The Italian national electromagnetic field monitoring network

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Abstract

The paper describes the Italian national Electromagnetic Field (EMF) monitoring network, that the Italian Ministry of Communications established with the technical support of Fondazione Ugo Bordoni (FUB) and in collaboration with the local Environmental Protection Agencies of all Italian regions.

I Introduction and background

The paper is structured as follows: section I gives a brief overview of the rationale behind the building of the monitoring network and of the international and Italian regulatory frameworks. Section II describes the network architecture and operation. A deeper insight in the data validation procedures and in the presentation of results is given in section III, while some key results obtained during the monitoring activity are reported in section IV. Section V presents the public data communication campaign, which complemented the monitoring initiative with a series of meetings and events aimed at the public. Finally, conclusions are given in section VI.

I.1 Rationale for building the EMF monitoring network

The decision to deploy the national EMF monitoring network was taken in order to counteract the widespread fear, among the national public opinion, of unknown health hazards due to exposure to EMF. The network and the related public communication campaign had a multiplicity of aims:

- inform the public about the current scientific knowledge, that shows no evidence of health effects due to the exposure to radio-frequency EMF, and about the current Italian regulation, which is among the most restrictive adopted worldwide;
- demonstrate that the exposure to radio-frequency EMF is well below the prescribed limits in the vast majority of cases;
- activate procedures to reduce the exposure levels when they exceed the attention thresholds;

- reduce social conflicts generated by the above mentioned fear, which lacks scientific bases, thus paving the way to the development of radio-communication networks.

Before entering the description of how these goals were pursued and achieved, it is useful to spend some words to illustrate the Italian situation and some of its peculiarities.

Mobile telephony is now commonplace around the world. This wireless technology relies upon an extensive network of fixed antennas, or base stations, relaying information with radio-frequency (RF) signals. Over 1.4 million base stations exist worldwide and the number is increasing significantly with the introduction of third generation technology.

Some people perceive risks from RF exposure as likely and even possibly severe. Several reasons for public fear include media announcements of new and unconfirmed “scientific” studies, leading to a feeling of uncertainty and a perception that there may be unknown or undiscovered hazards. Other factors are aesthetic concerns and a feeling of a lack of control or input to the process of determining the location of new base stations.

In Italy, more than in other European Countries, anxiety and fears have arisen and, all over the Country, demonstrations of protest against antennas or cellular base stations installation were organised by local groups of citizens. Those demonstrations created a sort of stall situation, where the mobile telephony operators found difficulties in their activity of new antennas installation.

At the moment, considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects. However, if the risk continues to be perceived by a significant part of the population, it is clear that some actions should be taken by the Government, both at communicational and operative levels.

The first act was the formalisation of a Decree (March 28th, 2002) providing that several actions must be taken in order to control electromagnetic emissions and to finance, using the sale proceeds from UMTS licences, scientific research and the implementation of a national network for electromagnetic fields monitoring.

The way Italian Government acted is a clear example of communicational and operative approach. An operative law was formalised and a measurement activity started, strictly connected with a wide communication campaign.

The Italian Ministry of Communications was responsible for the monitoring network and, as provided by the law, FUB was involved as technical consultancy. The Foundation arranged the technical aspects related to the project, and in particular was responsible of the realisation and management of the national network. The positioning of the monitoring stations all over the national territory and the transmission of the collected data towards a unique national storage unit are specific assignments of the Regional and Provincial Agencies for Environmental Protection (ARPA/APPA). The campaign of communication was carried out by the Ministry of Communications with the support of FUB and involved actions at national and local level.

The project started in 2002 and data collection formally ended in Autumn 2006; the active campaign of communication on the territory officially started in mid 2003 with the presentation to the public of the BluBus vehicle and is now closed. A secondary campaign of communication, involving two vehicles called BluShuttle, is still going on.

Regarding the monitoring network, at time of writing there are discussions about the possibility of re-funding it in order to avoid interruption of an activity that proved fruitful under many respects.

I.2 Regulatory framework

International and European Union regulations

Most of international regulations, as well as the European Council Recommendation 519/99 on exposure of the general public to electromagnetic fields (1999) [1], are essentially based on the guidelines formulated by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) [2], a non-governmental organisation formally recognised by the World Health Organization (WHO), which establish exposure limits by taking into account ascertained health effects.

The reference levels for exposure of the general public to time-varying electromagnetic fields proposed by ICNIRP, and then accepted by the European Union, are shown in Table I.

Table I. REFERENCE EXPOSURE LIMITS PROPOSED BY ICNIRP

Frequency range	Electric field intensity (V/m) (f is the frequency in the unit shown in the leftmost column)	Magnetic induction (μT)
Up to 1 Hz	-	$4*10^4$
1-8 Hz	10,000	$4*10^4 / f^2$
8-25 Hz	10,000	5000/f
0.025-0.8 kHz	250/f	5/f
0.8-3 kHz	250/f	6.25
3-150 kHz	87	6.25
0.15-1 MHz	87	0.92/f
1-10 MHz	$87/f^{½}$	0.92/f
10-400 MHz	28	0.092
400-2000 MHz	$1.375\ f^{½}$	$0.0046 * f^{½}$
2-300 GHz	61	0.20

Coming to the European Union, so far no mandatory regulations have been adopted; there is however an indication that all Member States should adopt precautionary measures, which should be as homogeneous as possible throughout the Union, but recognising the different (and generally more restrictive) regulations already in force in some Countries, namely Belgium, Bulgaria, Italy, Luxemburg and Poland [8].

Italian regulations

The Italian regulator adopted a more precautionary stance than most other Governments concerning electromagnetic field exposure, abiding by the prudent avoidance principle.

The Italian regulatory framework on exposure to radio-frequency electromagnetic fields has been initially based on the Ministerial Decree issued on 10th September 1998, number 381. The regulatory body has been subsequently updated and completed after the issuing of the "Framework Act" (no. 36, 2001) and the related Actuation Decree (DPCM 8th July 2003). The "Framework Act" univocally establishes the main principles and the specific duties necessary for the protection of environment and of health of general public.

The current regulation is based on a multi-level protection.

- The protection against acute health effects is defined through **exposure limits**, that are "values of electric, magnetic, and electromagnetic field that shall never be exceeded in any exposure condition" (see Table II). For mobile phone frequency range the limit is 20 V/m.

Table II. EXPOSURE LIMITS FOR GENERAL PUBLIC

Frequency (MHz)	RMS value of electric field (V/m)	RMS value of magnetic field (A/m)	Power density of the equivalent plane wave (W/m^2)
0.1 ÷ 3	60	0.2	-
> 3 ÷ 3000	20	0.05	1
> 3000 ÷ 300000	40	0.1	4

Eliminato: 0

- The protection against long-term effect is sought by defining the **attention thresholds**, i.e. "values of electric, magnetic, and electromagnetic field that shall not be exceeded in residential areas, schools and other environments where people may have a prolonged stay", namely a continuous sojourn for more than four hours (see Table III).

Table III. ATTENTION THRESHOLDS FOR GENERAL PUBLIC

Frequency (MHz)	RMS value of electric field (V/m)	RMS value of magnetic field (A/m)	Power density of the equivalent plane wave (W/m^2)
0.1 ÷ 300000	6	0.016	0.1 (3 ÷ 300000 MHz)

The definition of a threshold equal to 6 V/m for the electric field is a consequence of applying a "caution factor" of 10 to the power density. Therefore the threshold is decreased from 1 W/m², corresponding to about 20 V/m for electric field, to 0.1 W/m², corresponding to about 6 V/m.

- The prudent avoidance approach, finally, implies the adoption of **quality targets**, i.e. "values of electric, magnetic, and electromagnetic field, emitted by any kind of equipment, that shall be attained in short, medium and long term even through available improvement procedures,

aiming at health and environment protection also against possible long-term effects" (see Table IV).

Table IV. QUALITY TARGETS FOR GENERAL PUBLIC			
Frequency (MHz)	**RMS value of electric field (V/m)**	**RMS value of magnetic field (A/m)**	**Power density of the equivalent plane wave (W/m2)**
0.1 ÷ 300000	6	0.016	0.1 (3 ÷ 300000 MHz)

The quality targets are the set of field values that should be pursued when a new telecommunication infrastructure is planned; it is not important if the structure is isolated or inserted in a context where other installations already exist.

As an example, during a base station planning phase it is necessary to take into account the fact that the field level in proximity of the structure should not exceed the quality targets, no matter if the station is a single structure or coexisting with other similar installations. In such a case, a reduction of the emission power of the station itself or of the surroundings emitting structures should be imposed.

Furthermore, the same quality targets may be imposed by the local authorities in densely crowded areas (like airports and railway stations) even in the case of a reduced sojourn time.

II Network architecture and operation

Possibly the main concern in designing the monitoring network was to ensure the independence of the measurements carried out, so that citizens might be confident that the presented results were not influenced by particular interests, such as those of telecommunications operators as well as political parties or other opinion groups.

To this aim, since the onset it was decided that the network would have been entirely funded by public money, without any form of sponsorship by operators or other non institutional subjects. The Ministry of Communications charged FUB of the realisation and maintenance of the network, while its operation on the territory would have been under the responsibility of local administrations, through the respective Environmental Protection Agencies.

This led to a decentralised architecture of the monitoring system, represented in Figure 1. The network is based on remote measurement stations and on a transmission structure, devoted to the measured data flow towards Local Control Centres (deployed on a regional or sub-regional basis) and thence towards the National Storage Centre, which is located in the premises of the Ministry of Communications.

In order to ensure methodological consistency, data monitoring strategies across Italian regions were harmonised by means of a set of guidelines issued by FUB. In particular, a series of training courses was issued in order to illustrate the correct positioning, operation and maintenance of the

monitoring stations. Positioning criteria aim to avoid local effects that could have an impact on measured values.

According to the guidelines, the typical duration of a measurement campaign could be between two and four weeks; however this is not a strict rule, and actually each local Environmental Protection Agency decided which sites to monitor and for how long. This is essential to the successful usage of the monitoring network: as a matter of facts, certain locations (such as schools, hospitals, densely populated districts, sites with several co-located transmitters) are particularly sensitive for various reasons, either political or technical, and it may be advisable to keep them monitored for longer periods than other areas. The guidelines also defined the criteria for correct positioning of monitoring stations, that had to be placed far from sources that could affect the measured values, such as cellular base stations: it is to be remembered that the monitoring network aimed at evaluating exposure levels for the population, hence they had to be placed where the population actually is.

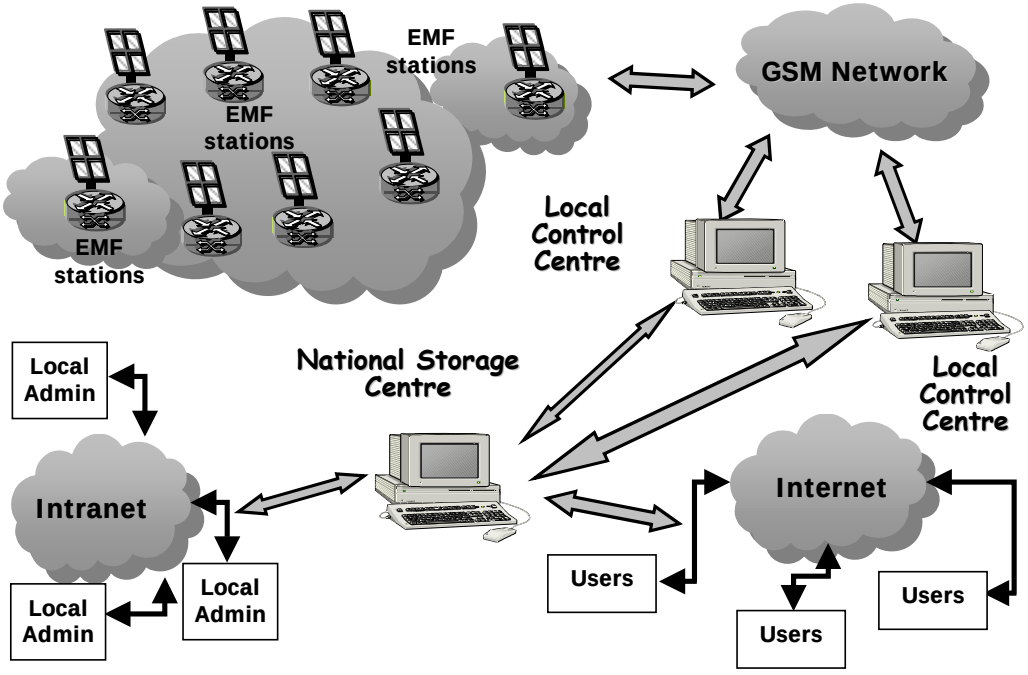


Figure 1. Architecture of the network for electromagnetic field monitoring

The stations were acquired through three subsequent public auctions, and the network in its full configuration comprises about 1200 of them. They were subdivided among Italian regions proportionally to their population, with a reference value of about one station per 50,000 inhabitants.

Both wide-band and multi-band probes were used to detect the electric field due to all the radio-frequency sources working between 100 kHz and 3 GHz, as stated in the mentioned Decree (March 28th, 2002). The dynamic range is 0.5 to 100 V/m and the operational temperature range

spans from –10 to +50 °C. Wide-band probes can satisfy the basic requirement for the monitoring network, that is, verifying the respect of the exposure limits over the whole frequency band. The probes measure directly electric field with three orthogonal sensors placed along the X, Y and Z axes, which are combined in order to evaluate the field. The evaluation regards wideband field, i.e. the combined electric field due to all sources in the measured band.

In addition, two- or three-band probes yield a separate measurement of the electric field due to the main classes of sources, namely, broadcast radio/TV transmitters and mobile telephone base stations. Hence, the second and third auction were focused on multi-band probes, since these can be an aid to the Environmental Protection Agencies in the process of interpretation and validation of the measured data.

The monitoring stations of all kinds (see Figure 2 for two examples) are light, compact and easily transportable. This was explicitly required in the auction, because sensors had to be moved in order to monitor the Italian territory as thoroughly as possible.

Figure 2. Examples of mounted monitoring station

All remote stations operate with photovoltaic arrays and are equipped with a GSM modem, which is used for communication with the relevant Local Control Centre: the downlink is used for remote configuration, programming and polling, while the uplink is used for reporting the measurements and other information such as alarms.

The Local Control Centre consists of a PC equipped with an *ad-hoc* software, which can interact with different types of monitoring stations. Once validated by the personnel of the local Environmental Protection Agency, data are transmitted from each Local Control Centre by email to the FUB staff, which uploads them onto the database that constitutes the National Storage Centre.

The valid data are also publicly available on the project web site, while the non valid data are simply stored for documentation purposes, but are not considered in the official statistics.

Published data consist in wideband mean (over 6 minutes) and peak values of electric field. The 6 minutes averaging period is prescribed by the Italian current regulations [6].

III Data collection, validation, storage and presentation

III.1 Preparation of the network for data collection

All monitoring stations were calibrated prior to their use within the monitoring network, and after two years of operation a new calibration is performed to ensure that the data reliability remains constant over time.

This activity must be performed in any accredited laboratory, able to issue recognised conformity certification.

In order to verify the performance declared by the manufacturer, FUB carried out a series of test measurements on a statistically significant sample of the monitoring stations. These measurements were performed at the Laboratories of ARPA Piemonte in Ivrea, Turin and are briefly described below. The description refers to the multi-band monitoring stations acquired with the third auction; for other stations the procedure was essentially the same with minor differences especially in the frequency bands.

Equipment used for the calibration

The calibration requires the availability of a known field, generated within a TEM cell for frequencies up to 150 MHz, and in an anechoic chamber for higher frequencies (up to 3 GHz).

Figure 3 shows the field generation and measurement chains adopted for the monitoring station calibration.

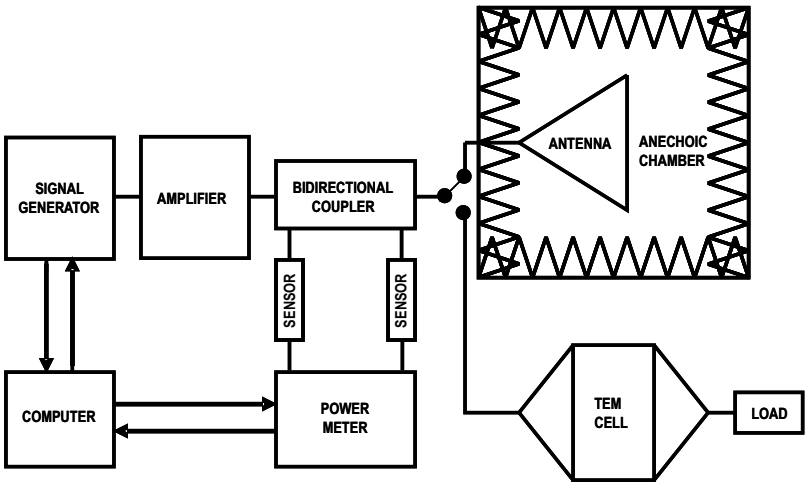


Figure 3. Field generation and measurement chains

Response verification procedures

The testing of the monitoring stations refers to:

- frequency response;
- linearity;
- isotropy.

These tests are performed for all the three sensors that constitute the multi-band station, namely: “wide” (100 kHz ÷ 3 GHz), “low” (100 kHz ÷ 862 MHz) and “high” (933 MHz ÷ 3 GHz). The frequency range of the “low” and “high” sensors comes from the need to measure the contributions to the total electric field due to broadcasting stations and cellular base stations, respectively.

Out-of-band attenuation is also measured for “low” and “high” sensors.

These measurements are needed to verify that:

- out-of-band attenuation is as stated in the equipment data sheet (at least 25 dB in this case);
- error in field estimation of all the tested equipment when exposed to a known field of any frequency, intensity and polarisation, is within the declared accuracy (1.9 dB) in at least 95% of cases.

The measurements were conducted at a temperature of 23 ± 2°C and relative humidity 50 ± 15%, while all transient effects are excluded by connecting the apparatus at the AC network (50 Hz, 220 V) at least two hours prior to any measurement.

Measurements were conducted in the TEM cell and subsequently in the anechoic chamber. In the latter case, the field probe electrical centre was positioned at 1.50 m from the ground.

Multi-band stations, that have three sensors placed along the same axis, were positioned so as to have that axis perpendicular to both the electric field polarisation and its direction of propagation. The measurements were performed in condition of uniform field, previously determined by means of a reference instrument.

The measurements were taken at several frequencies in the specified range (100 kHz ÷ 3 GHz), with particularly dense frequency points between 800 and 1000 MHz, in order to accurately evaluate the out-of-band attenuation curves of the two selective sensors.

Amplitude response was also evaluated at two given frequencies in the two sub-bands (100 MHz and 2.1 GHz) by exposing the monitoring stations at different values of known electric field between 0.5 and 100 V/m.

Finally, isotropy was evaluated by rotating the sensors in various positions around their axis.

III.2 Data validation criteria

As mentioned above, each Environmental Agency is responsible for validation of data measured in its territory.

Measured data cannot be anyhow changed: they can be declared either valid or not, without altering their contents; non valid data are recorded for statistical and documentation purposes only.

The validation process performed by each Environmental Agency follows a set of guidelines defined in a joint working group coordinated by FUB.

In the following, we briefly describe the main criteria adopted for data validation. The slight differences, depending on the particular model of monitoring station used, are not inserted in this paper for sake of brevity.

Data validation is performed in three phases.

Validation of a measurement campaign as a whole

It is based on general information about the location of the sensor, its surroundings, the type of monitored site, and similar issues that may influence all the data collected during this campaign. Known causes of error include:

- incorrect installation of a sensor and mutual influence of two sensors in the same location;
- unwanted coupling of the EMF with parts of the sensor structure, cables, metallic objects or electronic equipment or power lines in its proximity;
- incorrect sensor configuration.

Validation of single data samples, or groups of samples

It is based on the operational conditions occurring during a well identified time interval when the given samples are collected.

For instance, the activity of the sensor internal modem causes non validity of data because in these intervals the measured field includes a dominant component emitted by the modem itself. The latter can be active for various causes: reporting of measurements or alerts to the network, remote interrogation and configuration of the monitoring station by the Local Control Centre, direct communication with the cellular network for causes due to the operator (e.g., authentication, paging, etc.).

Furthermore, data measured during periods when the equipment was in an alert state are non valid. Alert states comprise faults of the EMF probe, tampering of the sensor by unauthorised persons, low power supply, temperature out of the working range.

In all the above cases, the corresponding data are automatically labelled as “non valid” by the equipment itself.

There are also measurements that are clearly invalid due to reasons to be identified by the operator. These anomalies include records that show unexpected fluctuations in operational conditions such as power supply voltage or temperature.

Validation of blocks of data

This third phase consists in the observation of data received in a predetermined time interval (typically one day) to find out possible anomalies with respect to the expected data.

These anomalies may be detected by comparison with results obtained with other instrumentation or with results obtained in analogous conditions (e.g. the same hour in subsequent working days).

Known causes of these anomalies may be of two kinds:

- emissions by fixed sources (e.g. amateur radio stations): as all fixed sources are included in the scope of the monitoring campaign, these data although not typical are to be considered valid;
- emissions by mobile sources, such as cellular phones (or other sources such as remote controls) operated by passers-by in the vicinity of the monitoring station. Anomalies of this kind cause the data to be considered “non valid” as they are not perturbations of the EMF due to fixed sources, which is the aim of the monitoring network.

  These situations can be easily identified by comparing the field peak and mean values measured over the 6 minutes interval: in most cases, the duration of the perturbation due to a phone call in the proximity of the monitoring station is much shorter than this period. Moreover, phone calls are usually non time periodical.

  It is worth noting that the perturbation of measurements due to passers-by does not occur frequently, because monitoring stations are normally placed in locations not accessible to the public in order to prevent possible vandalism or theft. Even when the stations are placed in private premises, and thus potentially exposed to fields originated by members of the household, the effect of a phone call on the measurements is appreciable only if the caller is in the close proximity (less than one metre) of the sensor for a significant portion of the 6 minutes averaging time.

III.3 Data storage and presentation

In order to promote a widespread dissemination of the monitoring campaign results, data collected all over the national territory are available on a dedicated web site (http://www.monitoraggio.fub.it/) created and hosted by FUB. An example of the site is shown in Figure 4.

Figure 4. The web site www.monitoraggio.fub.it

The web site is structured in four different areas:

- **Informative area**: this area contains information about the project, the architecture of the monitoring network, the data collection system and the data validation procedures;
- **Communication area**: this is a technical informative area. It contains details on the communication activity related to the monitoring project, such as BluBus and BluShuttle. In addition, it provides useful information about electromagnetic fields (both from technical and health viewpoints) and a complete collection of Frequently Asked Questions (FAQ) on bioelectromagnetism related topics;
- **Links**: this area links to several either scientific or institutional web sites relevant to the EMF issue. In particular, the visitor can easily reach the web sites of the Regional Agencies for Environmental Protection and contact them (e.g. requesting a monitoring campaign);
- **Data**: this area represents the core of the web site and contains all the data collected since the monitoring activity started. Results are presented in different ways in order to cover the requests both from general public and from expert users. Besides general synthetic information relative to the national or regional territory, raw data are available both as graphs or tables.

  The page opens on a national synthesis of the whole measurement activity (see Figure 4); by clicking on an interactive map, it is possible to see the situation at regional level and, for each region, have access to a list of places where measurements have been performed. By clicking on an address on this list, complete information is provided about the measurement activities carried out in that particular location.

The information is provided in three different forms: a) a list containing the sets of measured values; b) a 24-hour based data graph compared with the 6 V/m limit; c) a data sheet containing a brief presentation and a histogram that allows an intuitive visualization of the data. The collected data are freely available and could constitute a solid and reliable basis, unique in the world, at the scientific community disposal, in order to promote knowledge diffusion and to perform related studies.

The huge amount of data can give an extremely detailed snapshot of the exposition of different segments of population, as a function of geographical areas, working places and so on. The scientific community is now able to use the collected database for a long time, and this will easily allow to promote research involving different topics, such as epidemiology, statistics and sociology.

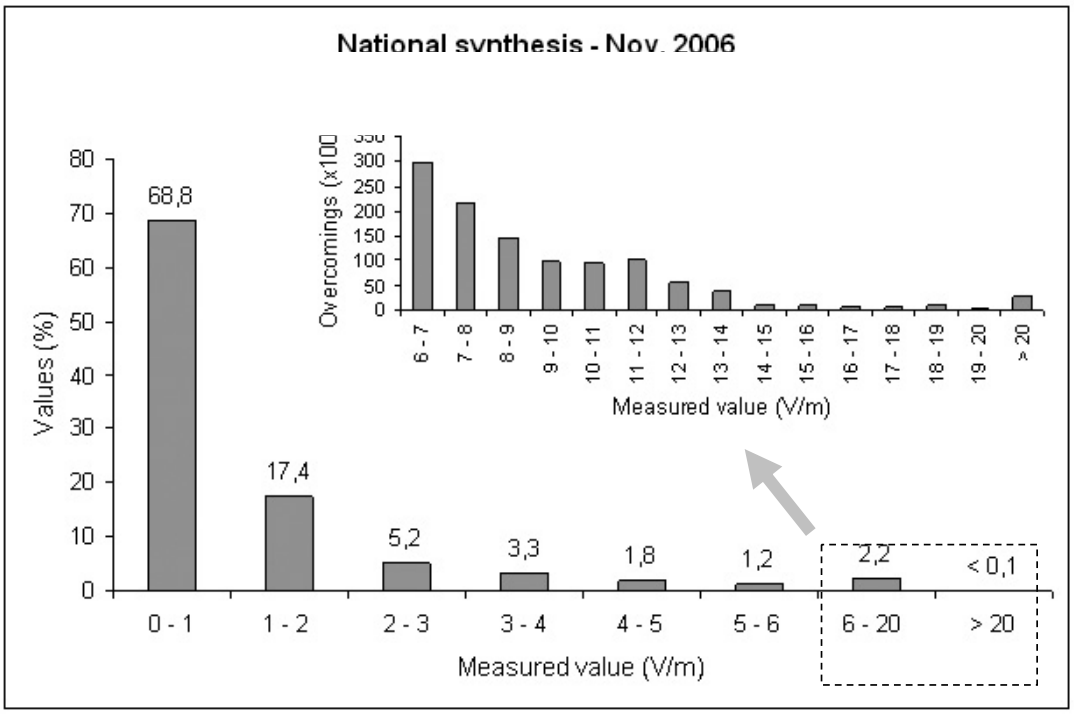
IV Summary of results

Space and readability considerations prevent us from giving here a wide account of the measured data, which amount to nearly 50 million samples (see Figure 5). Therefore, in this section we highlight only the most significant aggregate data and the main considerations that arise from their analysis.

The interested reader can visit the project's official web site where all data are publicly available, with a resolution that allows any visitor to single out any particular data of her/his interest, referring for instance to locations close to her/his home or working place.

Some considerations may be drawn from the results shown in the figure. The vast majority of samples is below 1 V/m, and over 90% is below 3 V/m. However, we have 2.2% of samples between 6 and 20 V/m. These values exceed both the attention threshold and the quality target (see section I.2), but they do not necessarily imply that the limits have been violated, because in many cases they correspond to locations where there is not continuous presence of people (and therefore the 20 V/m threshold applies).

A detailed distribution of field values exceeding 6 V/m is shown in the upper part of the figure. We may also note that the fraction of samples exceeding 20 V/m is quite small: more precisely, we have 29,326 values above this threshold, i.e. 0.06%.



Monitoring campaigns:	8,011	Schools:	2,087
Total observed time (hours):	4,602,682	Public places:	1,370
Collected samples:	49,422,794	Homes:	4,131
Monitored sites:	7,719	Hospitals:	131
Avg. monitoring time per site (days):	23		

Figure 5. Summary of measurements results (as of November 24th, 2006)

In cases corresponding to limits violations, the monitoring results were useful in highlighting this problem, and the necessary procedures for the reduction of the exposure were activated accordingly. Therefore, the monitoring network is an active instrument that local administrations can use to minimise exposure of the citizens to EMF.

The monitored sites have been divided into four different categories, i.e. schools, homes, hospitals and public places (including zones opened to the public like gardens, shops, etc.). The results of the performed measurements are shown in Figure 6. Most of the sites have an electric field value below the Italian limit of exposure. The majority of higher field values were found in homes and in public places, while protected areas, like schools and hospitals are exposed to quite low field values.

These data don't represent the statistical distribution of field exposure throughout Italy, but the results of measures performed in locations chosen by the local Environmental Protection Agencies following the common protocol decided at the national level.

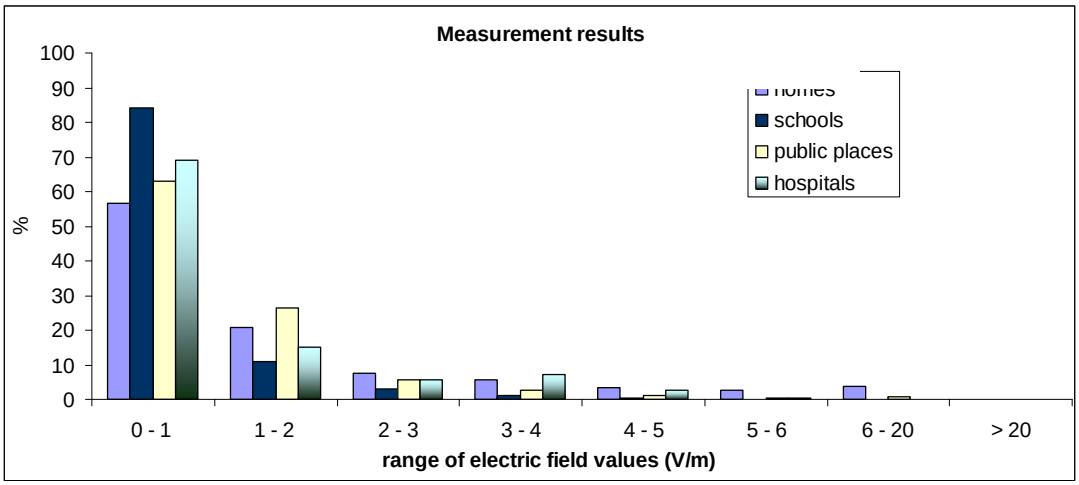


Figure 6. Summary of measurements results by location type

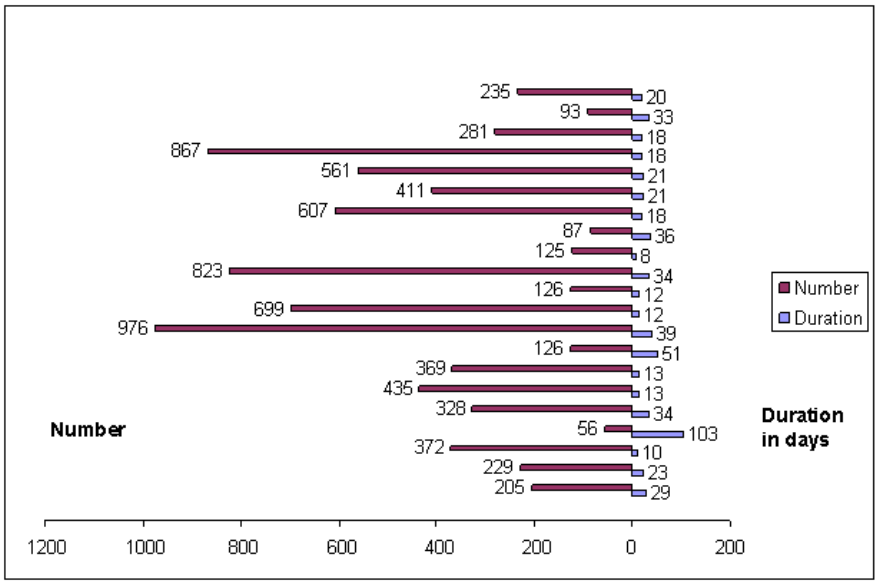


Figure 7. Measurement campaigns local characteristics

Figure 7 shows the average number of measurement campaigns performed by each local Environmental Protection Agency compared with the average duration in days. The vertical axis represents the Italian territory: each couple of bars corresponds to one of the 21 Environmental Protection Agencies. We can observe a wide variety of different situations: some agencies performed very long campaigns, while other preferred to perform several short campaigns.

These fluctuations were expected, because only the Local Authorities are familiar with the needs and the peculiarities of their territory. The distribution of the measurement campaigns affected the way each campaign was perceived by the citizens, as it appears from data press statistical examination.

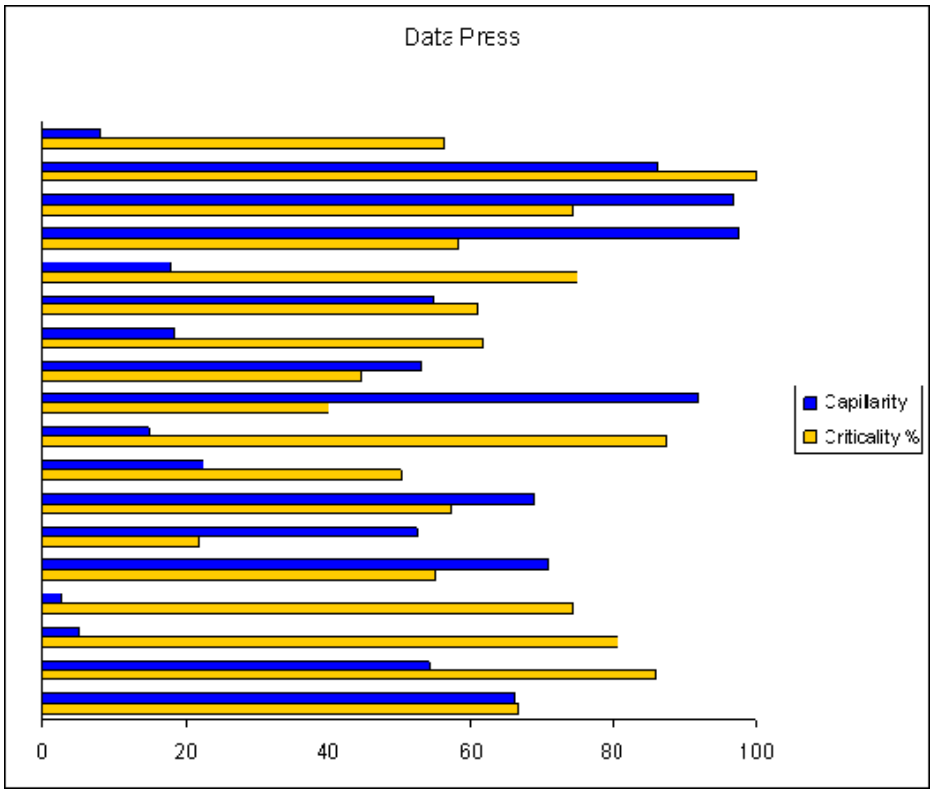


Figure 8. Data press analysis

Figure 8 illustrates the relationship between distribution of the measurement campaigns on the territory (synthetically defined "capillarity") and criticalities arising from press statistical analysis. Again, the data are subdivided by region.

The parameter taken into consideration was the percentage of articles presenting an alarming attitude (critical articles). This data has been compared with the number of measurement campaigns per unit of territory carried out in the same period by every single Agency.

At least in some regions, there is an indication of an inverse correlation between capillarity of the measurement campaigns and criticality on the press. Where the campaigns are well distributed on the territory, the criticality tends to be low. Obviously, there are some exceptions in some regions where the relationship between citizens and local Agency are hostile, possibly by local political and social factors that cause a high degree of suspect, if not an altogether negative attitude, of wide sections of the local population towards the local administration.

We must also consider that in some regions, on the contrary, the EMF exposure issue is less debated than in others. In these areas only few articles appeared on local press during the four weeks survey, and the high "criticality" value shown in the figure is not very significant because it was evaluated over too small a sample.

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The press survey showed that where there is a good and well distributed measurement campaign, citizens tend to have a minor risk perception and to be more confident in the actions carried out by the administration in the electromagnetic fields problem management [7].

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V The results communication campaign

Even though the main focus of the paper is on the technical and engineering issues, a few words are purposefully spent on the communication campaign that accompanied the monitoring activity, in order to make Italian public aware of the efforts that were being done to evaluate the actual exposure levels and of the results that these efforts produced.

BluBus and BluShuttle are a quite innovative communicational tool realised by FUB on behalf of the Italian Ministry of Communication with the aim of delivering on site correct, transparent and complete information directly to the citizens on the EMF exposure issue.

The initiative started on year 2003 from the idea of setting up a sort of itinerant conference as well as a mobile expertise laboratory, which can be provided to the interested Local Authorities.

The BluBus is a 12-metre bus which represents at the same time a sort of mobile conference site and a portable EMF laboratory. Outside it is possible to place a tent capable of accommodating up to 50 people (see Figure 9).

Figure 9. The BluBus and the surrounding area

On board instrumentation (see Figure 10) includes modern EMF measurement equipment, in particular a PMM8053 portable EMF field meter, an EMF monitoring station with a remote control centre and also a spectrum analyser and a biconical antenna for narrowband measurements.

Every time the BluBus stops in a city square, a field monitoring station is placed just in front of it, in order to realise a quick, real time demonstrative monitoring campaign. The data collected *in situ* can immediately be shown to the visitors. A technician explains the meaning of the results and answers to the citizens questions.

In addition to that, all visitors can receive information on FUB's activity and projects, as well as information and papers on EMF health effects and on National Monitoring Campaign results.

Figure 10. Interior view of the BluBus

The aim of this communication campaign was to reach the highest possible number of places and people all over the nation; for this reason, during year 2005 the campaign was extended by the introduction of two city cars, called BluShuttle (see Figure 11) equipped with a PMM8053 wideband EMF portable meter and an autonomous control centre.

Figure 11. One of the BluShuttle equipped city cars

The BluShuttles can travel aside the BluBus during its stages, reaching the places where a 12 metre bus can hardly be driven, or on their own.

The BluShuttle vehicles can move easily and faster from a place to another inside a city and in each point a short monitoring campaign (lasting no more than half an hour) is performed.

At the end of each measure, the software installed in the control centre produces a report sheet containing the general location data (address, present EMF sources, GPS coordinates), the photographic images of the site and of the sources, the average EMF level measured, and a chart with the levels of the EM field during the half hour of measurements. This document can be printed and distributed in real time to the visitors (see Figure 12).

Figure 12. BluShuttle report sheet

Both the BluBus and the BluShuttle campaigns were a success, as shown in Table V. The table shows also the wide press coverage obtained by the BluBus and the BluShuttle campaigns on media; those parameters are a clear indication of the success of the vehicles as a communication tool for people information on the territory.

During the period 2003/2006 the BluBus and the BluShuttles have been at Municipalities disposal and have travelled, upon Municipalities request, to several Italian cities. Figure 13 shows a graphical representation of BluBus and BluShuttle stages.

Table V. BLUBUS AND BLUSHUTTLE IN SHORT		
	BluBus activity (updated December 2006)	BluShuttlle activity (updated July 2007)
Travelled distance	Over 25,000	Over 15,000
Visited places	130	27
Stages carried out	137	37
Involved regions	19	10
Meetings attended	20	10
Results in term of communication extension		
Newspaper articles	237	24
Agencies	129	9
News on local/national TV	84	3
Radio infos	16	
Articles on web	101	3

Note: The number of stages exceeds that of visited places because some places were visited for more than one day

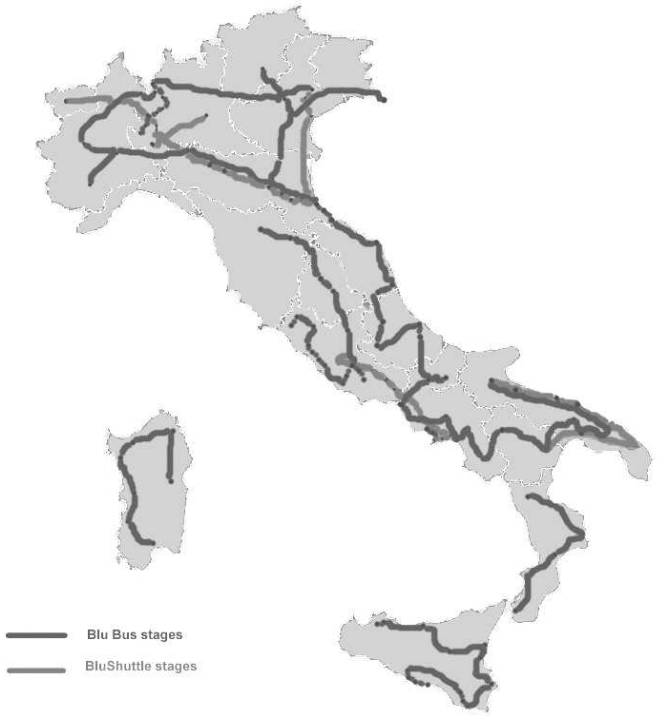

Figure 13. BluBus and BluShuttles routes

Now the activity of the BluBus vehicle is closed with a very favourable feedback from both the Institutions and the citizens. The activities of the two BluShuttle vehicles continues, because there are still many requests from Municipalities to carry out and those vehicles are really a very flexible way to carry on a communication campaign.

VI Conclusions

The paper illustrates the main issues that arose while projecting, building and making operative a nationwide EMF monitoring network with a summary of most significant measurement results.

The creation of a monitoring network has, as first objective, the creation of a “national map” describing the real situation and highlighting the criticalities.

Six months after the closure of the whole project, a detailed data analysis has shown that in most of the territory the measured values are below the 6 V/m limit set up by law.

In the few cases of exceeding values, procedures for the reduction to conformity have been carried out by Local Authorities.

Eliminato: overcoming

The monitoring network by itself would not have worked well enough from a communicational point of view; for this reason, a website presenting the results of each measurement campaign was created.

Another important part of the communicational process is the direct approach with population. This happened by means of two kinds of vehicles, the BluBus and the BluShuttle, which have travelled all along Italy, showing to the citizens how a monitoring campaign is carried out, what is the meaning of the numbers displayed by the instrument and giving a direct answer to the questions of the citizens who face the problem of EMF exposure in a worried approach.

The feeling of impending danger perceived by the population is strongly mitigated if there is a direct interaction between the worried individual, the Administration and the scientific world. As soon as the citizen perceives that the Administration is facing the problem and that the citizens’ health is cared for, the perception of the risk strongly diminishes.

Furthermore, where a higher risk perception exists, more initiatives have been promoted, such as seminars and scientific conventions, where the citizens had the opportunity to directly interrogate the experts.

The monitoring campaign, combined with the travelling communication campaign, contributed to create a different and more constructive approach to the problem by the citizens. This is demonstrated by the analysis of the data press that shows criticality and greater negative involvement in those areas where the monitoring campaign has been less efficient or less intense, and the beginning of a dialogue between citizens and Administration in those areas where the monitoring campaign has been intense and widely distributed.

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