WiFi and Mobile Phones
~
problem, what problem?

Wireless technology radiofrequency radiation

Alasdair Philips

Much Hadham seminar - October 2014

Powerwatch

Alasdair Philips:

- Qualified in Electronics and in Agriculture
- First built walkie-talkies while at school in 1964
- Has designed electronic equipment for 40 years
- Worked on radio-based Mobile-Fax design in early 1970s
- Has monitored EMF-bioeffects research for about 30 years
- Included in most official UK EMF/health stakeholder groups

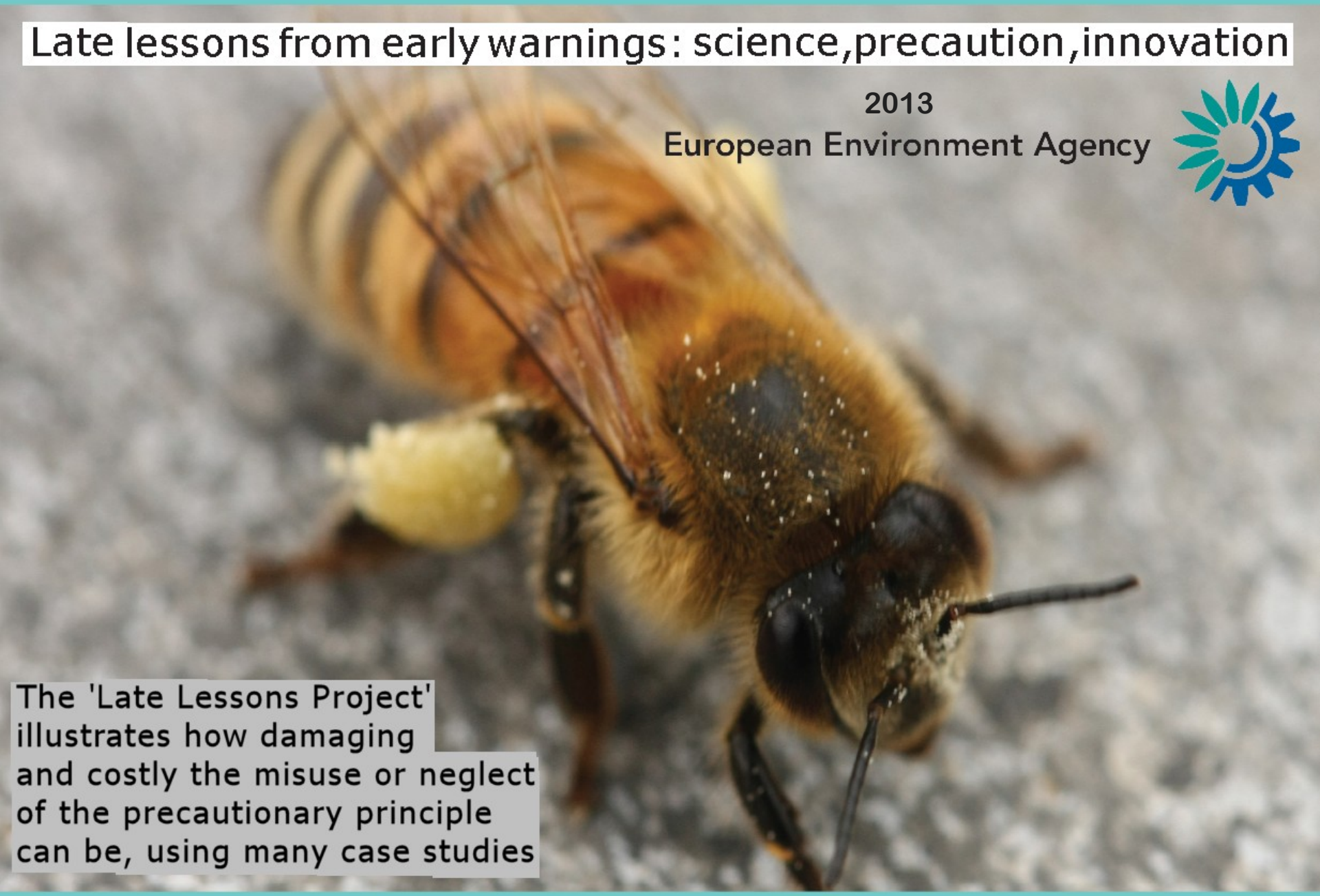
Powerwatch was founded in 1988

www.powerwatch.org.uk

Late lessons from early warnings: science,precaution,innovation

2013

European Environment Agency

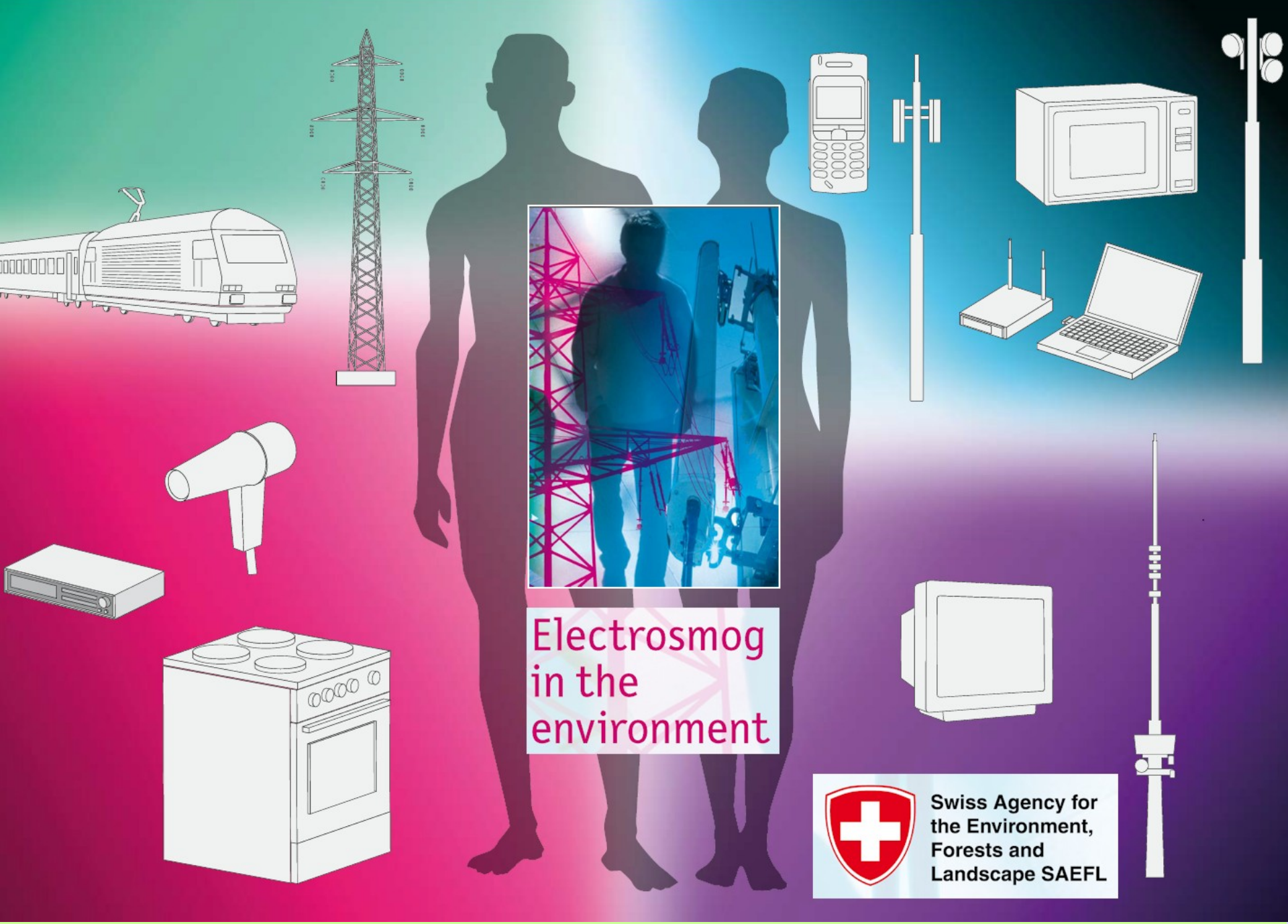


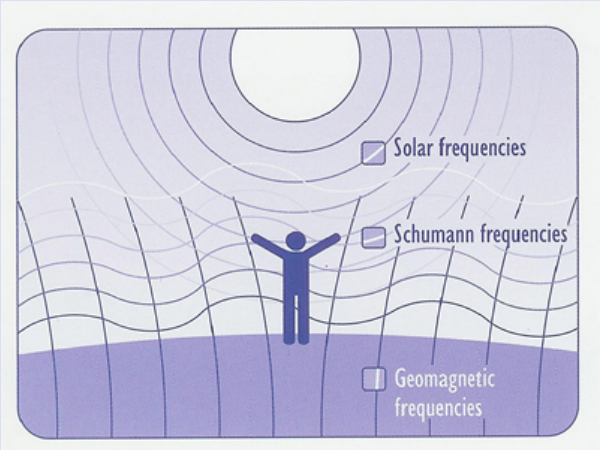
The 'Late Lessons Project' illustrates how damaging and costly the misuse or neglect of the precautionary principle can be, using many case studies

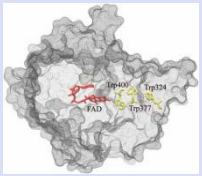
A few previously denied hazards

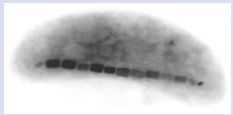
These are from a very long list!

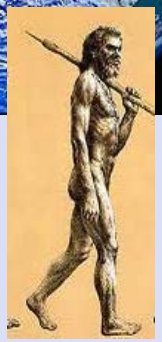
- Radium creams for a “healthy glow”
- X-rays in pregnancy
- Smoking
- Radioactive fall-out from bomb tests
- Lead in petrol ~ swap to Benzene !


Electrosmog
in the
environment
Swiss Agency for
the Environment,
Forests and
Landscape SAEFL









Earth forms (4.5 bn)

Cryptochromes ~2.5 bn

Magnetotactic bacteria (2 bn)

Bird compass (90 m)

Early man (6 m)

Electrification (1880-1930)

Present day

Big bang (13.2 bn)

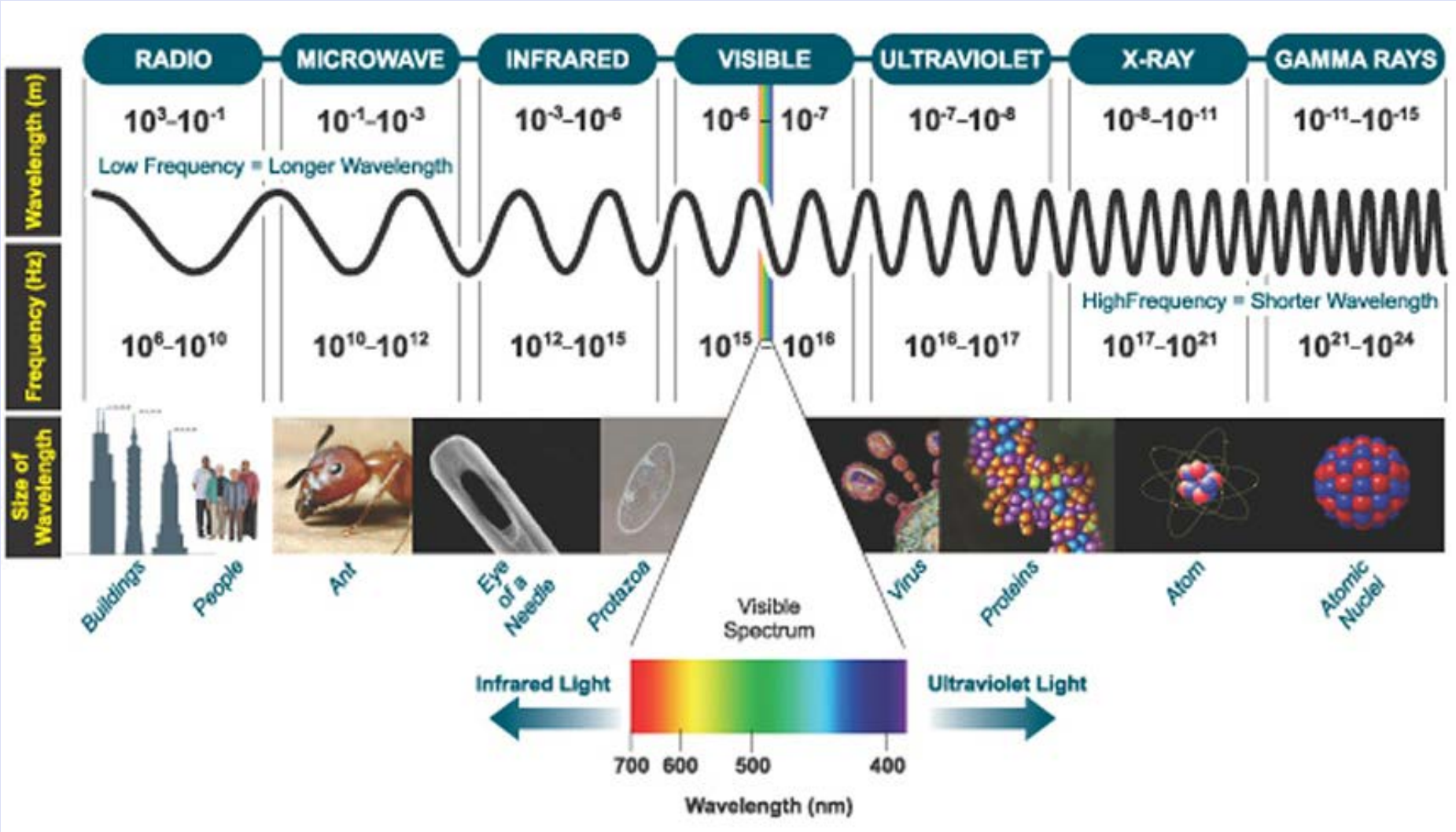
Significant RF 50 years

10^{11} 10^{10} 10^{9} 10^{8} 10^{7} 10^{6} 10^{5} 10^{4} 10^{3} 10^{2} 10^{1} 1

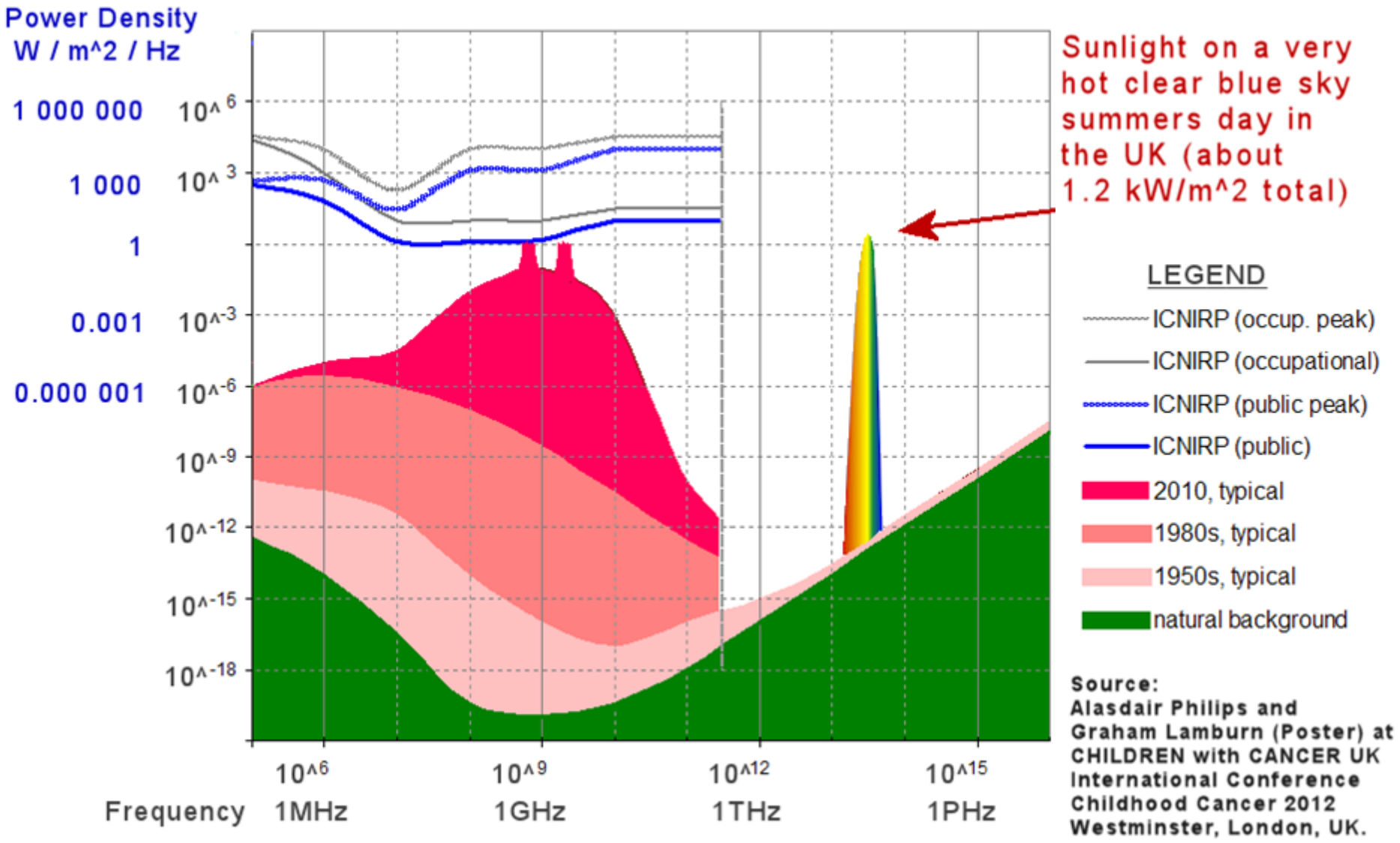
Time (years)

The Electromagnetic Spectrum

non-ionising // ionising

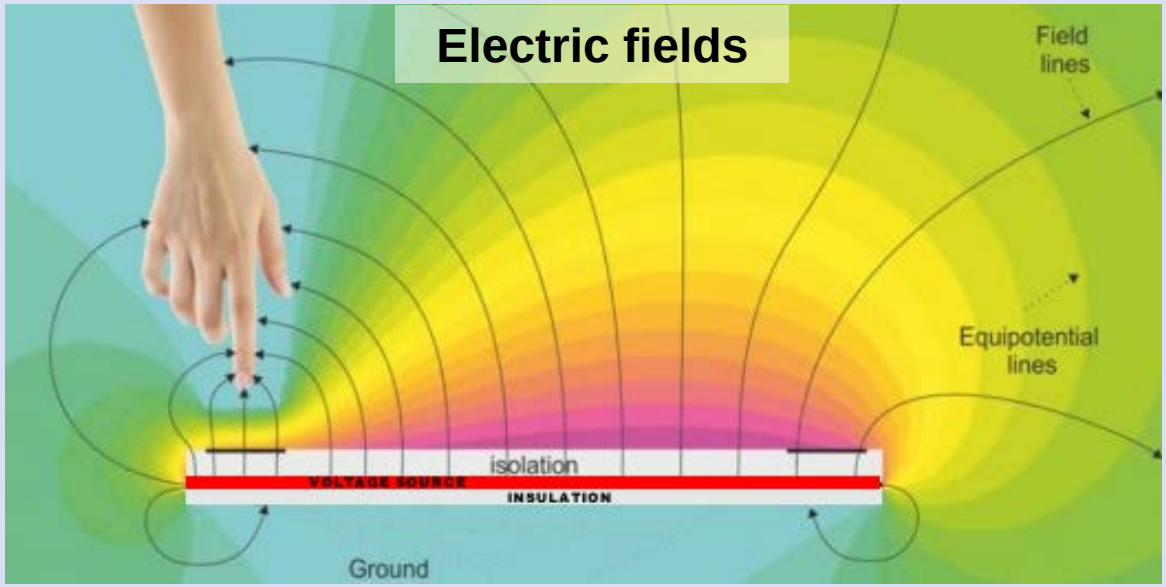


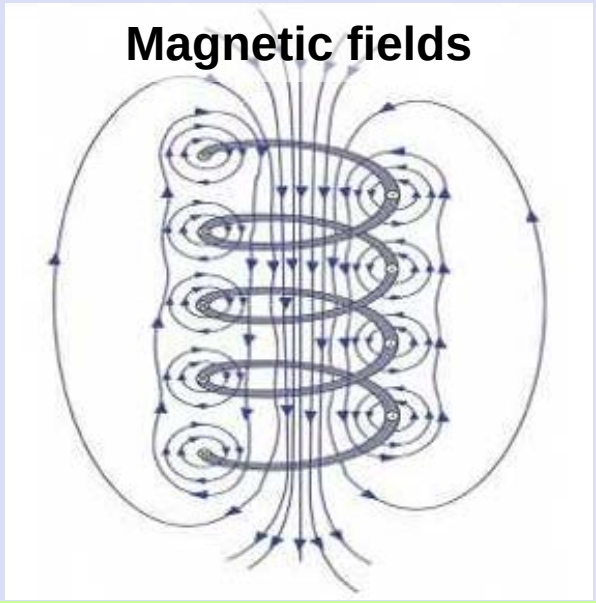
Changes in EMF/RF Environment over time

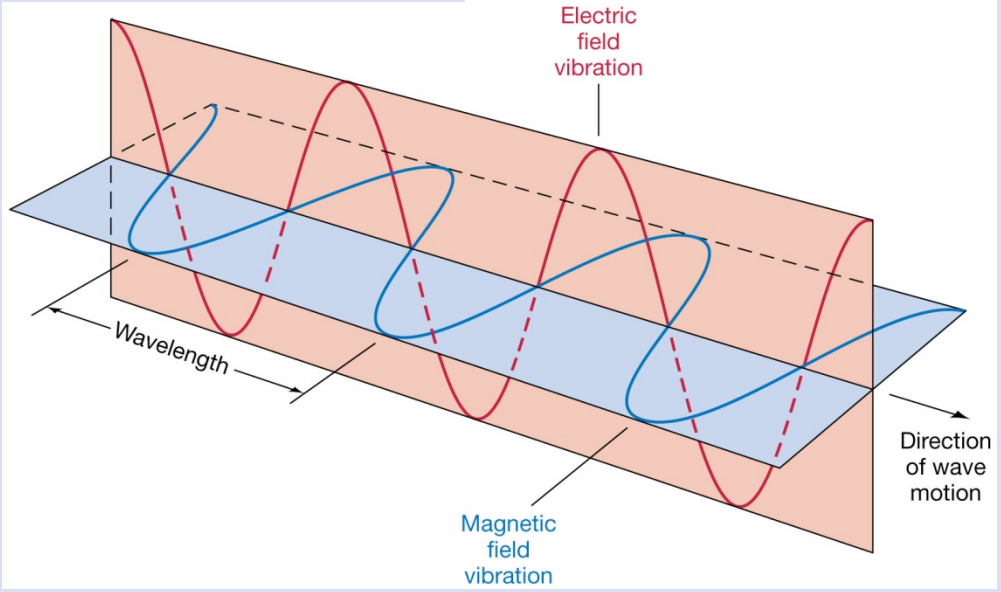


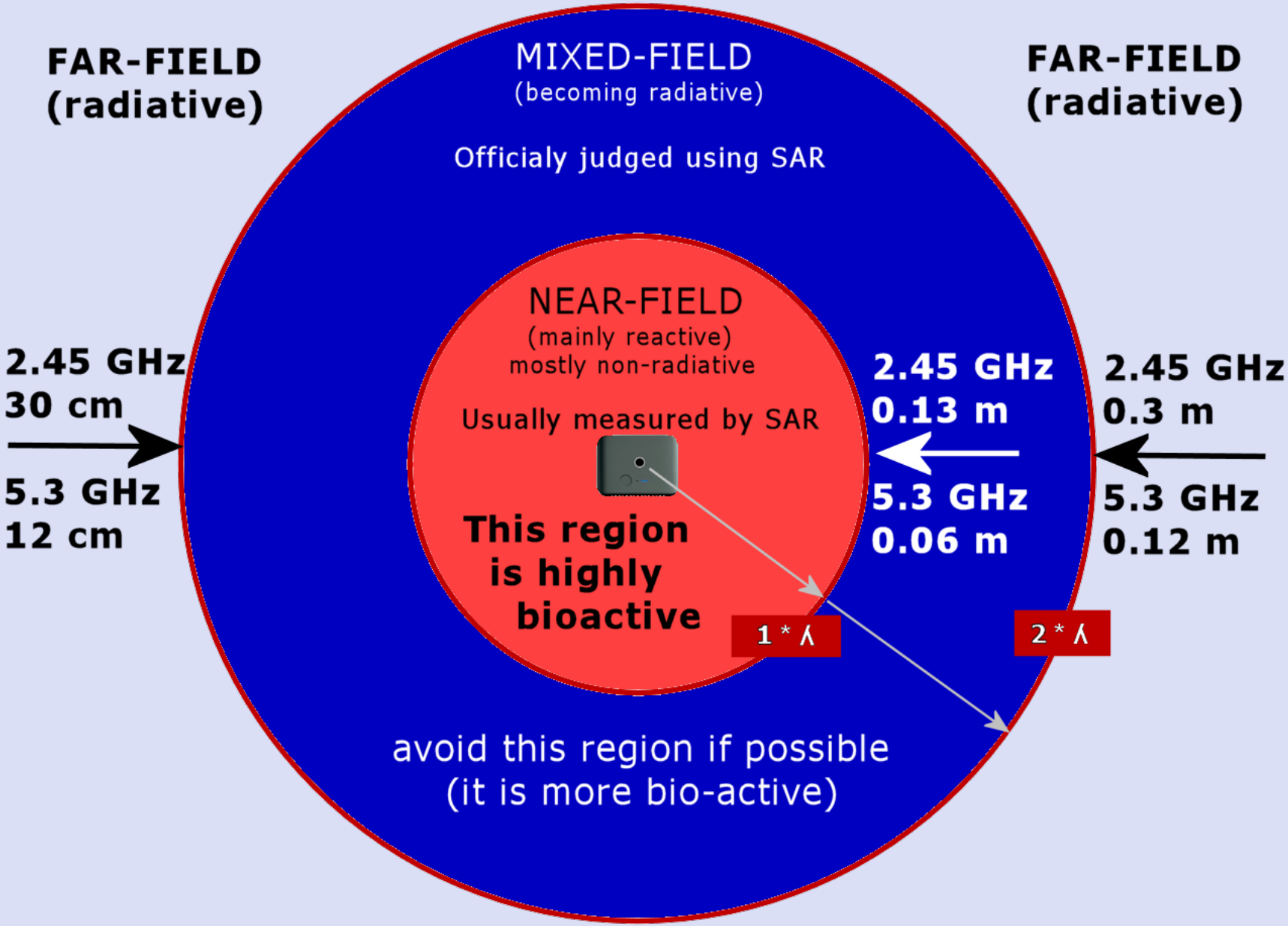
Source:
Alasdair Philips and Graham Lamburn (Poster) at CHILDREN with CANCER UK International Conference Childhood Cancer 2012 Westminster, London, UK.

Electric, magnetic and electromagnetic fields








FAR-FIELD
(radiative)
MIXED-FIELD
(becoming radiative)
Officialy judged using SAR
FAR-FIELD
(radiative)
NEAR-FIELD
(mainly reactive)
mostly non-radiative
Usually measured by SAR
This region
is highly
bioactive
2.45 GHz
30 cm
5.3 GHz
12 cm
2.45 GHz
0.13 m
5.3 GHz
0.06 m
2.45 GHz
0.3 m
5.3 GHz
0.12 m
1 * λ
2 * λ
avoid this region if possible
(it is more bio-active)

Assessment of RF SAR etc

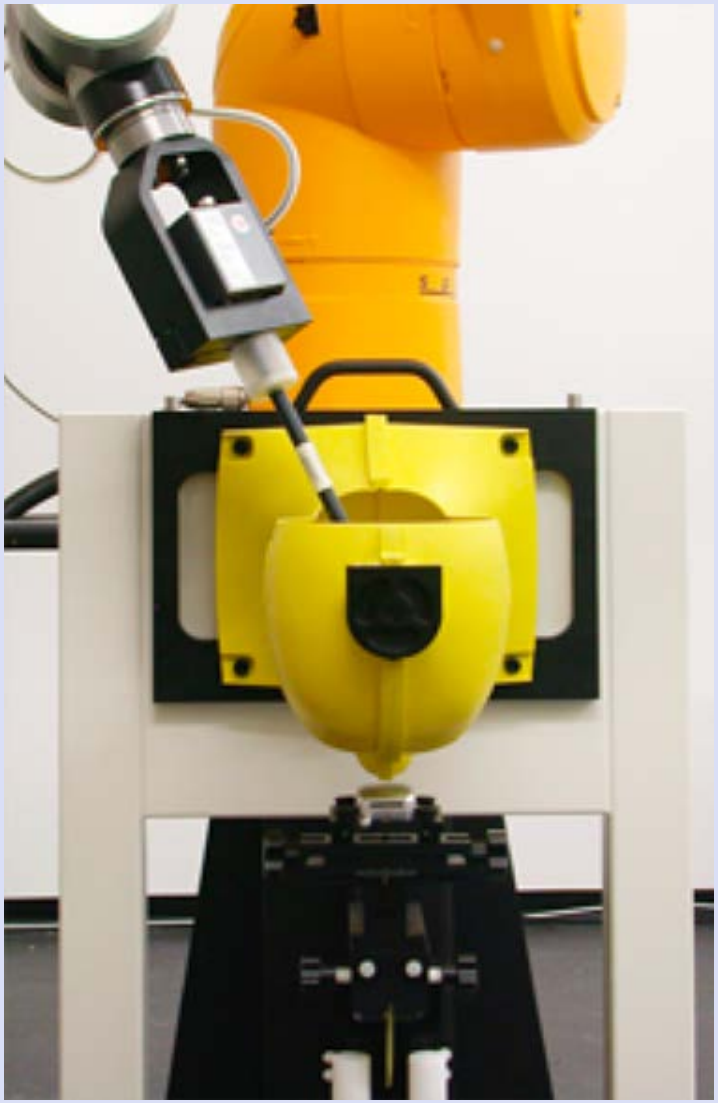
Currently Specific Absorbed Rate (SAR) is measured using a “phantom head” filled with a gooey mushy gunk that is nick-named “liquid brain” and they look for the maximum fields related to a heating effect…

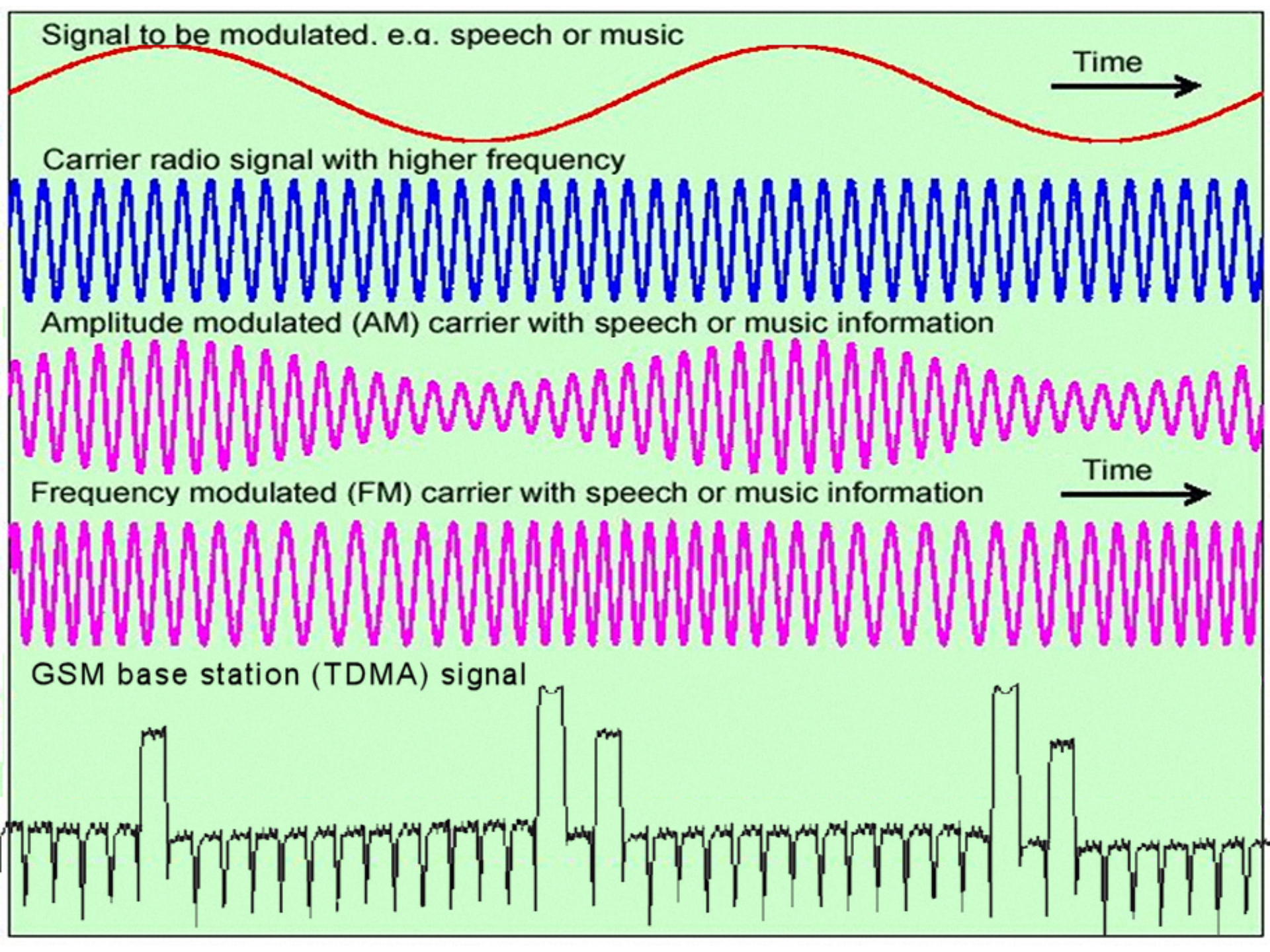
They also mathematically “model” the brain in some more detail, but again only looking for maximum absorbed power.

Not a great deal to do with proper living working brains. Here are the slowed-down sounds of brain synapses exchanging electrical messages.

news.bbc.co.uk/today/hi/today/
newsid_7679000/7679354.stm

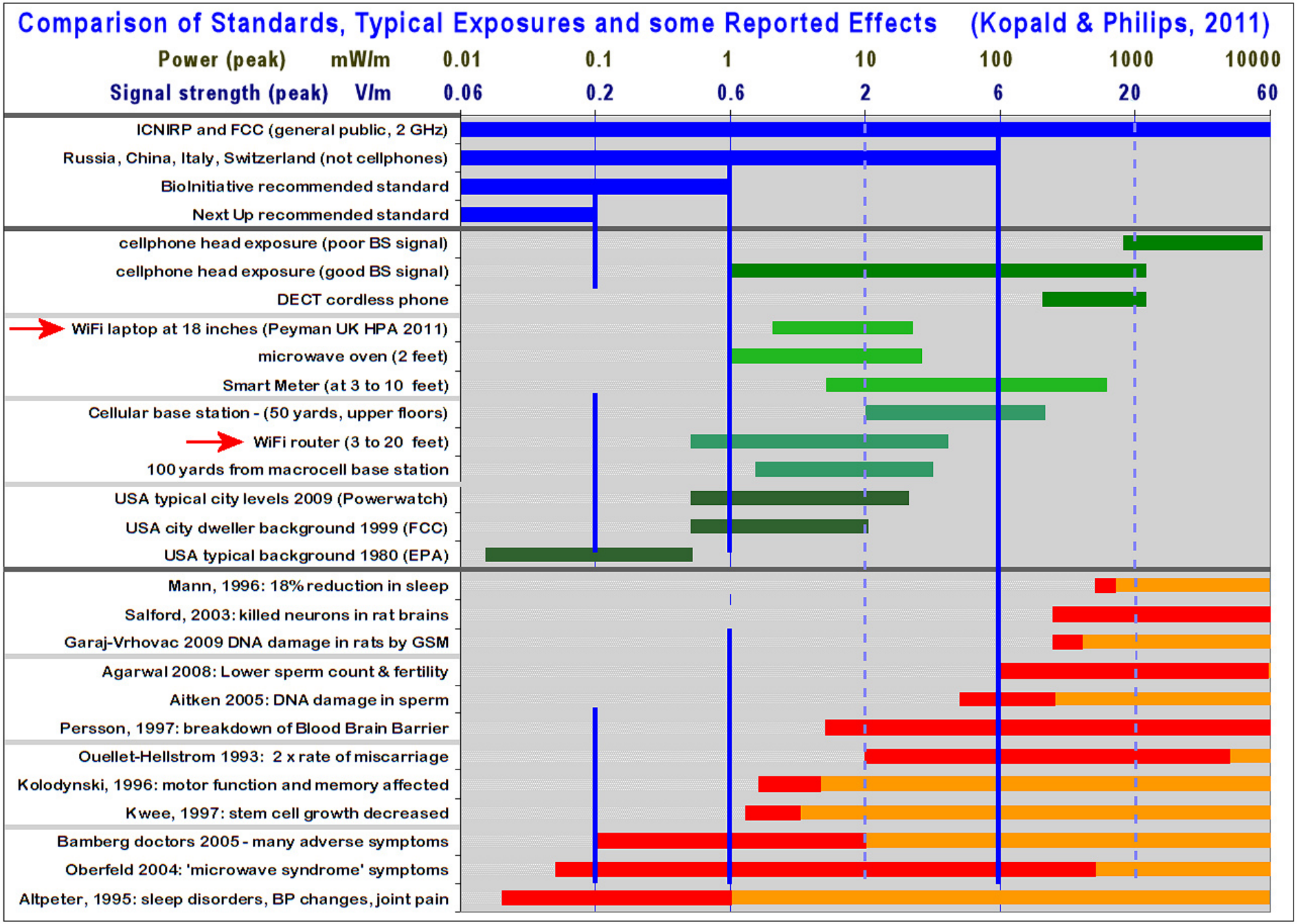
also available in full from the Powerwatch website




Signal to be modulated. e.g. speech or music
Time
Carrier radio signal with higher frequency
Amplitude modulated (AM) carrier with speech or music information
Time
Frequency modulated (FM) carrier with speech or music information
GSM base station (TDMA) signal

What about real signals?

- Background, no mast nearby
- DECT domestic cordless phone base unit
- TETRA (police and emergency services) mast
- GSM mast
- 3G (UMTS) mast


Comparison of Standards, Typical Exposures and some Reported Effects (Kopald & Philips, 2011)
Power (peak) mW/m 0.01 0.1 1 10 100 1000 10000
Signal strength (peak) V/m 0.06 0.2 0.6 2 6 20 60
ICNIRP and FCC (general public, 2 GHz)
Russia, China, Italy, Switzerland (not cellphones)
BioInitiative recommended standard
Next Up recommended standard
cellphone head exposure (poor BS signal)
cellphone head exposure (good BS signal)
DECT cordless phone
WiFi laptop at 18 inches (Peyman UK HPA 2011)
microwave oven (2 feet)
Smart Meter (at 3 to 10 feet)
Cellular base station - (50 yards, upper floors)
WiFi router (3 to 20 feet)
100 yards from macrocell base station
USA typical city levels 2009 (Powerwatch)
USA city dweller background 1999 (FCC)
USA typical background 1980 (EPA)
Mann, 1996: 18% reduction in sleep
Salford, 2003: killed neurons in rat brains
Garaj-Vrhovac 2009 DNA damage in rats by GSM
Agarwal 2008: Lower sperm count & fertility
Aitken 2005: DNA damage in sperm
Persson, 1997: breakdown of Blood Brain Barrier
Ouellet-Hellstrom 1993: 2 x rate of miscarriage
Kolodynski, 1996: motor function and memory affected
Kwee, 1997: stem cell growth decreased
Bamberg doctors 2005 - many adverse symptoms
Oberfeld 2004: 'microwave syndrome' symptoms
Altpeter, 1995: sleep disorders, BP changes, joint pain

International exposure guidelines

1800 MHz Public Exposure Guidelines		Equivalent	c.f. speed	
	uW/m2	**V/m**	**m.p.h.**	
NRPB prior to IEGMP (Stewart) Report	100,000,000	194	9479	A
ICNIRP (1998), WHO	9,000,000	58	2847	B
Belgium (ex Wallonia)	1,115,000	21	1002	C
Italy (sum of frequencies)	100,000	6	300	D
Russia, PRChina	100,000	6	300	E
Switzerland, Lichtenstein, Luxembourg	95,000	6	292	F
Belgium Wallonia	24,000	3	147	G
Wien (sum GSM)	10,000	1.9	95	H
Italy (single frequency)	1000	0.6	30	I
Salzburg 1998 (sum GSM)	1000	0.6	30	J
EU-Parl, GD Wissenschaft, STOA GSM (2001)	100	0.2	9	K
Salzburg GSM/3G outside houses (2002)	10	0.06	3	L
Salzburg GSM/3G inside houses (2002)	1	0.02	1	M
Bürgerforum BRD proposal, waking areas (1999)	1	0.02	1	N
Bürgerforum BRD proposal, sleeping areas (1999)	0.01	0.002	0.1	O
Mobile phone handsets can work down to about	0.000 002	0.000 03	0.0015	

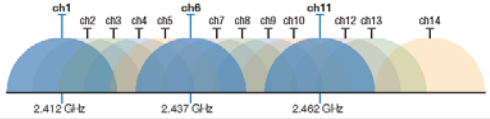
802.11 Wi-Fi Physical Layer and Transmitter Measurements

Tektronix

	802.11b (HR/DSSS)	802.11a and 802.11g (ERP)	802.11n (HT)	802.11ac (VHT)	Channel # / Center Frequency

Channel Allocation

2.4 GHz

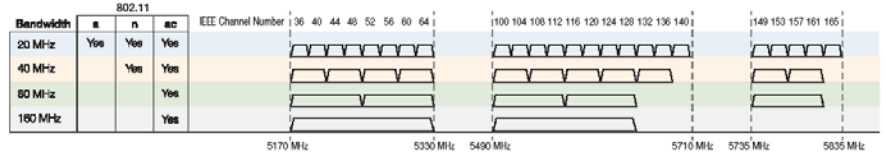


2.4 GHz										
Primary Channel	1	2	3	4	5	6	7	8	9	
2nd Channel	5	6	7	8	9	10	11	12	13	
Center Channel	3	4	5	6	7	8	9	10	11	
Center Frequency	2422	2427	2432	2437	2442	2442	2452	2457	2462	

5 GHz

802.11

Bandwidth	a	n	ac
20 MHz	Yes	Yes	Yes
40 MHz		Yes	Yes
80 MHz			Yes
160 MHz			Yes



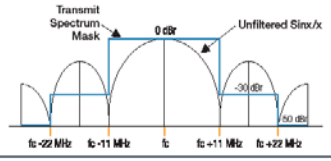
2.4 GHz					
Channel Number	Center Frequency	North America (FCC)	Europe (ETSI)	Japan	ROW
1	2412	Yes	Yes	Yes	Yes
2	2417	Yes	Yes	Yes	Yes
3	2422	Yes	Yes	Yes	Yes
4	2427	Yes	Yes	Yes	Yes
5	2432	Yes	Yes	Yes	Yes
6	2437	Yes	Yes	Yes	Yes
7	2442	Yes	Yes	Yes	Yes
8	2447	Yes	Yes	Yes	Yes
9	2452	Yes	Yes	Yes	Yes
10	2457	Yes	Yes	Yes	Yes
11	2462	Yes	Yes	Yes	Yes
12	2467	No	Yes	Yes	Yes
13	2472	No	Yes	Yes	Yes
14	2484	No	No	802.11b only	No

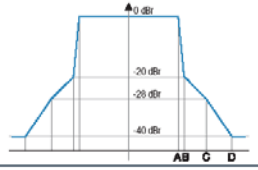
5 GHz					
Channel Number	Center Frequency	U.S.	Europe	Japan	China
36	5180	Yes	Indoors	Yes	Yes
38	5190	No	No	Client Only	No
40	5200	Yes	Indoors	Yes	Yes
42	5210	No	No	Client Only	No
44	5220	Yes	Indoors	Yes	Yes
46	5230	No	No	Client Only	No
48	5240	Yes	Indoors	Yes	Yes
52	5260	DFS	Indoors/DFS/TPC	DFS/TPC	Yes
56	5280	DFS	Indoors/DFS/TPC	DFS/TPC	Yes
60	5300	DFS	Indoors/DFS/TPC	DFS/TPC	Yes
64	5320	DFS	DFS/TPC	DFS/TPC	Yes
100	5500	DFS	DFS/TPC	DFS/TPC	Yes
104	5520	DFS	DFS/TPC	DFS/TPC	Yes
108	5540	DFS	DFS/TPC	DFS/TPC	No
112	5560	DFS	DFS/TPC	DFS/TPC	No
116	5580	DFS	DFS/TPC	DFS/TPC	No
120	5600	No	DFS/TPC	DFS/TPC	No
124	5620	No	DFS/TPC	DFS/TPC	No
128	5640	No	DFS/TPC	DFS/TPC	No
132	5660	DFS	DFS/TPC	DFS/TPC	No
136	5680	DFS	DFS/TPC	DFS/TPC	No
140	5700	DFS	DFS/TPC	DFS/TPC	No
149	5745	Yes	SRD	No	Yes
153	5765	Yes	SRD	No	Yes
157	5785	Yes	SRD	No	Yes
161	5805	Yes	SRD	No	Yes
165	5825	Yes	SRD	No	Yes

5 GHz				
Channel Number	Center Frequency	Korea	Australia	Brazil
36	5180	Yes	Yes	Indoors
38	5190	Yes	No	Indoors
40	5200	Yes	Yes	Indoors
42	5210	Yes	No	Indoors
44	5220	Yes	Yes	Indoors
46	5230	Yes	No	Indoors
48	5240	Yes	Yes	Indoors
52	5260	Yes	DFS/TPC	Indoors
56	5280	Yes	DFS/TPC	Indoors
60	5300	Yes	DFS/TPC	Indoors
64	5320	Yes	DFS/TPC	Indoors
100	5500	Yes	DFS/TPC	DFS
104	5520	Yes	DFS/TPC	DFS
108	5540	Yes	DFS/TPC	DFS
112	5560	Yes	DFS/TPC	DFS
116	5580	Yes	DFS/TPC	DFS
120	5600	Yes	No	DFS
124	5620	Yes	No	DFS
128	5640	Yes	No	DFS
132	5660	No	DFS/TPC	DFS
136	5680	No	DFS/TPC	DFS
140	5700	No	DFS/TPC	DFS
149	5745	Yes	Yes	Yes
153	5765	Yes	Yes	Yes
157	5785	Yes	Yes	Yes
161	5805	Yes	Yes	Yes
165	5825	Yes	Yes	Yes

DFS = Dynamic Frequency Selection
TPC = Transmit Power Control
SRD = Short Range Devices 25 mW max power

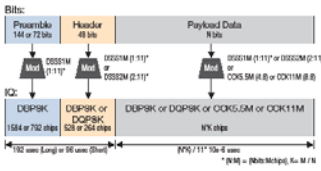
Spectral Shape and Emission Mask

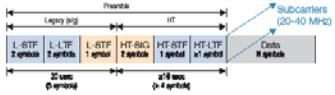


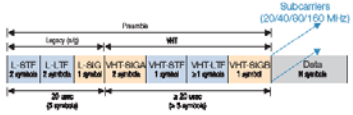


Spectral Mask for 20, 40, 60, and 160 MHz Channels				
Channel Size	A	B	C	D
20 MHz	9 MHz	11 MHz	20 MHz	30 MHz
40 MHz	19 MHz	21 MHz	40 MHz	60 MHz
80 MHz	39 MHz	41 MHz	80 MHz	120 MHz
160 MHz	79 MHz	61 MHz	160 MHz	240 MHz

Packet Information







Data Rates and Modulation Types

802.11b			
Signal Field HEX	Data Rate	Spreading/ Coding Scheme	Modulation
0A	1 Mbps	11 chip barker code	DBPSK
14	2 Mbps	11 chip barker code	DQPSK
37	5.5 Mbps	CCK	DQPSK
6E	11 Mbps	CCK	DQPSK

802.11a/g (20 MHz Bandwidth)			
Rate	Modulation	FEC Rate	Data Rate
1101 (13)	BPSK	1/2	6 Mbps
1111 (15)	BPSK	3/4	9 Mbps
0101 (5)	QPSK	1/2	12 Mbps
0111 (7)	QPSK	3/4	18 Mbps
1001 (9)	16QAM	1/2	24 Mbps
1011 (11)	16QAM	3/4	36 Mbps
0001 (1)	64QAM	2/3	48 Mbps
0011 (3)	64QAM	3/4	54 Mbps

802.11n			802.11ac					
MCS	Modulation	FEC Rate	Data Rate (SISO: 1 Stream, Short Guard Interval)					
			20 MHz	40 MHz	20 MHz	40 MHz	80 MHz	160 MHz
0	BPSK	1/2	7.2 Mbps	15.0 Mbps	7.2 Mbps	15.0 Mbps	32.5 Mbps	65 Mbps
1	QPSK	1/2	14.4 Mbps	30.0 Mbps	14.4 Mbps	30.0 Mbps	65 Mbps	130 Mbps
2	QPSK	3/4	21.7 Mbps	45.0 Mbps	21.7 Mbps	45.0 Mbps	97.5 Mbps	195 Mbps
3	16QAM	1/2	28.9 Mbps	60.0 Mbps	28.9 Mbps	60.0 Mbps	130 Mbps	260 Mbps
4	16QAM	3/4	43.3 Mbps	90.0 Mbps	43.3 Mbps	90.0 Mbps	195 Mbps	390 Mbps
5	64QAM	2/3	57.8 Mbps	120.0 Mbps	57.8 Mbps	120.0 Mbps	260 Mbps	525 Mbps
6	64QAM	3/4	65.0 Mbps	135.0 Mbps	65.0 Mbps	135.0 Mbps	292.5 Mbps	585 Mbps
7	64QAM	5/6	72.2 Mbps	150.0 Mbps	72.2 Mbps	150.0 Mbps	325 Mbps	650 Mbps
8	256QAM	3/4			86.7 Mbps	180.0 Mbps	390 Mbps	780 Mbps
9	256QAM	5/6				200.0 Mbps	433.3 Mbps	866.7 Mbps

Transmitter Measurements

Type of Measurement	Measurement	802.11						IEEE Standard Limit
		DSSS	b	a	g	n	ac	
Transmit Power	Transmit Power	Yes	Yes	Yes	Yes	Yes		Country Dependent
	Transmit Power On/Off Ramp	Yes	Yes					(10% - 90%) 2 us
Transmit Spectral	Transmit Spectrum Mask	Yes	Yes	Yes	Yes	Yes	Yes	Standard Mask
	RF Carrier Suppression	Yes	Yes					-15 dB
	Center Frequency Leakage			Yes		20 MHz		-15 dBc or +2 dB w.r.t. averages subcarrier power
						40 MHz		-20 dBc or +0 dB w.r.t. averages subcarrier power
	Transmit Spectral Flatness			Yes			Yes	± 4 dBc, + 4/-6 dB (various BWs, 20 - 160 MHz)
	Transmission Spurious			Yes				Country Dependent
	Out-of-band Spurious Emission	Yes	Yes	Yes	Yes			Country Dependent
Transmit Frequency	Transmit Center Frequency Tolerance	Yes	Yes		Yes			± 25 ppm (DSSS, b, g)
				Yes				± 20 ppm (20 MHz and 10 MHz), ± 10 ppm (5 MHz)
						Yes	Yes	± 20 ppm (5 GHz band), ± 25 ppm (2.4 GHz band)
	Symbol Clock Frequency Tolerance	Yes	Yes	Yes	Yes	Yes	Yes	same specifications as above

Type of Measurement	Measurement	802.11						IEEE Standard Limit
		DSSS	b	a	g	n	ac	
Transmit Modulation	Transmit Modulation Accuracy	Yes						Peak EVM<0.35%
			Yes					Peak EVM<0.36%
	Transmitter Constellation Error							
	Modulation Type / Coding Rate	Limits in dB						
	BPSK 1/2			-5		-5	-5	
	BPSK 3/4			-8				
	QPSK 1/2			-10		-10	-10	
	QPSK 3/4			-13		-13	-13	
	16-QAM 1/2			-16		-16	-16	
	16-QAM 3/4			-19		-19	-19	
	64-QAM 2/3			-22		-22	-22	
	64-QAM 3/4			-25		-25	-25	
	64-QAM 5/6					-27	-27	
	256-QAM 3/4						-30	
	256-QAM 5/6						-32	

A 2004 Patent by Swiss-Com AG

International Publication Date
2 September 2004 (02.09.2004)

SWISS-COM AG [CH/CH]
Ostermundigenstrasse 93,
CH-3000 Bern 29 (CH)

International Publication Number
WO 2004/075583 A1

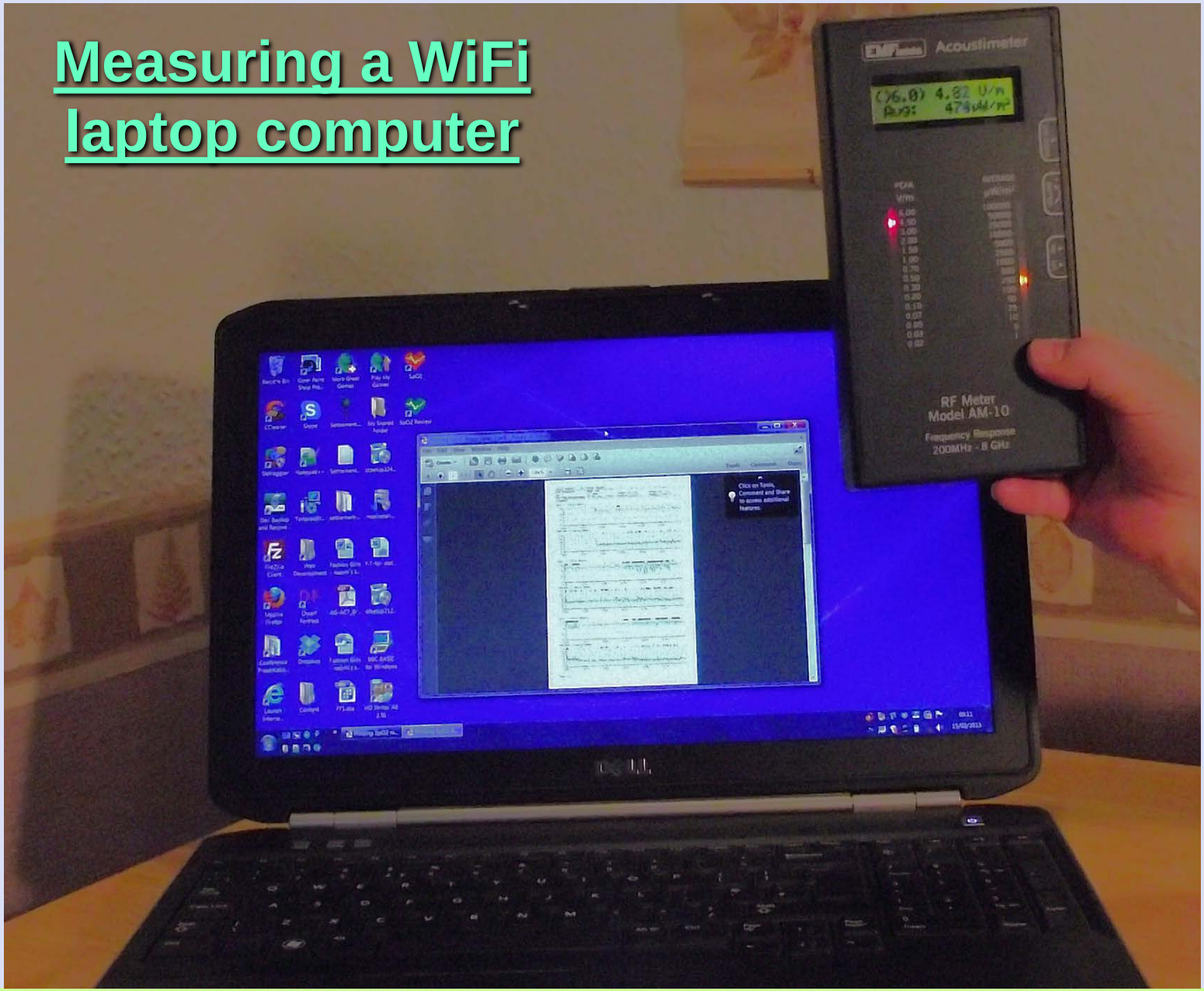
Abstract: A method and system for reduction of electrosmog in wireless local networks, one or more mobile network units (1) communicating with a base station (2) of a wireless local network (5). After a predefinable time interval without connecting signal, the base station (2) changes over from the normal transmitting-receiving mode into a sleep mode, in which sleep mode no beacon signals and/or other radio frequency signals are transmitted from the base station (2). If a mobile network unit (1) requires a network connection, it transmits an alert signal, and, upon receiving the alert signal of the mobile network unit (1), the base station transmits beacon signals to the mobile network unit (1) and changes over into the normal transmitting-receiving mode.

Reduction of Electrosmog in Wireless Local Networks

This invention relates to a method and system for reduction of electrosmog in wireless local area networks (WLAN), one or more mobile network units communicating with a base station by means of radio frequency signals in a wireless local area network.

The influence of electrosmog on the human body is a known problem. The risk of damage to health through electrosmog has also become better understood as a result of more recent and improved studies. These findings indicate that the genotoxic effect of electromagnetic radiation is elicited via a non-thermal pathway.

Measuring a WiFi laptop computer



The Bamberg Report 2005 (357 GP patients)

Symptom groups

Group 1 no symptoms

Group 2 sleep disturbance, tiredness, depressive mood

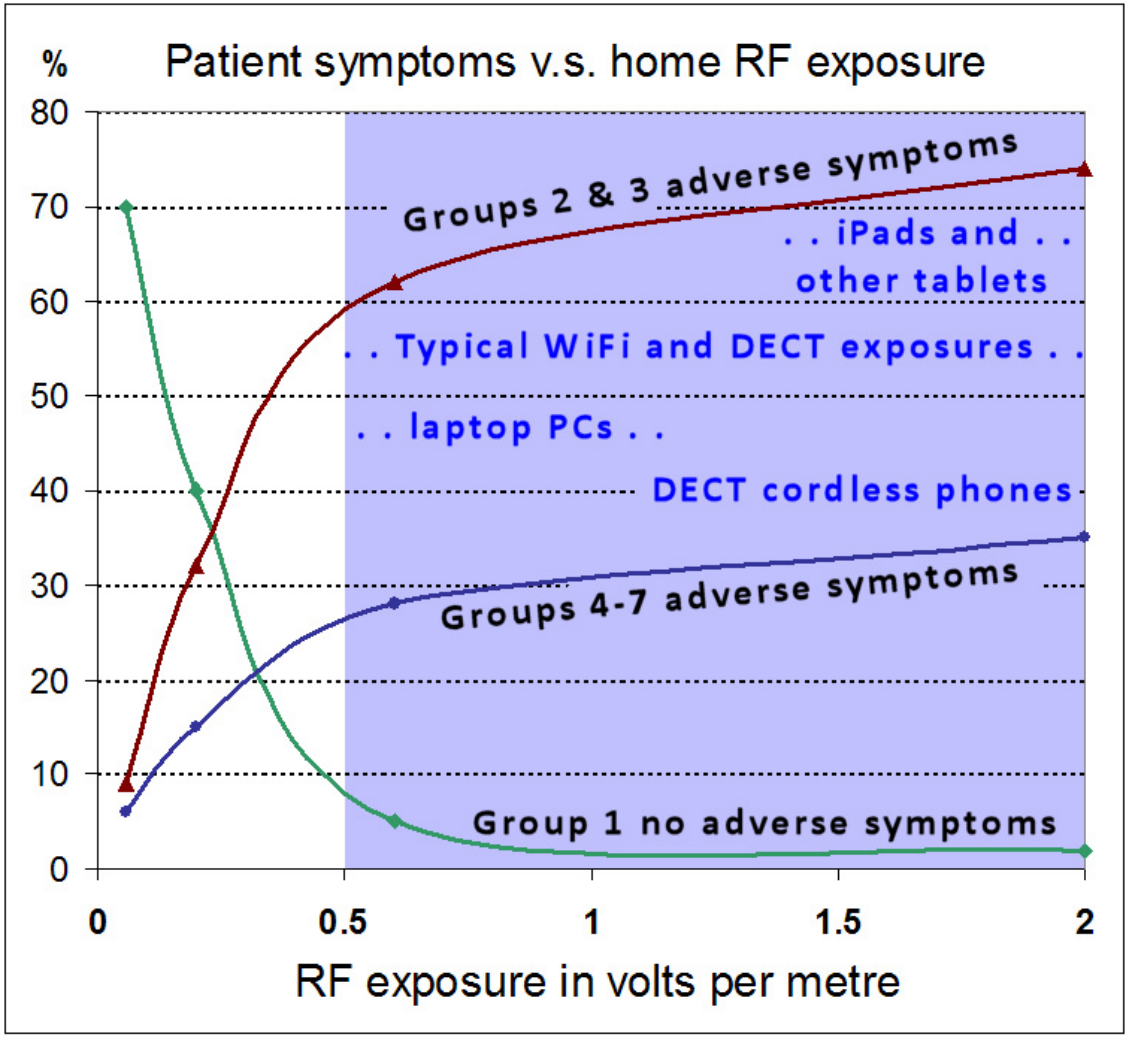
Group 3 headaches, restlessness, irritability, disturbance of concentration, forgetfulness, learning difficulties

Group 4 frequent infections, lymph node swellings, joint and limb pains, nerve and soft tissue pains, allergies

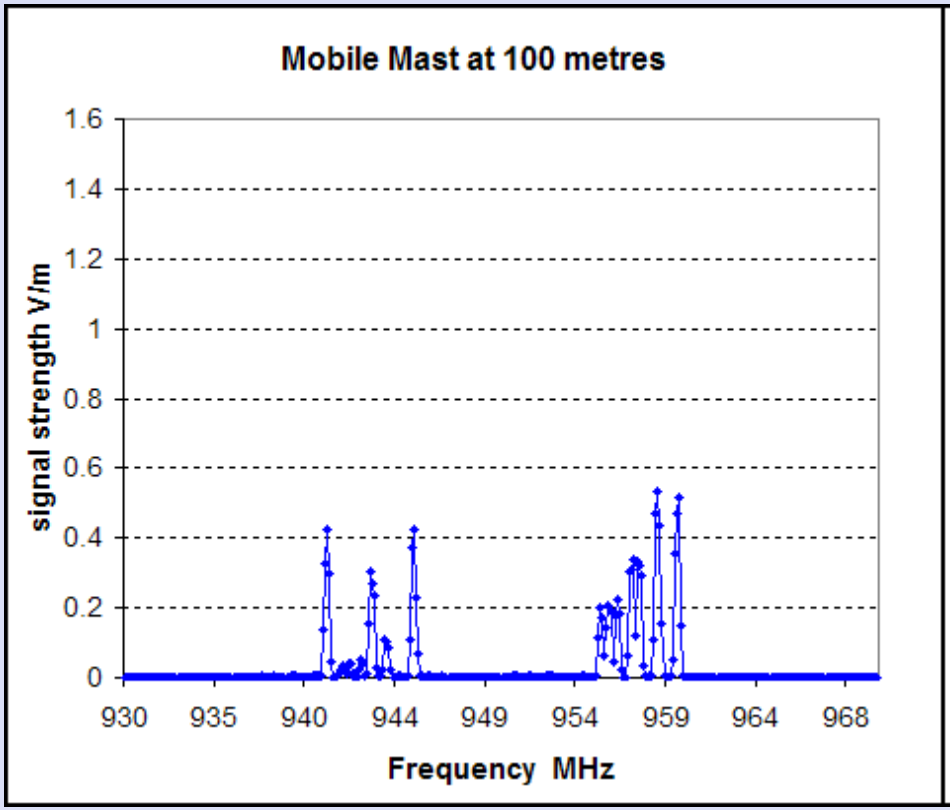
Group 5 tinnitus, giddiness, impaired balance, visual problems, eye inflammation, dry eyes

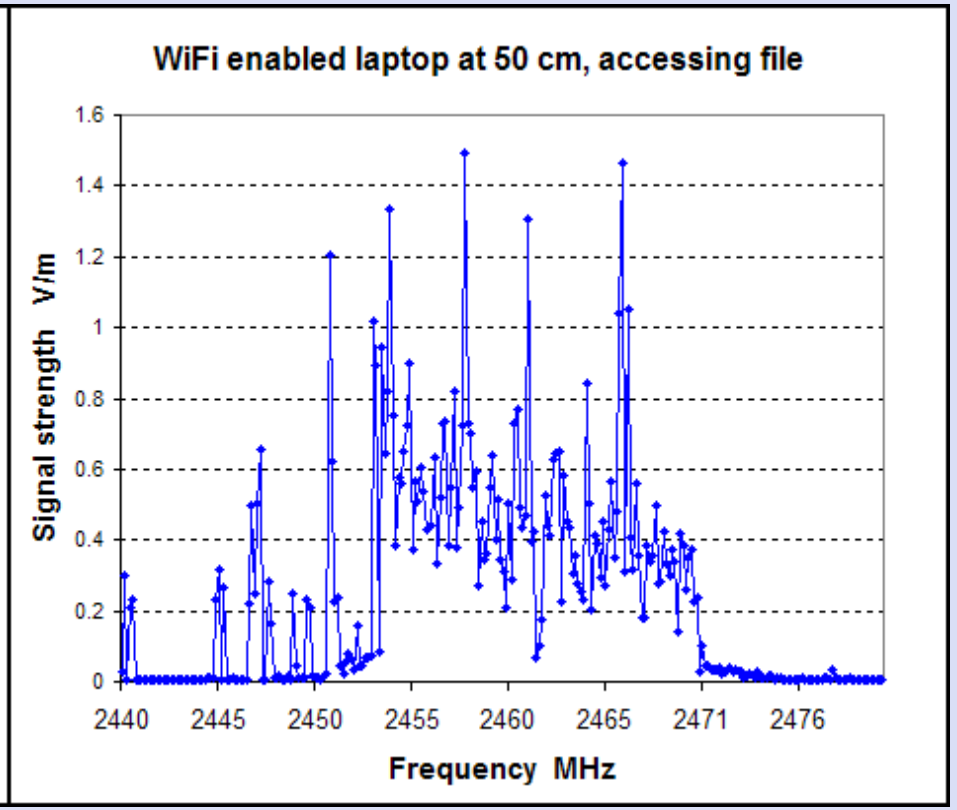
Group 6 tachycardia, episodic hypertension, collapse

Group 7 Other symptoms



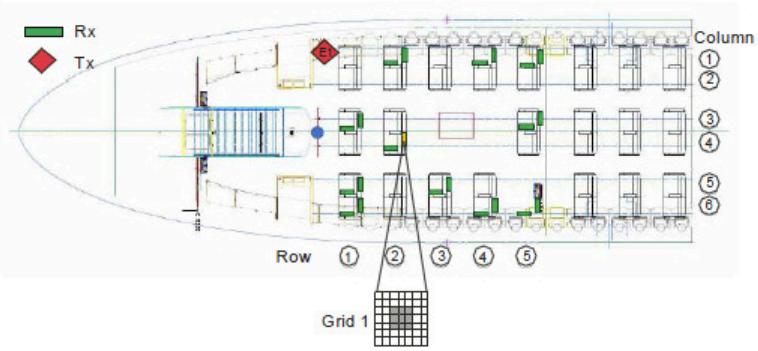
Typical exposure from a mobile phone mast at 100 metres c.f. when using a WiFi laptop

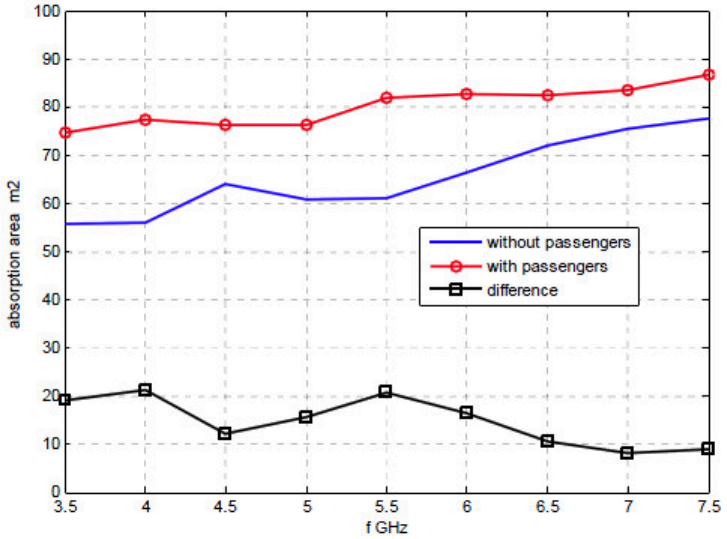




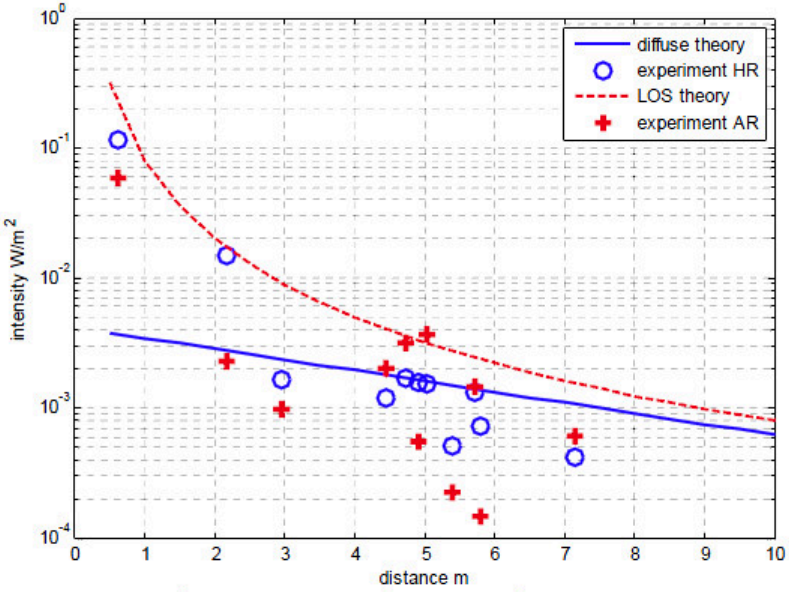
Jørgen Bach Andersen, Aalborg University, Denmark

Sven Kuhn, Rasmus Krigslund, Troels B. Sørensen





Measuring whole-body-absorption by real people



Incident power density determines whole-body SAR . The closest takes all!

Spanish Murcian Study (Navarro 2003, Oberfeld 2004)

The health of 94 people in a Spanish town was plotted against levels of pulsing microwaves in their homes from local mobile phone masts.
These symptoms occurred at RF levels now commonly found.

Depression increased by up to 64-fold (p=0.001)

Fatigue, irritability and headaches increased by up to 37-fold (p=0.001)

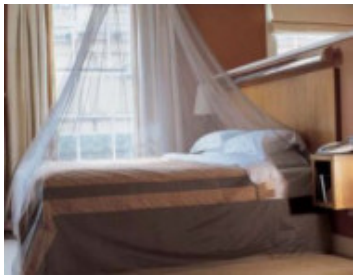
The authors of the study concluded:

"***Based on the data of this study the advice is to strive for levels not higher than 1 microwatt per square meter (0.02 V/m) for indoor exposure to pulsing microwaves in homes"***

Signal levels in a WiFi classroom and around WiFi laptops and, especially iPads and other tablets, almost always exceed this level by 100-fold – i.e. at least 2 volts per metre are common

EMF Detection and Prevention

Thank you for listening



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Powerwatch

Thank you for listening