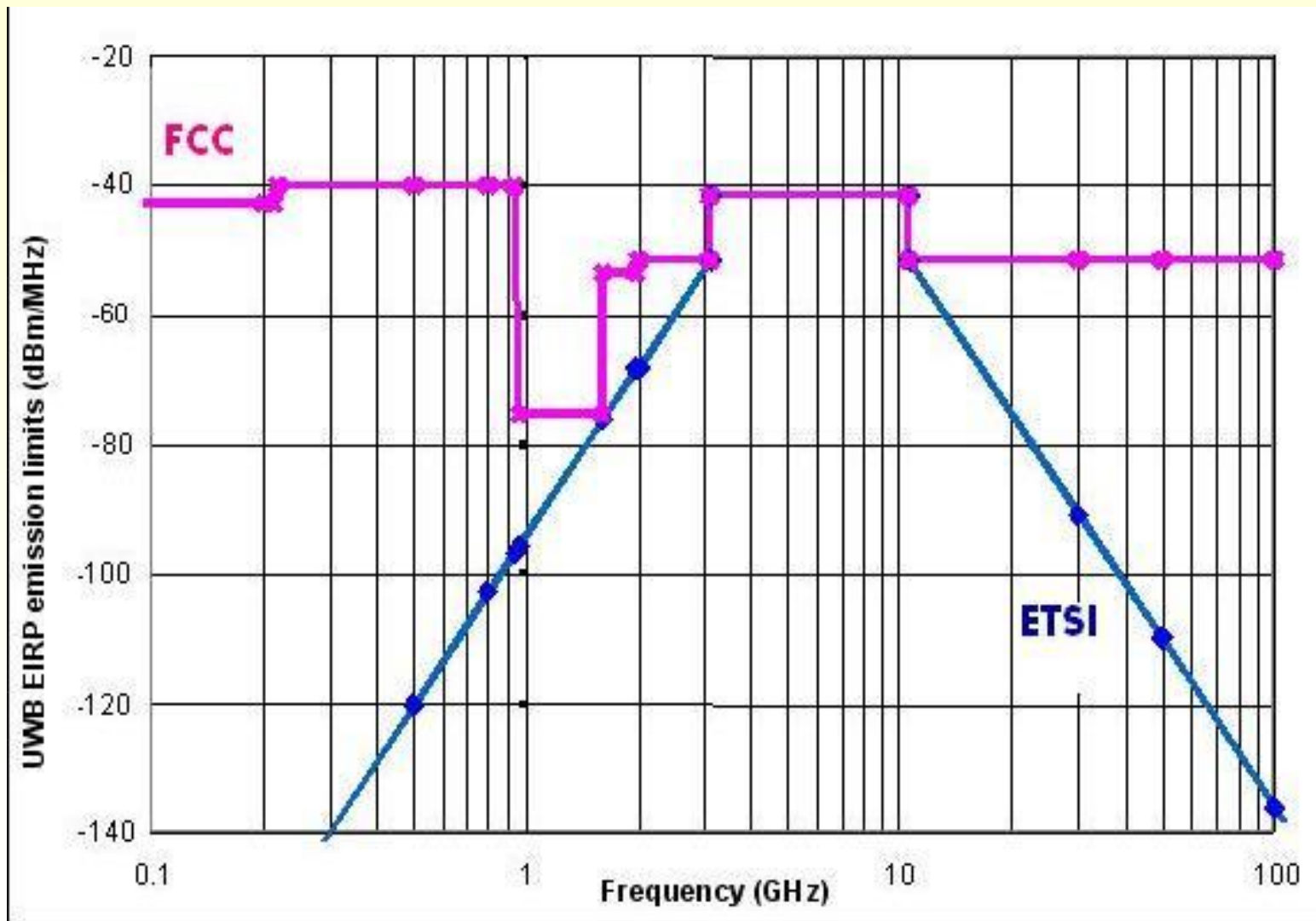


Standards, Thresholds, Regulatory Framework: Europe-N. America

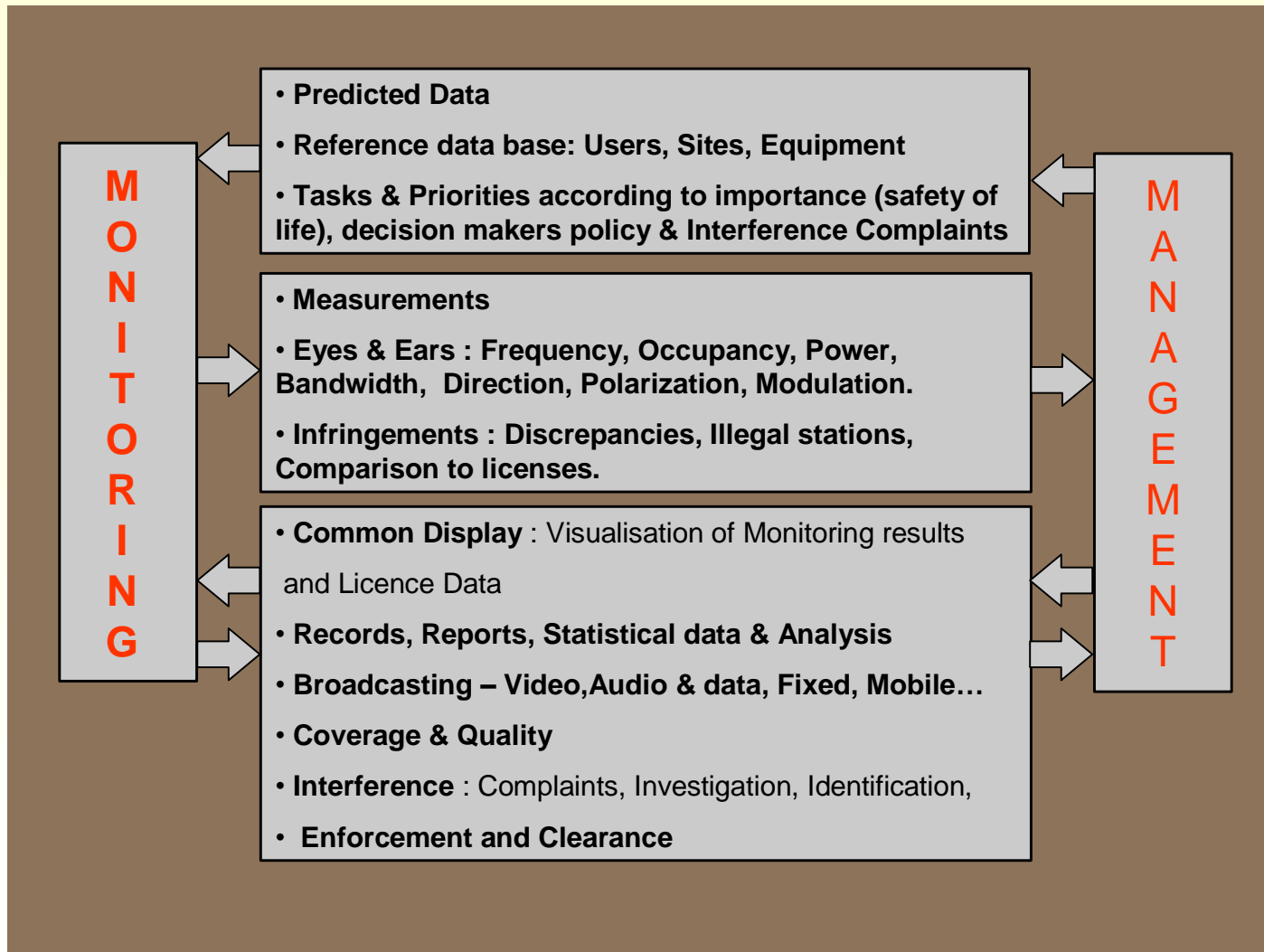
Standard	TV			Cellular standardised	Main Power and TV frames/s	<i>Spurious Emissions</i>	<i>Human Hazards</i>	
	Analog	Digital	Bandwidth				Base Stations	Handsets
Europe	PAL-SECAM	DVB-T	7-8 MHz	UMTS/ TETRA	50 Hz	Stringent	Flexible	
North America	NTSC	ATSC	6 MHz	CDMA2000	60 Hz	Flexible	Stringent	

[Standards and thresholdsEU_US.doc](#)

UWB emissions masks ETSI-FCC



Spectrum Control (see ITU-R HB)

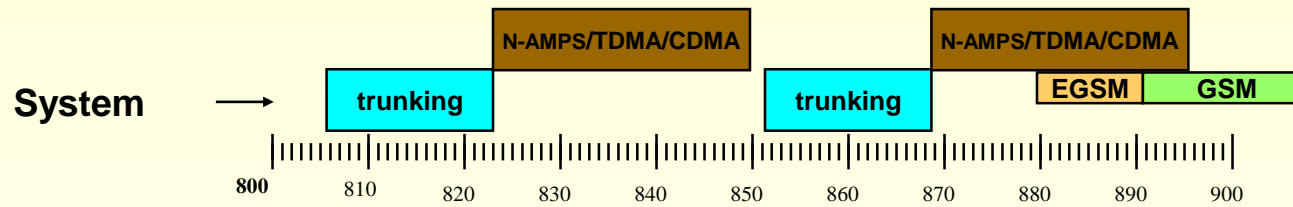


800/900 MHz Cellular, Trunking & TV allocations

15 October 2008

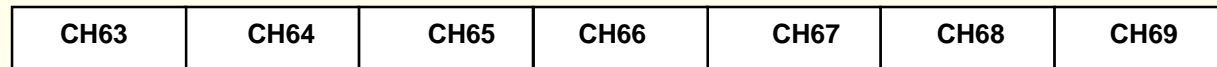
Israel allocation

US standard

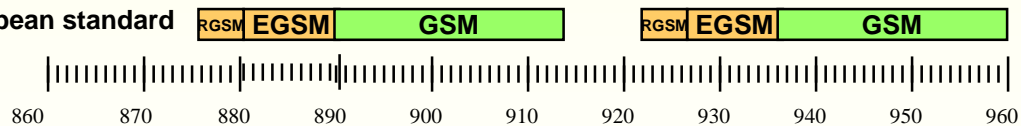


EUROPEEN

TV standard

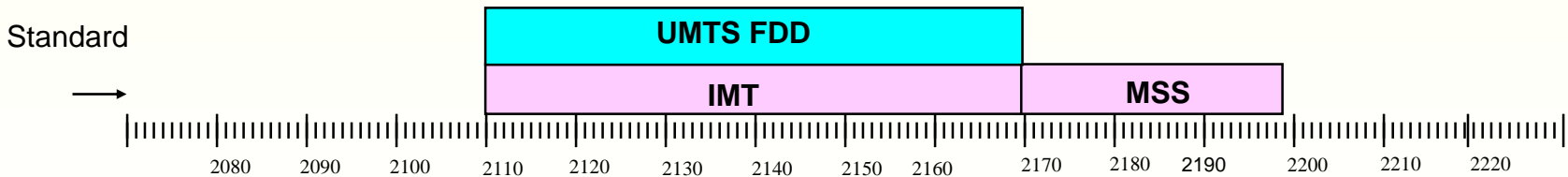
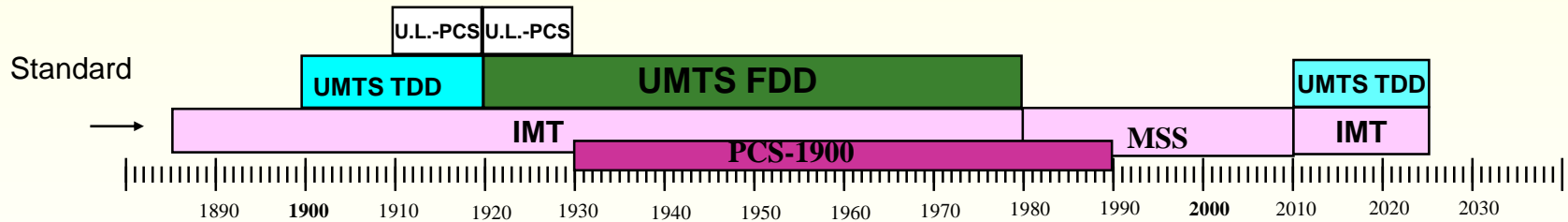
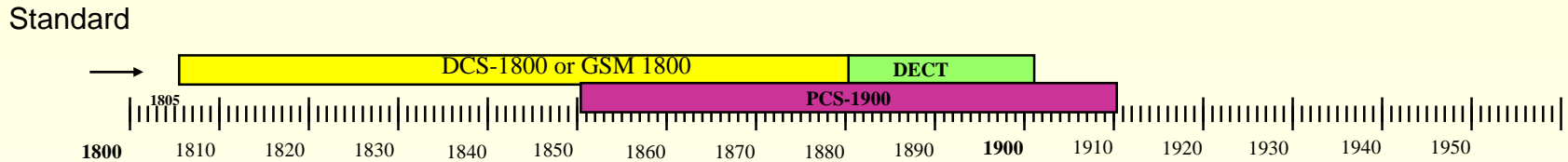
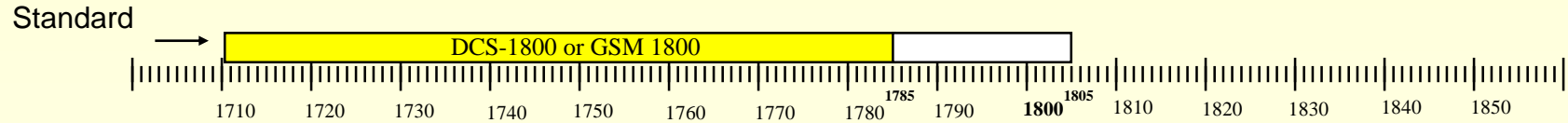


System European standard

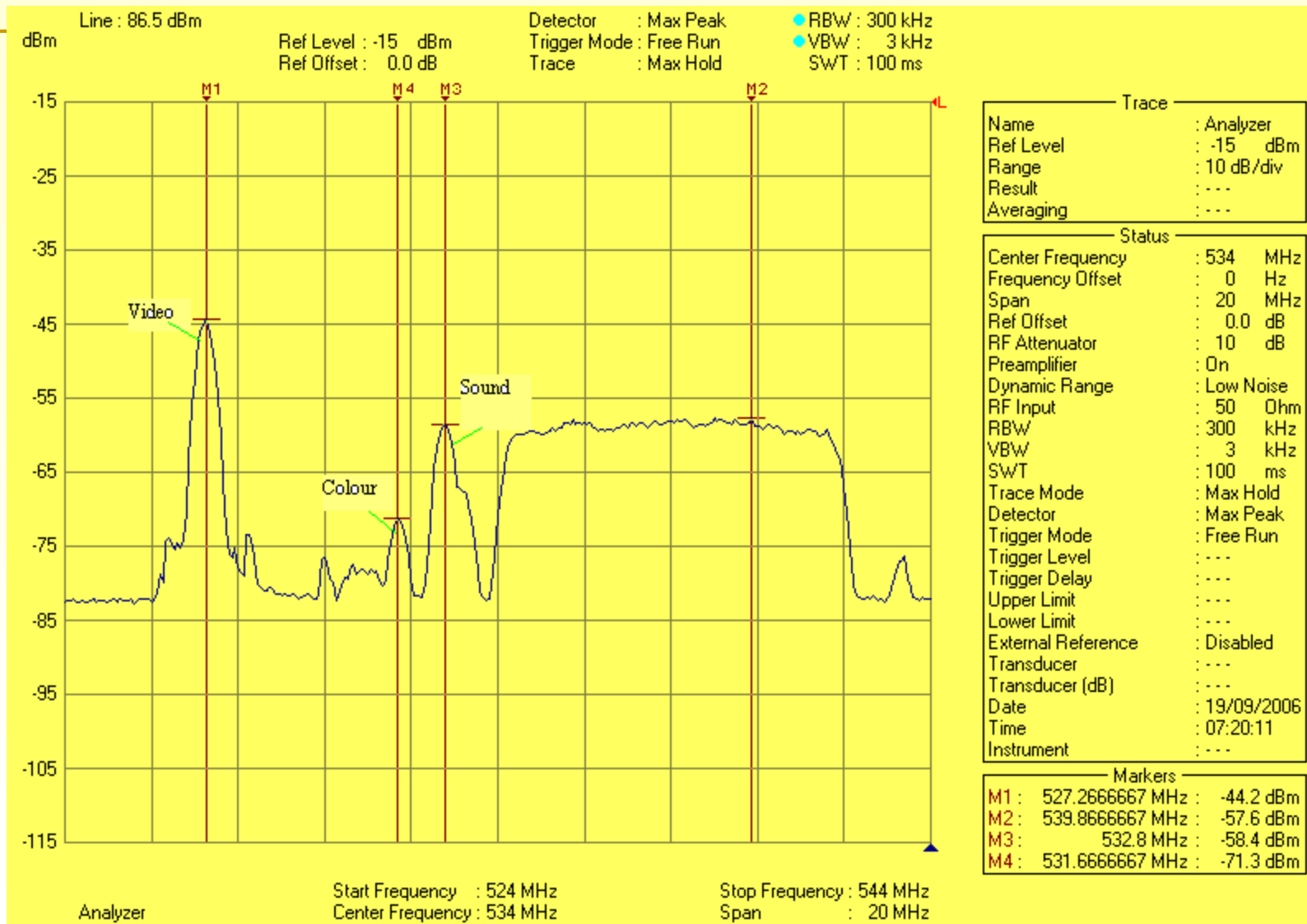


LAND Mobile Standards 1700-2200 MHz

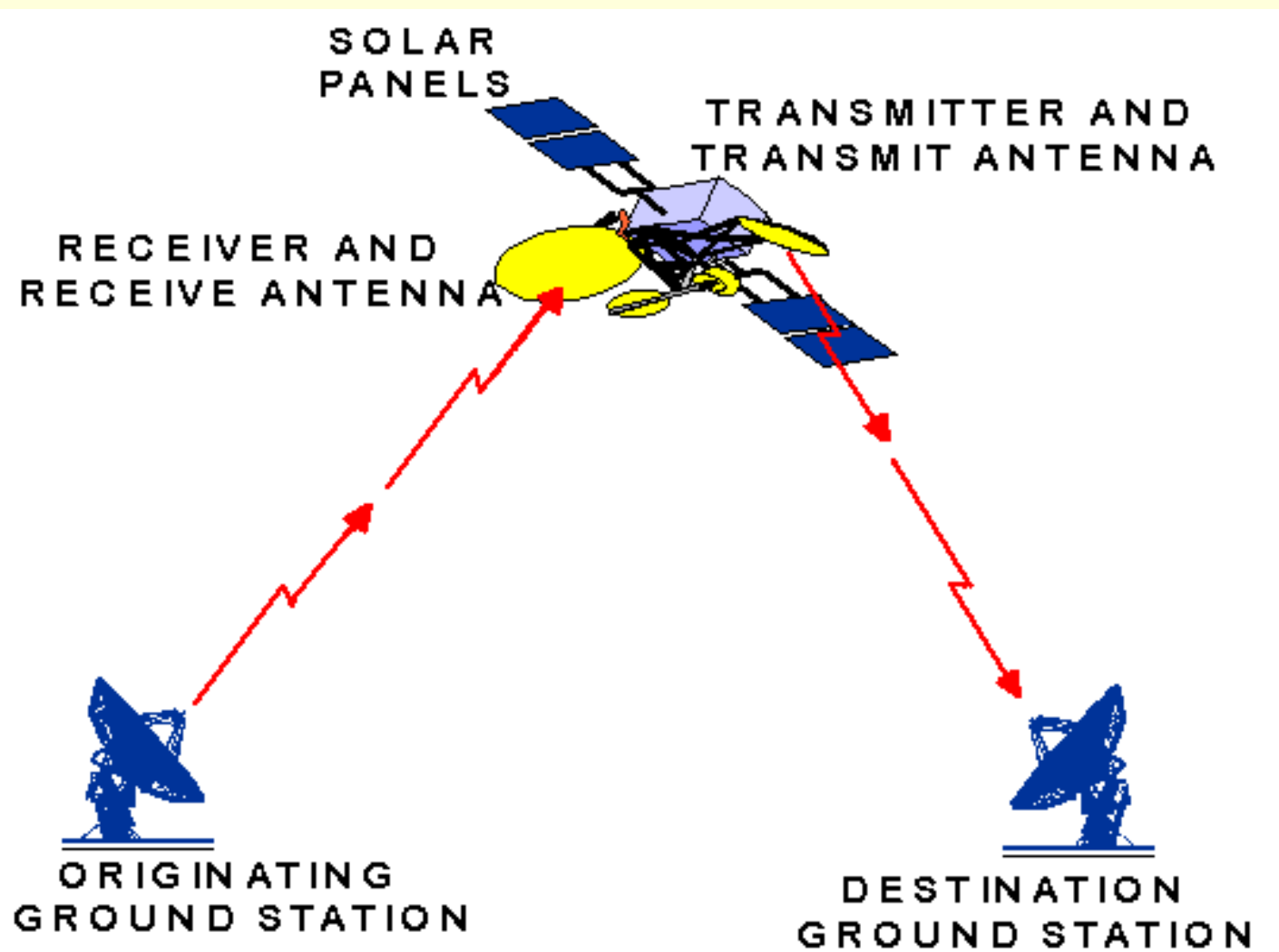
15 October 2008



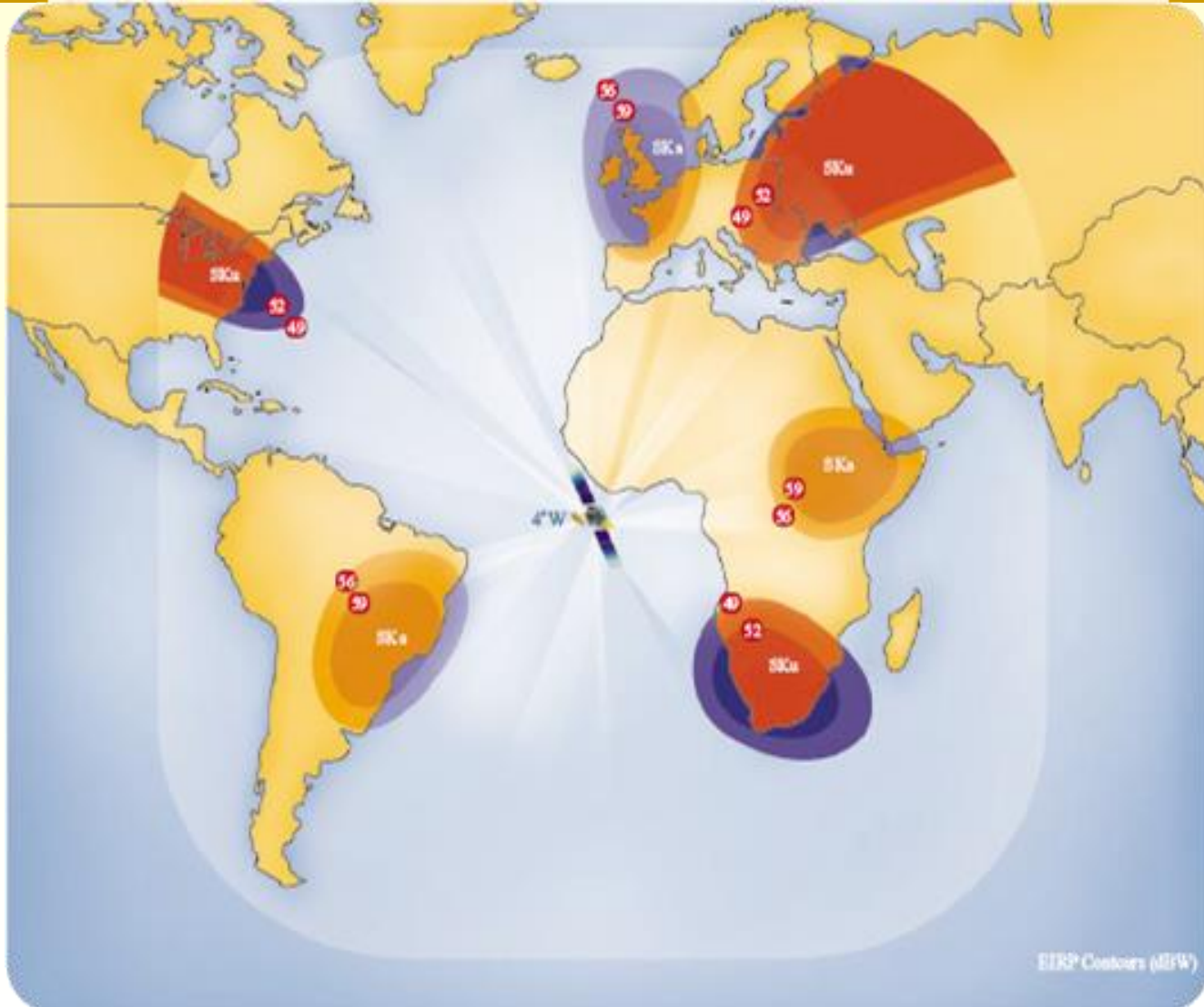
Analogue and Digital TV figures



Fixed Satellite Service, Rami



Amos-3 Global changeable Ku & Ka footprints, Rami



Dr. Haim Mazar (Madjar) mazar@ties.itu.int , mazarh@moc.gov.il Regulation and Standardization of Wireless Communications in Israel, Europe and America 22.12.2009

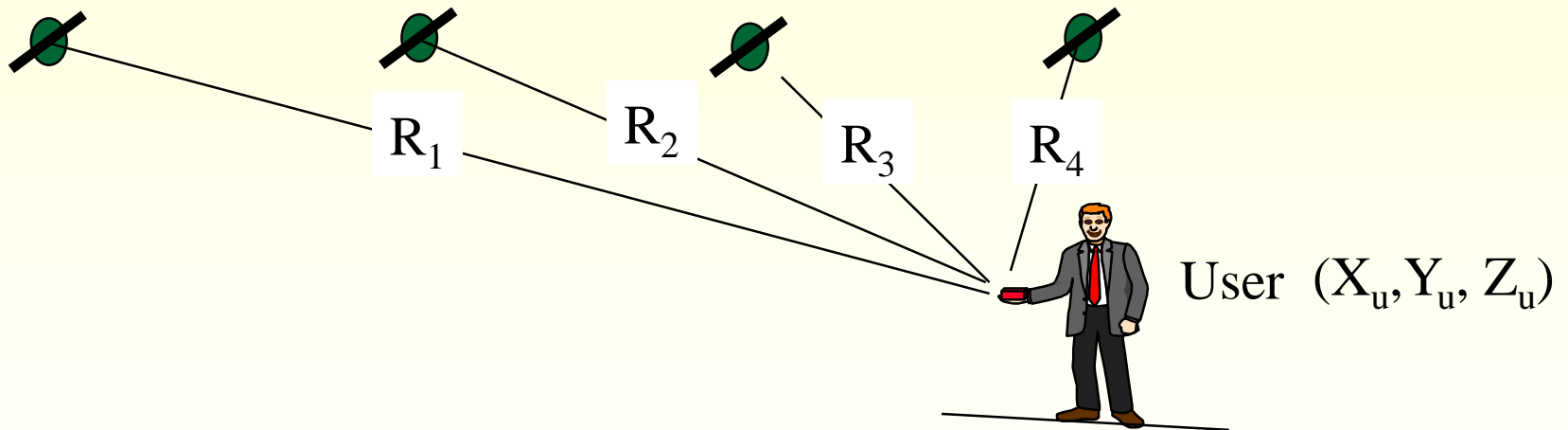
Amos Satellite, Rami



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GPS Principle, Struzak

i-th satellite message: "my time is T_i ; my position is (X_i, Y_i, Z_i) "



Pseudo-ranges:

$$R_i = c(dT_i).$$

Position:

$$(X_i - X_u)^2 + (Y_i - Y_u)^2 + (Z_i - Z_u)^2 = (R_i - C_b)^2$$

$$c = \text{light velocity} \quad C_b = \text{clock bias} \quad i = 1 \dots 4.$$

Free space Loss

PL=PropagationLoss; P_t =T_xPower, P_r =R_xPower; d=distance, λ =wavelength; E_{rms} =field strength

$$A_e = \frac{g\lambda^2}{4\pi}$$

$$PL = \frac{P_t}{P_r} = \frac{P_t}{\left[(P_t \div 4\pi d^2) \cdot \frac{\lambda^2}{4\pi} \right]} = \left(\frac{4\pi d}{\lambda} \right)^2$$

$$PL(dB) = 10 \cdot \log \left(\frac{4\pi d}{\lambda} \right)^2 = 20 \cdot \log \left(\frac{4\pi d}{\lambda} \right)$$

$$\text{Poynting Vector} = \frac{P_t}{4\pi d^2} = \frac{P_r \cdot 4\pi}{\lambda^2} = \frac{1}{\mu_0} (\vec{E} \times \vec{B}) = \frac{E_0^2}{120\pi} \quad E_0 = \frac{\sqrt{30 \cdot P_t}}{d}$$

Transmission loss due to free-space

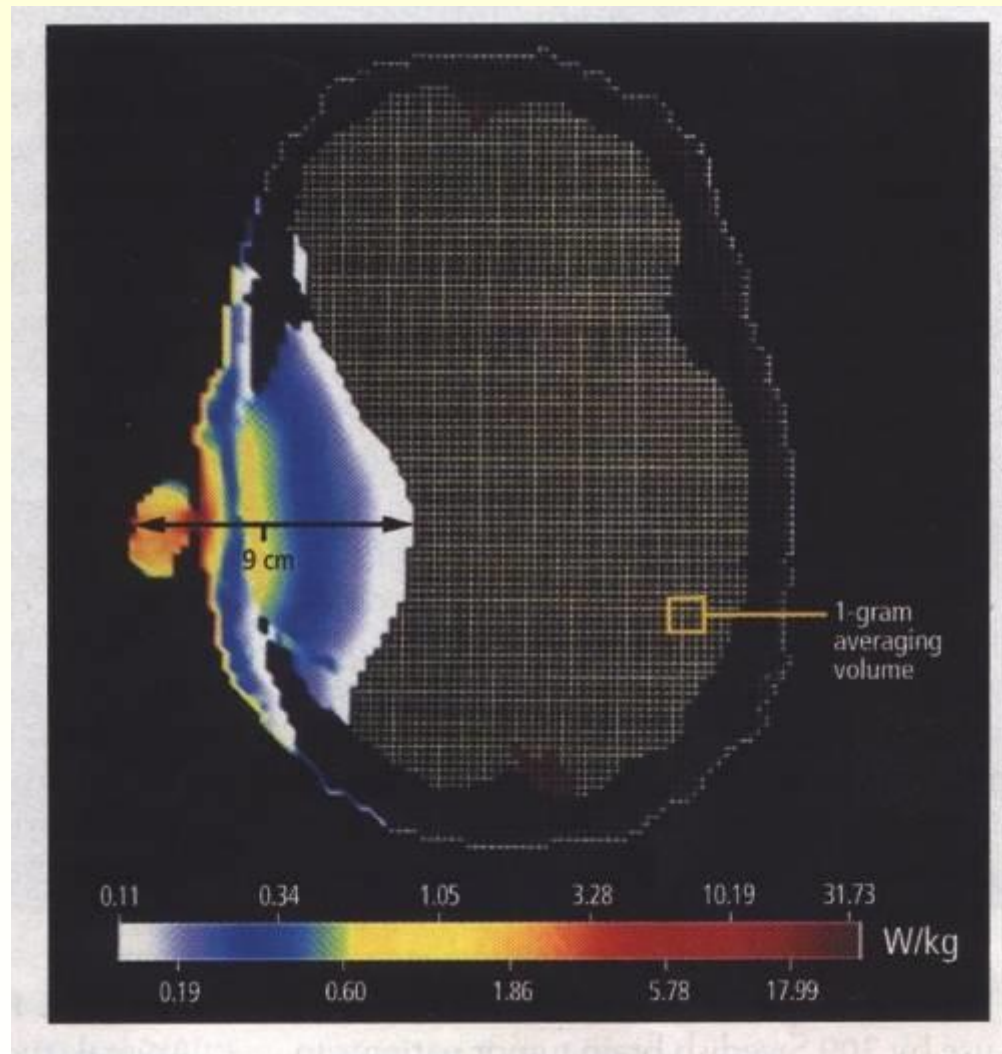
$$L_{bfs} = 32.44 + 20 \log f \text{ (MHz)} + 20 \log d \text{ (km)} \text{ dB}$$

- Free space field strength calculation for broadcasting signals

$$E = 76.9 + P - 20 \log d + H + V$$

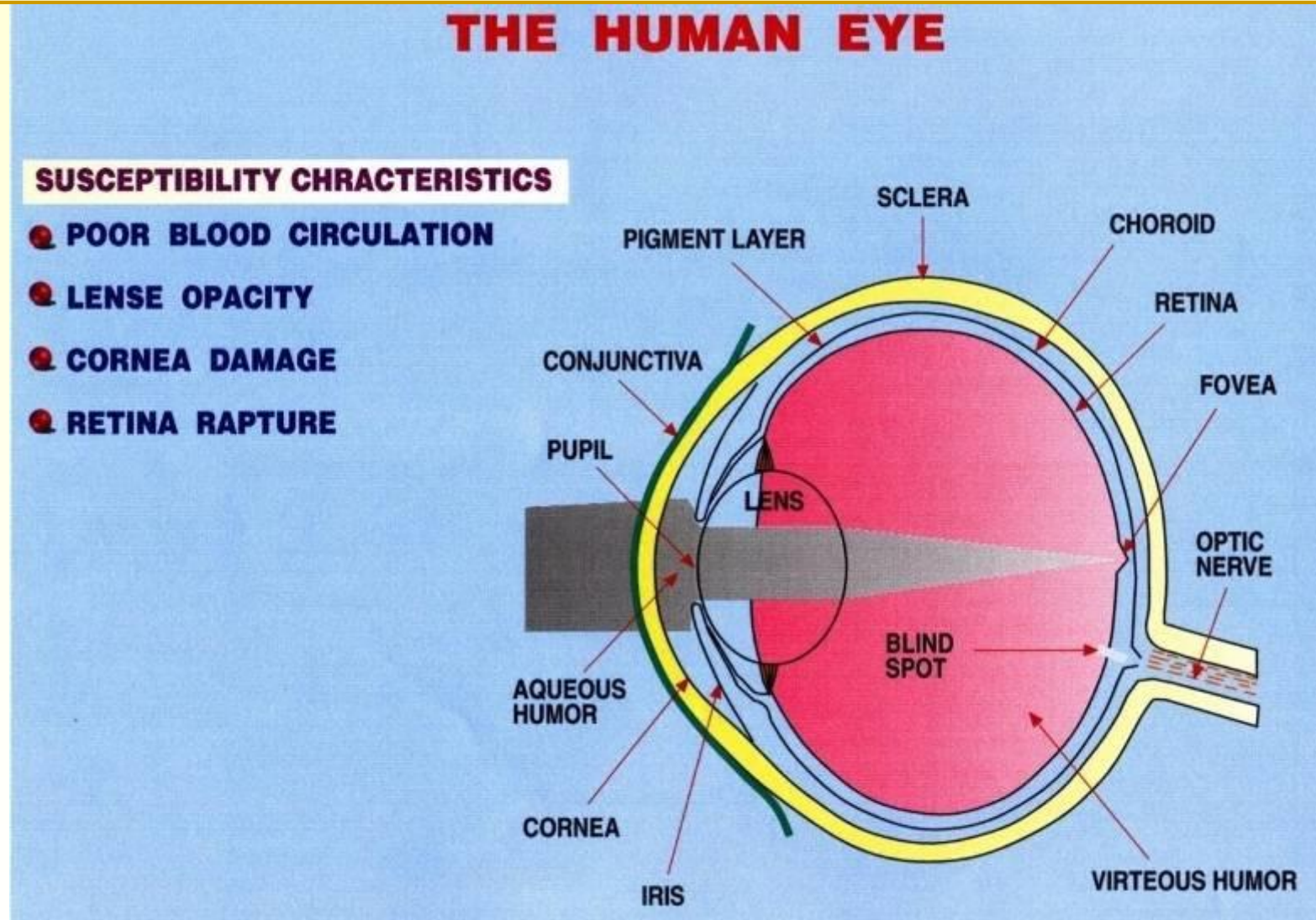
- where:
 - E : field strength (dB(μ V/m)) of the broadcasting signal
 - P : maximum e.r.p. (dBW) of broadcasting station
 - d : slant path distance (km) (see definition in Annex 4)
 - H : h.r.p. correction (dB)
 - V : v.r.p. correction (dB).

Typical SAR from a Cell Phone, Moshe Netzer



Dr. Haim Mazar (Madjar) mazar@ties.itu.int , mazarh@moc.gov.il Regulation and Standardization of Wireless Communications in Israel, Europe and America 22.12.2009

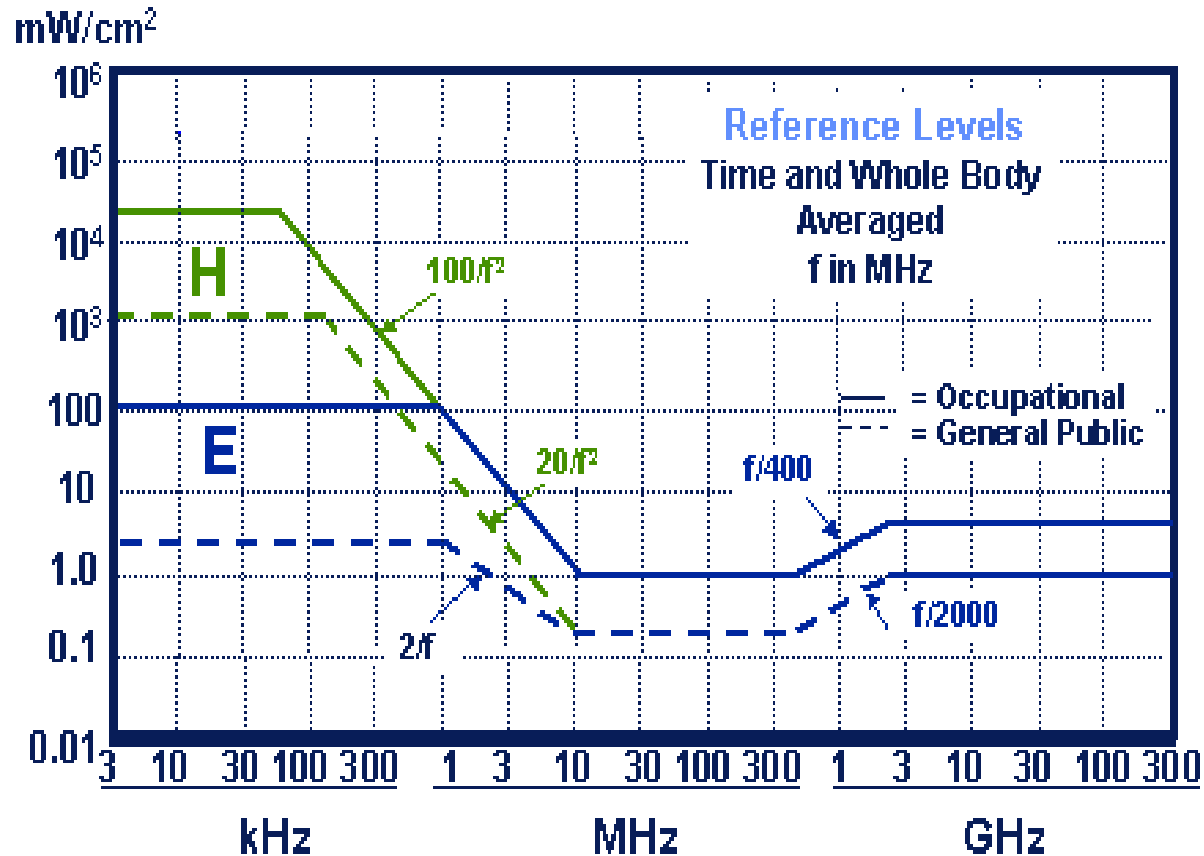
The Human Eye, Moshe Netzer



Basic limits and reference levels RF

workers: 0.4 W/kg , general public 0.08 W/kg

International Council on Non-Ionizing
Radiation Protection (ICNIRP)



ICNIRP and EC Levels for RADHAZ

Frequency range	Equivalent plane wave power density S_{eq} (W/m^2)	Magnetic Flux Density (μT), B
25-800 Hz	-	5,000/f
400-2000 MHz	f/200	$0.0046 f^{1/2}$
2-300 GHz	10	0.2

Same formula adopted in Europe and North America:

100 μT for 50Hz Europe, and 83.3 μT for 60Hz North America.

Differences ICNIRP versus USA (FCC)

Power Density Limits (W/m^2)

Frequency range	ICNIRP	ANSI (USA)
	General Public	Uncontrolled
400 - 1,550 MHz	$f/200$	$f/150$
1,550 - 2,000 MHz	$f/200$	$f/150$

IEEE C95.1-2005 exposures at 400-2,000 MHz is now 4/3 more stringent (new $f/200 W/m^2$) relative to IEEE 1991 ($f/1500 mW/cm^2 = f/150 W/m^2$)

The updated IEEE value (2005) is identical (not to FCC nor ANSI present levels) to the ICNIRP level ($f/200 W/m^2$)

1998 Tolerability to EM Risk, relative to **ICNIRP**

US, Canada and Japan are more tolerant of risk - **133%** ICNIRP

Countries **less** tolerant of risk, with **more stringent** thresholds:

Country	Power Density Relative to ICNIRP
Switzerland	1%
Italy	2%- 20%
Poland	2%
Luxembourg	5%
China	8%
Israel	10%
Bulgaria	12%
Russia	20%
Belgium	25%
Greece	80%

1998 Tolerability to Magnetic Risk, relative to **ICNIRP**

Countries Less Tolerant to Magnetic Risk

Country	<i>Magnetic Flux Density Relative to ICNIRP</i>
Switzerland	1%
Italy	3% (daily mean, for more than 4 hours); 10% (for 'designed lines')
Slovenia	10% (for new installations)
Israel	10% (proposed in 'occupational' area)
Russia	10% (indoor); 50% (outdoor)
Poland	75%
Greece	80%