



Monitoring of electromagnetic field levels in Latin America

Implementation of Recommendation ITU-T K.83



Organization of
American States



Acknowledgments

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Additional information and materials relating to this Report can be found at: www.itu.int/itu-t/climatechange

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Executive summary

In the era of information and communication technology (ICT), for an increasingly globalized and interconnected world, the accuracy of information plays a decisive role. The availability of accurate information is especially important when dealing with possible health effects caused by electromagnetic fields (EMF). Lack of awareness on the issue due to incomplete, inaccurate or distorted information may generate public distrust and rejection towards the installation of new wireless technologies, by claiming that the emissions are harmful to health.

Municipal authorities are compelled to take decisions to appease certain situations of public concern regarding EMF levels and their impact on health. These decisions may include the prevention of the installation of antennas or forbidding the use of existing ones. The downsides of such decisions hamper technological development and widen the digital divide between developed and developing countries, as the development and quality of telecommunication services is inextricably linked to the installation and proper maintenance of appropriate networks. The "*quality/infrastructure*" nexus is then compromised.

Evidence shows that the situation described is not an isolated event as such incidents occur continuously in developing countries, where the information on EMF levels and their impact on health is not easily accessible to the public. It is in this regard that both central and local governments should maximize and unify their efforts to reverse this situation.

International organizations like the International Telecommunication Union (ITU) and the World Health Organization (WHO), among others, provide international standards and regulatory frameworks for the management of human exposure to EMF emitted by telecommunication equipment, and also offer guidelines for the assessment of human exposure. ITU developed several international standards that look at measuring techniques, procedures and numerical models for evaluating the electromagnetic fields stemming from telecommunication systems and radio terminals. In particular, Recommendation ITU-T K.83 "Monitoring of electromagnetic field levels" was developed to provide guidance on making long-term measurements in the monitoring of electromagnetic fields (EMF), with the end-purpose of providing the general public with accessible data on EMF levels.

This Report describes and analyses the implementation of Recommendation ITU-T K.83 "Monitoring of electromagnetic field levels" in the Latin American region.

It presents the continuous monitoring systems which have been installed in Argentina, Brazil, Colombia, Ecuador, El Salvador and Uruguay, as well as the policies adopted at governmental level for the implementation of Recommendation ITU-T K.83. It also analyses some decisions from the Inter-American Telecommunication Commission (CITEL) of the Organization of American States (OAS) and the Telecommunications Regional Technical Commission (COMTELCA) of Central America, which support the implementation of Recommendation ITU-T K.83 as a viable tool to solve this problem.

This Report shows how compliance with national and international standards can help manage and mitigate the root causes of public concern regarding EMF, making it easier to garner social acceptance for the installation of new wireless technologies. It highlights the need for a proper communication policy and for collaboration among local, regional and national authorities and telecommunications operators to achieve these objectives.

Drawing from the successful experience of Latin America, this Report is intended to become a reference for national and local authorities for the assessment of human exposure to EMF emitted by telecommunication equipment under the implementation of Recommendation ITU-T K.83.

It also aims to raise awareness on this issue, disseminate the empirical data gathered in the Latin American region to the general public and facilitate dialogue among stakeholders.

1 Introduction

Electromagnetic fields (EMF) are ubiquitous in everyday life and can be generated by various sources, both natural and man-made. They are intangible and cannot be seen by the naked eye.

This phenomenon can trigger biological effects, like heating, where "biological effect" does not necessarily equal "health hazard"¹.

Technological development has revolutionized the way one lives, works, and communicates. Technology relies on electricity, which generates electromagnetic fields². As technology has pervaded various aspects of modern life, concerns regarding the possible health effects of EMF have grown rapidly.

The undetectable nature of EMF, along with reduced public understanding of some scientific subjects, has generated misconceptions regarding EMF and has thus increased fears of possible health risks.

These concerns are exacerbated by lack of appropriate risk communication strategies. When public perception and the level of risk acceptance are not properly understood and managed, there may be mistrust towards technology and related regulatory measures.

Fear of detrimental health effects can end up slowing down and hindering the installation of new wireless technologies, thereby widening the digital divide. This process is depicted in Table 1.

Table 1 – Managing social acceptance



The situation described above reflects the current controversy regarding EMF in the Latin American region.

Technology, such as mobile phones and antennas, is a complex and extremely technical subject, which may not be easily understood by a generic audience. Furthermore, public perception of environmental or health risks is a phenomenon that often involves subjective and emotional judgements stemming from the cultural context and similar past experiences.

As shown in Table 1, public concern for EMF related to health issues can result in rejection of the installation of wireless technologies, if not addressed by a proper risk management strategy, which includes health risk assessment and communication components.

¹ WHO, "What are electromagnetic fields?", available at: www.who.int/peh-emf/about/WhatisEMF/en/

² European Commission (2005), "Health and electromagnetic fields", available at: http://ec.europa.eu/health/archive/ph_determinants/environment/emf/brochure_en.pdf

Public understanding of technological development, science and related health risks depends on how the issue is presented³.

When developing a risk management strategy to respond to public concerns, policy-makers should be aware of the social dimensions that influence public perception of risk. Both measured and perceived risks should be understood and taken into consideration⁴.

To perform risk management, taking measurements to control electromagnetic emissions is as important as a clear communication of the results to the public.

Recommendation ITU-T K.83, "Monitoring of electromagnetic field levels", provides indications on how to make long-term measurements to control EMF in selected areas of public concern. This is done with the aim of showing that EMF levels are under control and within the prescribed limits⁵.

Measurements help quantify electromagnetic emissions. Thus, when the results of the measurements are presented to the public in an understandable format, they can help raise public awareness and facilitate understanding of science while mitigating concerns.

An appropriate strategy for communicating risks to the public is a fundamental component of an effective risk management strategy. Therefore, the purpose of Recommendation ITU-T K.83 is to provide the general public with clear and easily accessible data concerning electromagnetic field levels in the form of results of continuous measurement.

Public participation in controlling EMF exposure levels through continuous monitoring systems and easy access to information through the Internet can markedly facilitate the management of social acceptance of the installation of wireless networks. Thus, public participation can ensure the timely approval of new facilities while protecting health and guaranteeing the safety of the community.

A comparative analysis of risks and benefits of wireless technologies could also be considered to overcome public resistance to the deployment of new wireless technologies. Studies focusing on social and economic benefits of mobile communication technologies can play a fundamental role in raising awareness of technological development, supporting clarification of science and building social acceptance.

Establishing and maintaining a dialogue among all stakeholders, namely civil society, national and local authorities, industry, scientific community, media and associations, is crucial to prevent irrational fear of technological development from growing.⁶

A decision-making process, which is based on clear scientific evidence and conducted in an open, fair and accountable manner by the authorities, is instrumental in engaging all stakeholders. To achieve this, the ultimate goal of Recommendation ITU-T K.83 is to provide national and local authorities with appropriate measurement tools to improve their decision-making processes. At the same time, the industry and the scientific community are also expected to co-operate with national and local authorities in order to settle maximum levels of exposure, support technological improvements and implement preventive measures.

³ WHO Handbook: "Establishing a Dialogue on Risks from Electromagnetic Fields", available at: www.who.int/peh-emf/publications/en/EMF_Risk_ALL.pdf

⁴ WHO Handbook: "Establishing a Dialogue on Risks from Electromagnetic Fields", available at: www.who.int/peh-emf/publications/en/EMF_Risk_ALL.pdf

⁵ Recommendation ITU-T K.83, available at: www.itu.int/ITU-T/recommendations/rec.aspx?rec=11037

⁶ WHO Handbook: "Establishing a Dialogue on Risks from Electromagnetic Fields", available at: www.who.int/peh-emf/publications/en/EMF_Risk_ALL.pdf

2 ITU governance

As mentioned in the Introduction, the proliferation of sources of EMF emissions due to the increasing use of radio spectrum, along with public understanding of science- and health-related risks, has generated in some cases, in the rejection of the installation of new wireless infrastructure, thereby hindering technological and socio-economic development. This issue is particularly sensitive in countries where there is no regulation in place and citizens do not feel protected and safe.

Recognizing this problem and the urgent need to find a solution to prevent the widening of the technological divide between developed and developing countries, the ITU membership has raised this issue at various conferences and adopted the following Resolutions:

- **Resolution 72** "Measurement concerns related to human exposure to electromagnetic fields" of the World Telecommunication Standardization Assembly (adopted in Johannesburg in 2008 and revised in Dubai in 2012)⁷;
- **Resolution 62** "Measurement concerns related to human exposure to electromagnetic fields" of the World Telecommunication Development Conference (adopted in Hyderabad in 2010 and revised in Dubai in 2014)⁸; and
- **Resolution 176** "Human exposure to and measurement of electromagnetic fields" of the Plenipotentiary Conference (adopted in Guadalajara in 2010 and revised in Busan in 2014)⁹.

Disseminating information

At these conferences, the following aspects were noted: (i) the importance of ICT for social, economic and cultural development, (ii) the crucial role of wireless technologies to bridge the digital divide, (iii) the need to raise public awareness about the possible effects of exposure to EMF, and (iv) the importance to collect and disseminate accurate, science-based and clear information on EMF-related health risks to lessen public concerns.

Assisting countries

To overcome the absence of regulation in some countries, the importance of disseminating information concerning exposure to EMF, EMF measurement methodologies were reaffirmed. This was done in order to assist national authorities, particularly in developing countries, to develop appropriate national regulations in compliance with international standards.

Furthermore, it was decided that ITU will work to identify the needs of developing countries and to build human capacity concerning the measurement of EMF related to human exposure. Conditions like the high cost associated with obtaining radio frequency (RF) measurement equipment, which might deepen the gap between developed and developing countries in performing measurements of exposure levels to EMF, require urgent action.

⁷ Resolution 72 (WTSA-12), available at: www.itu.int/pub/T-RES-T.72-2012

⁸ Resolution 62 (WTDC-14), available at: www.itu.int/pub/D-TDC-WTDC-2014

⁹ Resolution 176 (PP-14), available at: www.itu.int/pub/S-CONF-ACTF-2014

Cooperation with other international organizations

The Resolutions also aimed at strengthening coordination with WHO and other international organizations working in this field, including: (i) the International Commission on Non-Ionizing Radiation Protection (ICNIRP), (ii) the International Electrotechnical Commission (IEC) and (iii) the Institute of Electrical and Electronics Engineers (IEEE). Efforts should be made to harmonize regulatory frameworks and science-based standards for regulators and policy-makers to help them formulate appropriate national standards.

By adopting these Resolutions, ITU Member States reaffirmed their commitment to: (i) comply with ITU Recommendations and other relevant international standards, as well as (ii) cooperate and share expertise, also through regional cooperation mechanisms.

Box 1: ITU-T Study Group 5


Within the Telecommunication Standardization Sector (ITU-T) of ITU, Study Group 5 (SG5) is the lead study group on ICT environmental aspects related to electromagnetic phenomena and climate change.

SG5's Working Party 2 studies EMF issues under Question 7/5: "Human exposure to electromagnetic fields (EMFs) due to radio systems and mobile equipment". The resulting international standards (ITU-T Recommendations) provide high-level frameworks for the management of human exposure to EMFs emitted by telecommunication equipment (best practice regulatory guidelines), and also offer guidelines for the assessment of human exposure based on existing ITU-T Recommendations and standards produced by other standards development organizations (SDOs).

To achieve these goals, Question 7/5 looks at measuring techniques, procedures and numerical models for evaluating the electromagnetic fields stemming from telecommunication systems and radio terminals.

Source: www.itu.int/dms_pub/itu-t/oth/0b/04/T0B040000512C01PDFE.pdf

3 Recommendation ITU-T K.83, "Monitoring of electromagnetic field levels"

	<p>Box 2: Summary of Recommendation ITU-T K.83</p> <p>Recommendation ITU-T K.83 gives guidance on how to make long-term measurements for the monitoring of electromagnetic fields (EMFs) in the selected areas that are under public concern, in order to show that EMFs are under control and within limits.</p> <p>The purpose of this Recommendation is to provide to the general public, clear and easily available data concerning electromagnetic field levels in the form of results of continuous measurements.</p> <p>Source: Recommendation ITU-T K.83: http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=11037</p>
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As stated in the Introduction of Recommendation ITU-T K.83, "Electromagnetic fields are imperceptible and unknown for the general public. This unawareness and imperceptibility, distrust and rejection among the population, which can result in social conflicts and lead to delays in the deployment of new wireless technologies.

The solution to these problems is the control of the electromagnetic emissions by taking measurements and having a proper communication. Measurements turn emissions into something objective and, when presented to the public in an understandable format, help diminish the unawareness and helplessness of the public."¹⁰

Recommendation ITU-T K.83 "Monitoring of electromagnetic fields levels" builds upon the resolutions adopted by the ITU membership, as described in section 2.

It asserts: (i) the need to control electromagnetic emissions by taking continuous measurements, and (ii) the importance to communicate and disseminate the results of the measurements in a clear and transparent manner. It defines the methods for the implementation of continuous measurement systems for electromagnetic emissions, in order to establish a common practice at the international level for this type of measurements.

¹⁰ Recommendation ITU-T K.83, available at: www.itu.int/ITU-T/recommendations/rec.aspx?rec=11037

Recommendation ITU-T K.83 presents two recommended methods: using the frequency selective measurement or using the broadband measurement. In both cases, the measurements of electromagnetic fields must fulfil three requirements: they must be objective, reliable and continuous.

"The objectivity of the measurements is achieved whenever a public and/or independent body carries out the taking of the measurements and manages their publication. Reliability derives from compliance with international norms and standards regarding the measurement of electromagnetic fields and by an accredited calibration of the measuring equipment. The continuous taking of objective and reliable measurements (24/365) provides permanent monitoring of emissions and a maximum transparency.

For years, in various parts of the world, broadband systems have been used for the continuous measurement of electromagnetic fields with satisfactory results, increasing citizens' confidence in governments, and reducing their fear and ignorance regarding electromagnetic emissions. An alternative are the frequency selective measurement systems, which should be applied to meet particular requirements."¹¹

Other ITU-T Recommendations developed by SG5, such as ITU-T K.52 "Guidance on complying with limits for human exposure to electromagnetic fields"¹², ITU-T K.61 "Guidance on measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations"¹³ and ITU-T K. 70 "Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations"¹⁴, provide additional guidance on the measurement methods, which can be used for compliance assessment with exposure limits. These are also effective methods for managing public risk perception.

Recommendation ITU-T K.83 *"presents the basis for the implementation of continuous measurement systems for electromagnetic emissions, in order to constitute a common practice at the international level for this type of measurements"*.¹⁵

The experience in the Latin American region shows that objective measurements can be achieved through the implementation of continuous measurement systems for electromagnetic emissions. The results of these measurements, when correctly communicated to the general public, help mitigate public concerns regarding EMF-related health risk, support open decision-making processes, facilitate the installation of wireless networks and thereby reduce the digital divide. More information on the specific projects implemented in some Latin American countries is detailed in section 4.

¹¹ Recommendation ITU-T K.83, available at: www.itu.int/ITU-T/recommendations/rec.aspx?rec=11037

¹² Recommendation ITU-T K.52, available at: www.itu.int/ITU-T/recommendations/rec.aspx?rec=12238

¹³ Recommendation ITU-T K.61, available at: www.itu.int/ITU-T/recommendations/rec.aspx?rec=9139

¹⁴ Recommendation ITU-T K.70, available at: www.itu.int/ITU-T/recommendations/rec.aspx?rec=9140

¹⁵ Recommendation ITU-T K.83, available at: www.itu.int/ITU-T/recommendations/rec.aspx?rec=11037

4 Implementation of Recommendation ITU-T K.83 in Latin America

4.1 Pilot project of Argentina and ITU

To respond to the growing public rejection of wireless systems, the Argentinian government through the *Secretaría de Comunicaciones de Argentina* (SECOM – Secretariat of Communications of Argentina) is committed to find a viable solution to reduce public concerns and increase acceptance for the installation of wireless networks.

Generally, resistance to the installation of networks leads to the formulation of restrictive municipal regulations. This has occurred all over Latin America.

In order to engage all key stakeholders, SECOM invited mobile phone operators and mayors, through the *Federación Argentina de Municipios* (FAM – Argentinian Federation of Municipalities) to take part in a pilot project launched in May 2010 with the technical and financial support of ITU.

Mayors and mobile phone operators were called upon to work together within the framework of a Collaboration Agreement, which aimed at:

- Building an information society to promote development, both at a national and local level, technological innovation and access to various services for mobile communication;
- Fostering collaboration between municipalities and mobile phone operators to raise awareness and develop new opportunities created by the incorporation of new technologies in the running of local government and in articulating its relationship with citizens; and
- Strengthening the importance and need to allow the installation of support structures for radio communication antennas and the infrastructure key to deliver quality service and to satisfy the communication needs of the population.

To achieve the objectives set in the Collaboration Agreement, the following activities were carried out:

- Creation of an advisory service to municipalities on technical, legal and tax-related issues and for information on antenna structures for mobile communication and associated infrastructure (*Servicio de Asesoramiento Técnico/Technical Advisory Service, (SAT-FAM)*);
- Elaboration of a best practice code for the installation of antennas and associated infrastructure to serve as a guide for the development of municipal regulation;
- Establishment of a pilot project of a continuous monitoring system of non-ionizing radiation (NIR), in collaboration with the Institute of Investigation and Environmental Engineering of the National University of San Martín, to assess, through public surveys, the reaction of the citizens to the implementation of this continuous monitoring system;
- Creation of a webpage to report on NIR levels in municipalities (through radiation maps) and to allow for a comparison with the maximum levels established at a national level; and
- Development, publication and distribution of informative material (leaflets, presentations with specialists, seminars, etc.).

ITU's collaboration

ITU, together with SECOM, actively participated in this project, by setting the basis for an agreement between FAM and mobile phone operators.

ITU's main tasks included: (i) selecting the university responsible to carry out the pilot project of a continuous monitoring system of NIR; (ii) developing the terms of reference for the technical advisory service; (iii) preparing a best practice code for the installation of antennas and associated infrastructure;

and (iv) drafting a technical report on the pilot project including the technical specifications for the equipment and the preparations for its installation.

Figure 1: Ahmed Zeddami, Chairman of ITU-T Study Group 5 "Environment and Climate Change", Héctor Carril, Chairman of ITU-T Study Group 5 Regional Group for the Americas and Malcolm Johnson, Deputy Secretary-General, ITU, who fostered the application of the Recommendation ITU-T K.83 worldwide, visited the system



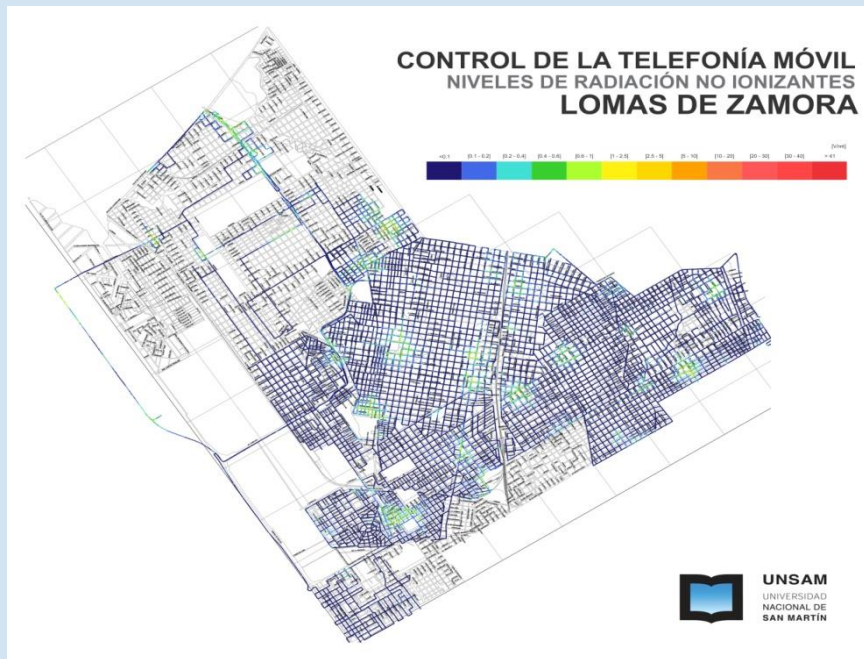
SAT-FAM's continuous monitoring system

Launched in May 2010, the Argentinian pilot project was composed of a system of twelve continuous monitors (set up in selected areas of public concern) and a control centre for the reception and processing of data received by control sensors. Besides the continuous monitoring system, municipal radiation maps were developed in some cities.

Figure 2: Example of continuous monitoring systems in Loma de Zamora based on Recommendation ITU-T K.83



Figure 3: Example of radiation maps in Lomas de Zamora, developed by SAT-FAM and National University of San Martin



The results of the pilot project were published on a dedicated website¹⁶ created by SAT-FAM. This transparent communication of the measurement results to the general public, contributed to strengthening public confidence towards wireless technologies and to overcome unjustified delays in the deployment of new antennas.

Figure 4: Sections of the SAT-FAM's website, available at <http://www.satfam.org/>



¹⁶ Website of the Argentinian pilot project, available at: www.satfam.org/. Please note that the website of the pilot project will be migrated to the website of the national system of continuous monitoring for NIR, currently under development. More information is available in section 4.8.

Furthermore, the success of the Argentinian pilot project propelled a proposal to SG5 for the creation of a standard on these continuing monitoring systems, which contributed to drive the development of Recommendation ITU-T K.83.

After that, Recommendation ITU-T K.83 was approved in 2011 and building on the satisfactory results achieved, the Argentinian government concluded the pilot project and established a national system of continuous monitoring of NIR, which is presented in section 4.8.

4.2 ITU' and COMTELCA's pilot project in Central America

Public rejection of the deployment of new wireless networks is a sensitive social issue in Central America.

Drawing from the successful Argentinian experience, the Telecommunications Regional Technical Commission (COMTELCA)¹⁷ requested in 2012 ITU's assistance to study, develop and implement a similar pilot project of continuous monitoring systems of NIR in Central America.

This project aimed to understand the root causes of public rejection of the installation of mobile networks and their associated infrastructure in Central America, as well as to provide guidance to policy-makers to develop national legislation to control NIR and manage public concerns related to possible health and environmental risks.

The project started in June 2012 and was developed around three phases. The last phase is expected to end in the third quarter of 2015, with the finalization and adoption of national standards for NIR.

ITU worked together with the governments of Honduras, El Salvador and Panama to carry out studies aiming at:

- Assessing the existing problems and socio-political context in each of the beneficiary countries and its municipalities regarding the installation of antennas.
- Providing general guidelines to assist countries in drafting national standards for NIR in case of absence of regulation.
- Developing a long-term sustainable work plan to implement the management of social acceptance of the installation of antennas.
- Elaborating a best practice guide for the installation of support infrastructure of antennas and related municipal regulation, protection of the environment and cultural heritage, as well as urban planning and NIR levels control.

Additional objectives were set for El Salvador:

- Developing a handbook, which provides guidance on performing effective and clear communication to the general public on the effects of EMF radiations and their management.
- Implementing a pilot project of continuous monitoring systems equipped with maps of municipal radiations in El Salvador, with the objective of evaluating the effects on municipalities witnessing public rejection towards the installation of radio communication antennas.

The pilot project of continuous monitoring systems was launched in September 2013, based on the specifications set out in Recommendation ITU-T K.83 along with the financial support of ITU and of the *Superintendencia General de Electricidad y Telecomunicaciones* (SIGET – General Superintendency of Electricity and Telecommunications of El Salvador). More information on the pilot project carried out in El Salvador is provided in section 4.3.

¹⁷ More information on COMTELCA is available in section 5.

Figure 5: ITU's work in Central America



Furthermore, ITU also organized a training programme for all COMTELCA's members on the practical implementation of Recommendation ITU-T K.83 as part of its capacity building activity.

As a result of the successful implementation of the pilot project in El Salvador and based on the results of the studies conducted in Honduras, El Salvador and Panama, COMTELCA decided to promote the adoption and implementation of similar systems of continuous monitoring of NIR in the rest of the Central American region.

4.3 National monitoring system of non-ionizing electromagnetic fields: pilot project in El Salvador

The *Superintendencia General de Electricidad y Telecomunicaciones de El Salvador* (SIGET – General Superintendency of Electricity and Telecommunications in El Salvador) is the national authority responsible for telecommunications in El Salvador. SIGET is committed to providing access to efficient telecommunication services in the country, while protecting the environment.

Since the 2010 ITU Plenipotentiary Conference, the government of El Salvador is committed to taking concrete actions to establish systems of NIR measurements, and to develop strategies to facilitate the dissemination of the results of the measurements, in order to appease public concerns regarding the installation of new telecommunication infrastructure, resulting from the increasing demand of communication services. To meet these objectives, SIGET worked closely with ITU and COMTELCA to develop and launch, in September 2013, a pilot project on a continuous monitoring system for non-ionizing electromagnetic fields in El Salvador.

Monitor sensors were installed in selected sites across different cities of the country, such as the surroundings of hospitals, educational institutions or areas with a high population or infrastructure density, to provide continuous measurements of electromagnetic field levels.

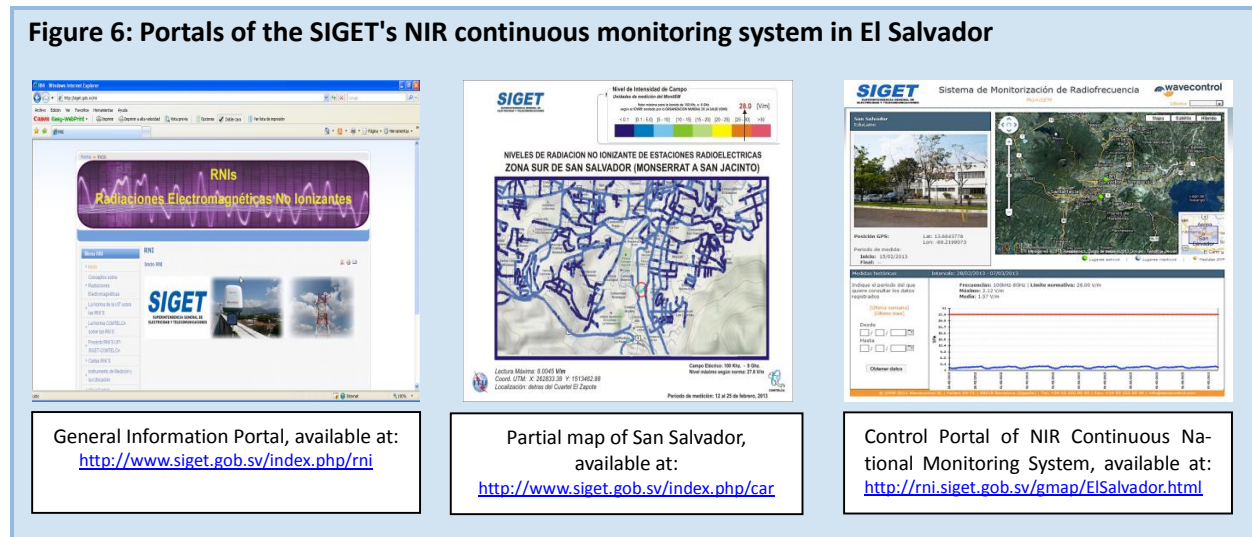
These measurements were conducted under the specifications of Recommendation ITU-T K.83. Measurement results helped verify compliance with the exposure limits established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) international standards. In future, the system will use the exposure limits set by a National Model Standard as a reference. The National Model Standard is being developed by an inter-institutional multidisciplinary bureau to pave the way for the future regulation on the installation of telecommunications infrastructure and other services, which make use of the radio spectrum in the country.

Measurement results are presented in a clear manner, through a simple graph and can be easily accessed by the general public on an online platform, consisting of two portals.

The first portal¹⁸ aims at providing useful resources related to electromagnetic fields, environment and health issues. It is a resource repository, including general notions, national regulation, international standards and policies, presentations, studies and links to websites of interest. It also contains partial maps of the metropolitan area of San Salvador and its surroundings, where the first NIR map was developed.

The second portal¹⁹ provides the results of the measurements of electromagnetic fields generated by radio stations and other similar sources carried out in the country. In the same portal, measurements of compliance with the exposure limits established by ICNIRP are available. These measurements are occasionally carried out for existing radio base stations, at the request of interested communities or individuals across the whole country.

Figure 6: Portals of the SIGET's NIR continuous monitoring system in El Salvador



As part of the institutional support to higher education, a group of graduates in Information Systems at the Central American University of José Simeón Cañas (UCA), is developing a new portal, which will allow the general public the possibility for dynamic interaction with the results of the measurements, both occasional and continuous with maps of municipal radiation. The development of this portal started in head departments in the fourth quarter of 2014, in line with the 2014 investment plan. This new portal, to which the general information repository will be moved, will allow the user to locate an area of interest in any part of the country with one click of the mouse and observe in detail the measurements made in that area and their levels, if existent, on any mobile device.

The pilot project was conducted successfully in 2013. Currently, the system is still running, operated by SIGET, and it represents the first national monitoring system for non-ionizing electromagnetic fields established in the country.

4.4 National monitoring system for electromagnetic fields: pilot project in Colombia

Oscar León, Director of the National Spectrum Agency (ANE): **"Monitoring systems notify, educate and inform citizens in a simple and effective way, dispelling the myths which prevent the deployment of new communications infrastructure."**

¹⁸ General Information Portal, available at: www.siget.gob.sv/index.php/rni

¹⁹ Control Portal of NIR Continuous National Monitoring System, available at: <http://rni.siget.gob.sv/gmap/ElSalvador.html>

The rising demand of mobile services, as well as the implementation of the national broadband plan (Live Digital, 2010-2014²⁰), need to be supported by the deployment of new wireless infrastructure, which may encounter the rejection of behalf of the citizens, due to alleged harmful health risks.

To overcome this situation, Colombia's government worked towards the definition of a national legislation for the deployment of wireless infrastructure, including an effective communications strategy for the general public in order to facilitate public participation in the control of electromagnetic fields exposure limits, and thereby allowing the timely deployment of new antennas.

Under the leadership of the *Agencia Nacional del Espectro en Colombia* (ANE – National Spectrum Agency of Colombia), a national monitoring system of electromagnetic fields was launched officially, in August 2013, to measure the electromagnetic fields generated by wireless telecommunications systems in various cities across the country.

A continuous monitoring system consisting of 43 sets of equipment was deployed to permanently measure electromagnetic field levels in strategic sites across different cities of that country, such as the surroundings of hospitals, educational institutions or areas with a high population or infrastructural density. These measurements were performed under the specifications of Recommendation ITU-T K.83.

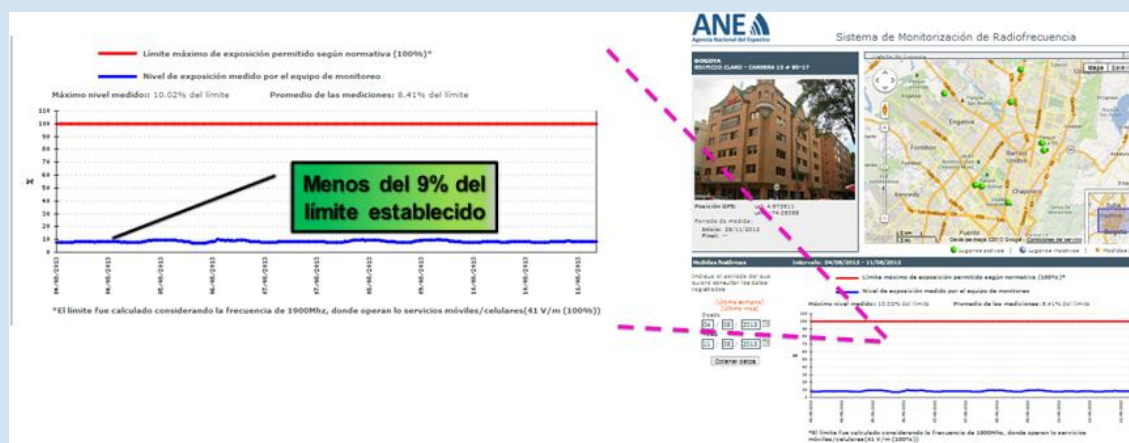
The results of the measurement and monitoring of electromagnetic fields generated by the radio stations are available on an online platform, consisting of two portals, aimed at the general public, where the data are presented in a clear and simple way.

The first portal²¹ shows the measurements results in a graph in terms of percentages in order for users to identify how close or far away they are from the recommended limits.

Any citizen can access the portal to verify compliance with the limits set by the international standards and the existing legislation in Colombia.

Figure 7: Examples of the measurements results from one of the installed sets of equipment in Bogota, available at:

http://smrni.ane.gov.co/AppPHP/indexGMap.php?map=mapacolombia&usuari=smrf&clau=smrf&idioma=es_ES



²⁰ Live Digital Plan, available at: www.mintic.gov.co/portal/vivedigital/612/w3-channel.html

²¹ Measurement results on the ANE's Monitoring Electromagnetic Fields System portal, available at: http://smrni.ane.gov.co/AppPHP/indexGMap.php?map=mapacolombia&usuari=smrf&clau=smrf&idioma=es_ES

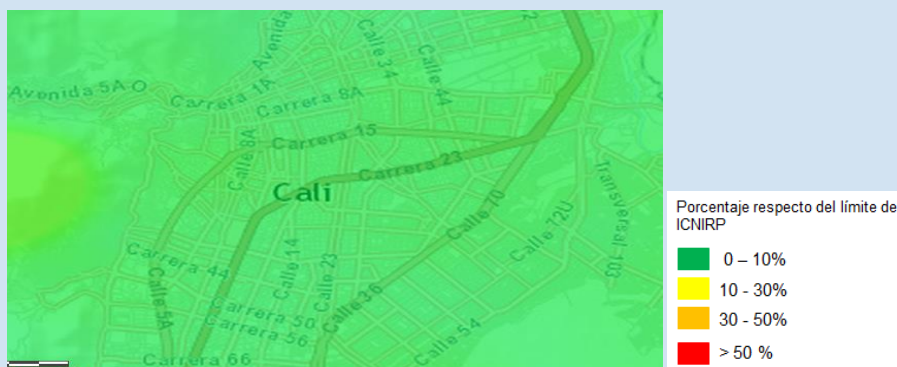
The second portal²² presents the results of the measurements performed in the urban centres of Colombia's 72 largest cities, covering close to 70% of the population with the help of an extensive repository of electromagnetic field maps.

These measurements were performed along all routes of every city to generate points of reference that show, graphically, if the levels measured are compliant with the recommended limits of electromagnetic field exposure and to which extent they do so. This process takes the recommended value as a reference for frequencies, where mobile phone networks operate.

These electromagnetic field maps can be interpreted as follows:

- If the area of interest is in green, it means that the measurement is less than 10% of the limit;
- If it is yellow, it means that the values are between 10% and 30%;
- If it is orange, it means that the measurement produces a figure between 30% and 50%; and
- If it is in red, it means that it exceeds 50%.

Figure 8: Example of a map showing the electromagnetic field levels in the central area of the city of Cali



The pilot project was conducted successfully in 2013. ANE's EMF continuous monitoring system proved to be a useful tool to empower citizens and facilitate their participation in verifying compliance with exposure limits. Therefore, the system has been enhanced and maintained. As of the publication of this Report, the system has been expanded and consists of 70 sets of equipment.

4.5 Activities related to monitoring EMF exposure in Brazil

Agostinho Linhares, Anatel, Vice-chairman of ITU-T SG5 Regional Group for the Americas: ***"The best way to demystify concerns about electromagnetic fields is to establish an open and honest dialogue with society. The monitoring system is a simple and direct way to show the population that electromagnetic field levels in radio frequency bands are under control and usually have a value well below the WHO's recommended limits."***

The *Agência Nacional de Telecomunicações* (Anatel – National Telecommunications Agency of Brazil) is an independent agency responsible for regulating and supervising the telecommunications sector in Brazil. It implements the Brazilian telecommunications policy and represents Brazil at international telecommunications fora.

²² Electromagnetic field maps on the ANE's Monitoring Electromagnetic Fields System portal, available at: <http://medicion.radiacion.antenas.sitimapa.com/ane/#>

Anatel recognizes the importance of maintaining an open dialogue with the civil society, operators, regulators and other governmental authorities on the issues related to human exposure to EMF and alleged health risks, by establishing a transparent communication on policies and measures implemented in the country in accordance with ITU Recommendations and WHO guidelines.

To this end, in 2013 and beginning of 2014, Anatel almost doubled its capacity for EMF assessment with the acquisition of new sets of broadband equipment and EMF monitoring equipment. A new spectrum management software is being implemented. This software has an EMF exposure package that provides signal propagation predictions, which will be included in the measurements results.

The new EMF monitoring system is composed of 66 units. It is compliant with the specifications of Recommendation ITU-T K.83 and presents some additional features for vehicle-mounted measurement systems.

Figure 9: New EMF monitoring system assembled on a car and on a base station that uses both photovoltaic cells and a battery to guarantee continuous monitoring without an electrical power source



It is expected that the results of the measurements conducted by this new EMF monitoring system will be made available on an online platform along with the measurements obtained by other existing equipment. Any user will have access to this online platform and will be able to verify that the measurements results are compliant with the established EMF exposure limits.

This new EMF monitoring system will represent an important tool for municipal authorities to manage social acceptance of antennas, by facilitating public participation in the NIR control process.

Figure 10: The new EMF monitoring system installed in Brazil's national stadium "Mané Garrincha" in Brasilia, during the 2014 FIFA World Cup



4.6 Pilot project in Ecuador to strengthen control of electromagnetic emissions

Claudio Rosas Castro, National Technical Intendent for Control (SUPERTEL): ***"We believe in preventive control, transparent management and the right of citizens to have a quality service. The Superintendency of Telecommunications contributes to the development of telecommunications in Ecuador."***

The unprecedented growth of broadband and mobile communications in Ecuador has required the extensive use of radio communication systems. The installations of new wireless infrastructure to support this broadband growth have triggered public concerns for EMF-related health issues.

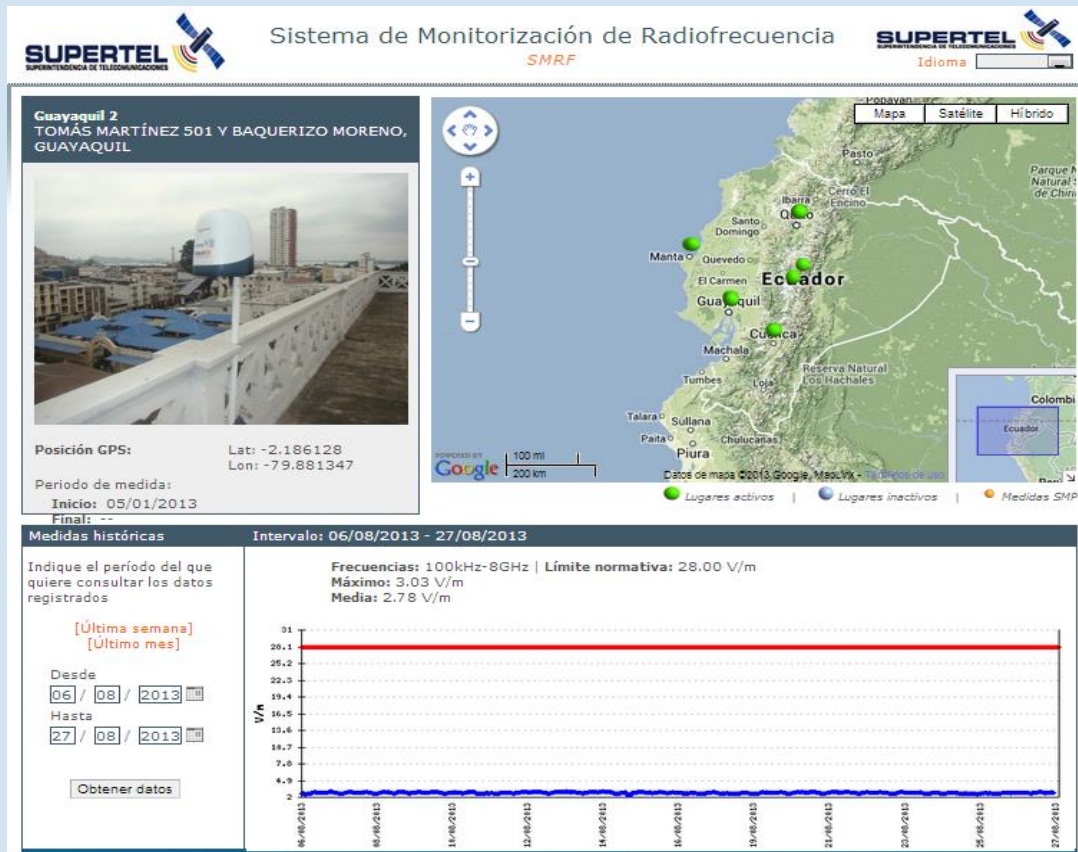
The *Superintendencia de Telecomunicaciones de Ecuador* (SUPERTEL – Superintendency of Telecommunications of Ecuador)²³ was the agency responsible for telecommunications services and consumer protection in Ecuador until February 2015. SUPERTEL was in charge of verifying that the EMF levels produced by radio communication devices and installations, including voice and data mobile services, were within permitted limits.

To respond to these public concerns and establish an open dialogue with citizens, SUPERTEL decided to implement a pilot project of continuous measurement systems for electromagnetic emissions in order to allow citizens to participate in the verification of EMF permitted levels at specific sites. The pilot project was launched in December 2013.

These autonomous systems performed continuous (24/365) measurements in a frequency range between 100 kHz and 8 GHz, and were installed in selected areas of public concern in various cities across the country.

²³ Since February 2015, SUPERTEL was incorporated by the *Agencia de Regulación y Control de las Telecomunicaciones* (ARCOTEL – Telecommunications Regulatory Agency of Ecuador), available at: www.arcotel.gob.ec/

Figure 11: Website of SUPERTEL's continuous monitoring system based on Recommendation ITU-T K.83, available at: <http://suptel-rni.suputel.gob.ec/gmap/ecuador.html>



The results of the measurements conducted by these systems, which are compliant with Recommendation ITU-T K.83, are presented in an understandable and accessible format to the general public through an online platform²⁴. In addition, SUPERTEL created the *Sistema Automático de Mediciones de Radiaciones no Ionizantes* (SAMRNI – Automatic System for Monitoring Non-Ionizing Radiation) through which georeferenced measurements are taken at intervals of seconds, and maps of electromagnetic emissions are generated for the entire Ecuadorian territory.

²⁴ Website of SUPERTEL's monitoring system of radio frequencies, available at: <http://suptel-rni.suputel.gob.ec/gmap/ecuador.html>

Figure 12: Sistema Automático de Mediciones de Radiaciones no Ionizantes (SAMRNI – Automatic System for Monitoring Non-Ionizing Radiation)

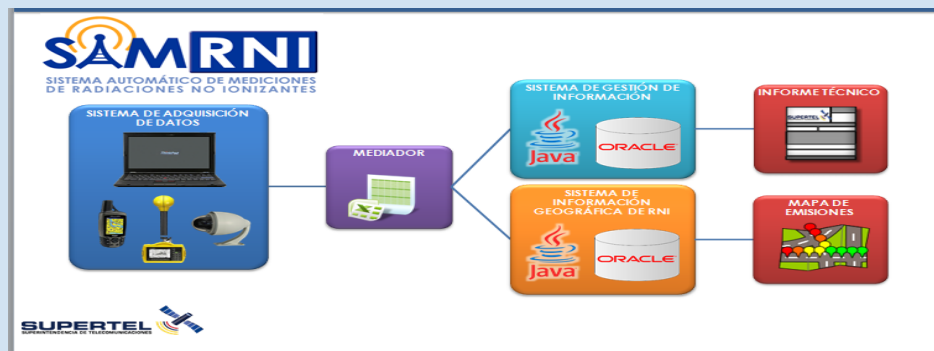


Figure 13: Example of map of the electromagnetic emissions



The pilot project conducted in Ecuador in 2013 helped improve the NIR control mechanism from both a technical and social perspective. Based on these satisfactory results, SUPERTEL maintained these continuous monitoring systems, which are still operating.

The transparent communication strategy adopted by SUPERTEL facilitated the dissemination of the measurements results through different channels such as the dedicated online platform, workshops and information sessions, thereby enabling the general public to access the data and verify compliance with exposure limits.

SUPERTEL also used the measurements results to foster studies on radio emissions.

4.7 Continuous monitoring of non-ionizing radiation in Uruguay

Leslie Green, Engineer, Management and Regulation Manager, URSEC: ***"The NIR continuous monitoring activities that we plan to kick-start represent a significant qualitative and quantitative leap, designed to provide assurance on the deployment and functioning of radio communication stations to the citizens, operators and various national public institutions and departments."***

In order to tackle public rejection towards the installation of new wireless infrastructure and to provide transparent information on compliance with the existing EMF exposure limits, the *Unidad Reguladora de Servicios de Comunicaciones de Uruguay* (URSEC – Regulatory Unit of Communication Services), which is the agency responsible for telecommunications in Uruguay, acquired a continuous monitoring system of NIR in 2014.

The system was tested by URSEC and is in the process of being installed. In the first phase, the system is made up of four fixed/transportable stations and a "dual" station for fixed/mobile applications.

Two of the fixed stations will be placed in frequently visited public sites, where there exists a concentration of broadcasting stations of multiple radio communication systems.

These stations will not be relocated and will instead be used to provide "indicative" measurements in order to create a local database to analyse the evolution of the EMF levels in these locations.

The other two fixed stations will be located in other specific sites for pre-established periods, to verify compliance with the limits established by the current regulation, address any problem in an accurate manner and facilitate the installation of new infrastructures.

With the "dual" fixed/mobile stations, dynamic maps will be elaborated to identify possible areas where the field levels could require subsequent specific monitoring.

With the aim of disseminating the results obtained to the public, information about the fixed stations' locations, as well as the measurements carried out, will be published on the institutional webpage of URSEC.

The system will be open and will allow the management of new stations, which might be added by operators or other national or departmental agencies.

The continuous monitoring system will be officially launched in 2015.

4.8 National monitoring system of non-ionizing radiation in Argentina

Nicolás Karavaski, Sub-controller of the National Commission of Communications: ***"The information, provided in an objective, reliable and continuous way, is a powerful tool to strengthen public trust in the implementation of new technologies."***

The *Secretaría de Comunicaciones de Argentina* (SECOM – Secretariat of Communications of Argentina), through its Resolution 11 (Buenos Aires, 28 March 2014)²⁵, established the *Sistema Nacional de Monitoreo de las Radiaciones No ionizantes* (SiNaM – National Monitoring System of Non-Ionizing Radiation).

This system will aim to measure NIR levels and ensure compliance with the national safety standards on exposure to radio frequencies. This system will be operated by the *Comisión Nacional de Comunicaciones de Argentina* (CNC – National Communications Commission of Argentina). According to Resolution 11, it must comply with the specifications of Recommendation ITU-T K.83 and be open so that municipalities, universities, research centres and other agencies can access it and add their own monitoring devices.

Resolution 11 also recognized the need to develop adequate policies and communication strategies addressing all stakeholders involved.

²⁵ Available in Spanish at: www.secom.gov.ar/descargas/1398178179resolucion112014.pdf

The general public will have access to the measurements results of SiNaM through a dedicated portal on the website of SECOM.

In order to develop the appropriate strategies and the necessary guidelines for the installation of antennas, Resolution 11 set up a "*Working Group on Public Control of Non-Ionizing Radiations*" composed of key stakeholders, including representatives of the National Commission for Communications, the Ministry of Environment, the Ministry of Health's Undersecretary of Health Relations and Research, the Secretary of Municipal Affairs of the Ministry of the Interior and Transport, the Argentine Federation of Municipalities, national universities and mobile communication services.

Public control of radiation

The possibility to access the measurements results performed by SiNaM (through the institutional website of SECOM) will give a greater assurance to the public regarding the effective compliance with the existing national safety standards, thereby facilitating the deployment of the base stations, key to telecommunications development.

It is expected that this form of public participation, direct or through various representative entities, will provide greater transparency to the control mechanism of NIR and will boost public confidence to overcome undue delays in the implementation of new wireless technologies. Furthermore, this new system will provide evidence that the EMF levels are compliant with the national safety standards established by the existing regulation.

Promoting a public control mechanism of NIR, along with an organized deployment of base stations, will fulfil the twofold objective of deepening technological progress, improving the quality of telecommunication services, as well as protecting the environment and health.

5 Telecommunications Regional Technical Commission (COMTELCA)

Oscar Estrada, Executive Secretary of COMTELCA: ***"I have no doubt that the International Telecommunication Union, through this project, has enabled countries of the region to find a solution to the social problem which limits the evolution and development of networks of mobile telecommunication services."***

The Telecommunications Regional Technical Commission (COMTELCA) is a regional cooperation body that is responsible for coordinating and harmonizing the development of the telecommunications industry in Central America. COMTELCA's membership comprises Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic.

COMTELCA expressed strong support for the development of a study to understand the current situation and condition of the installation of telephone networks and other mobile services, and their associated infrastructure in Central America. The study was triggered by the concerns expressed by the residents living close to electromagnetic radiation, and had as its ultimate objective to facilitate antenna installation, thereby encouraging the installation of mobile infrastructure to stimulate broadband development.

The projects carried out by ITU in collaboration with the governments of El Salvador, Honduras and Panama, led to an in depth unearthing of the problems associated with network installation in those countries and the assessment of the degree of public concerns for electromagnetic fields.

Taking into consideration the successful results obtained from the elaboration of radiation maps in the city of San Salvador, as well as the continuous monitoring systems implemented in El Salvador based on Recommendation ITU-T K.83, COMTELCA committed to promoting the implementation of this type of system throughout the Central American region. These successful examples of the implementation of continuous monitoring systems also garnered the attention of academics for the development of computer applications to facilitate the analysis of the effects of this type of radiation.

COMTELCA's Resolution N.1

As a result of the work carried out by ITU in Central America, the CXXVIII Ordinary Meeting of the Board of Directors of COMTELCA, held in Managua, Nicaragua, from 3 to 4 June 2013, adopted Resolution N.1²⁶.

Resolution N.1 states that the results of the pilot project in El Salvador proved the benefits of implementing similar projects in the rest of the countries of the region. It also resolves that COMTELCA work in close collaboration with ITU to facilitate and promote the implementation of similar projects in the other Central American countries.

²⁶ Available in Spanish at: www.comtelca.int/index.php?option=com_docman&Itemid=100028

6 Inter-American Telecommunication Commission (CITEL)

Franklin Merchán Calderón, Alternate Chair of the Permanent Consultative Committee II, Radiocommunications (PCC.II): ***"The work carried out by PCC.II of CITEL in relation to non-ionizing radiation (NIR) has addressed this issue in depth, proposing concrete solutions which are now being implemented in various countries of the region. These solutions help to guarantee the deployment of wireless communication systems, with the proper precautions and requirements to ensure quality services for citizens."***

The Inter-American Telecommunication Commission (CITEL) is the advisory body of the Organization of American States (OAS) responsible for telecommunications. It was established by the OAS General Assembly in 1994, with the mission *"to facilitate and promote the integral and sustainable development of interoperable, innovative and reliable telecommunications/ICT in the Americas, under the principles of universality, equity and affordability."* CITEL's membership comprises all OAS Member States and more than 100 Associate Members from the telecommunications, Internet, electronic media industry and others.²⁷

Within CITEL, the Permanent Consultative Committee II, Radiocommunications (PCC.II) is responsible *"for planning, coordination, harmonization, and efficient use of the radio spectrum, as well as geostationary and non-geostationary satellite orbits for radiocommunication services including broadcasting"* in accordance with ITU's Recommendations and guidelines.²⁸

CITEL, through the PCC.II rapporteur on technical and regulatory aspects related to the effects of NIR, carried out extensive research work throughout the Latin American region through trainings and investigations, to find a solution to the public concern for NIR and the resulting rejection of the installation of wireless networks.

Drawing from the experiences and successful results achieved with the support of ITU in some countries of the region which developed continuous monitoring systems and radiation maps, such as Argentina, Colombia, Brazil, Ecuador and El Salvador, and considering that various countries are currently implementing similar systems, CITEL adopted Recommendation PPC.II/REC.40 (XXII-13)²⁹ at the XXII meeting of PCC.II including Broadcasting, held from 4 to 8 November 2013, in Managua, Nicaragua:

Recommendation PPC.II/REC.40 (XXII-13)

... That Member States with difficulties in deploying antennas and associated infrastructures due to public opposition to NIR, should develop Radiation maps and Continuous Monitoring Systems based on Recommendation ITU-T K.83 as a communication and management tool that can facilitate social acceptance of the deployment of antennas.

Source: www.citel.oas.org/en/SiteAssets/PCCII/Final-Reports/P2!R-3455r1_i.pdf

Recommendation PPC.II/REC.40 (XXII-13) endorses the implementation of continuous monitoring systems, based on the specifications and guidance of Recommendation ITU-T K.83, as a viable tool to manage the installation of new wireless technologies, from both a technical and social perspective.

²⁷ CITEL website, available at: www.citel.oas.org/en/Pages/default.aspx

²⁸ CITEL's Permanent Consultative Committee II, Radiocommunications (PCC.II), available at: www.citel.oas.org/en/Pages/PCCII/default.aspx

²⁹ CITEL Recommendation PPC.II/REC.40 (XXII-13), available at: www.citel.oas.org/en/SiteAssets/PCCII/Final-Reports/P2!R-3455r1_i.pdf

7 Conclusions

Public concern for NIR, and the consequent rejection of the installation of wireless communication antennas, is responsible for hampering technological development and innovation all over the world.

Latin American countries have been seriously affected by this situation that led to the development of restrictive municipal standards affecting the installation of networks and the quality of services, thereby hindering the struggle to reduce the digital divide.

The solution to this problem requires an adequate assessment of the situation, which cannot be defined as a technological or a commercial battle, nor as a health problem, but as a conflict deriving from the public perception of EMF and the related health risks.

In order to elaborate on a long-term and sustainable plan that allows the management of social acceptance of the installation of antennas, it is necessary to address various issues, which influence public resistance to the installation of antennas.

In this respect, ITU, in response to the mandates stemming from its various World Assemblies and Conferences, carried out several activities, such as trainings, seminars and studies, to support its Member States in finding a solution to this issue.

In collaboration with ITU, studies on the situation of various countries such as Argentina, Colombia, Ecuador, El Salvador, Honduras, Panama and Peru were conducted and pilot projects were carried out.

The general conclusion resulting from these studies is that it is necessary, on the one hand, to address the root causes of public concerns for EMF-related health issues, and on the other hand, to carry out an effective compliance with national legislation and international standards, and to communicate effectively these results to the citizens.


In Latin America, many systems that were set up failed to consider urban development and environmental criteria, including land management. This generated firstly a visual negative impact, and secondly concerns regarding the antennas, which are associated with potential adverse health effects. In this respect, a vital part of the work needed to build public acceptance of the installation of antennas depends on achieving their integration in urban or rural areas, whilst respecting the cultural, architectural and historical heritage of the cities.

The development of a code of good practices for the installation of antennas and associated infrastructures is essential to manage social acceptance.

Furthermore, the creation of technical advisory services for municipalities, which municipal authorities can consult when drafting their regulation, will help to ensure that this regulation is in compliance with national legislation as well as international standards and guidelines established by WHO and ITU.

Verification of compliance with the maximum permitted levels of EMF exposure is an important tool in managing social acceptance of the installation of antennas.

The experiences of some Latin American countries described in this Report proved that setting up continuous monitoring systems of EMF led to the reduction of perceived risk by the citizens. Developing radiation maps and implementing continuous monitoring systems, as complementary tools to measuring compliance, allow the citizens to participate directly in controlling the radiations, thus applying a public control of NIR, and assisting in managing acceptance of the technology's installation.




Recommendation ITU-T K.83 "Monitoring of electromagnetic field levels", as well as other key Recommendations in this field such as Recommendations ITU-T K.52 "Guidance on complying with limits for human exposure to electromagnetic fields", ITU-T K.61 "Guidance on measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations" and ITU-T K.70 "Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations", are a landmark for the implementation of this type of measurements, providing technical support and legitimacy to governments in the safe deployment of wireless infrastructure.

Besides supporting the development of a clear and transparent communication strategy with the public, the implementation of Recommendation ITU-T K.83 made it possible to achieve affordable measuring equipment in the Latin American region, contributing to the dissemination of these continuous monitoring systems and thereby ensuring the desired technological development.

Abbreviations

This Report uses the following abbreviations:

ANATEL	<i>Agência Nacional de Telecomunicações</i> (National Telecommunications Agency of Brazil)
ANE	<i>Agencia Nacional del Espectro en Colombia</i> (National Spectrum Agency of Colombia)
ARCOTEL	<i>Agencia de Regulación y Control de las Telecomunicaciones</i> (Telecommunications Regulatory Agency of Ecuador)
CITEL	Inter-American Telecommunication Commission
CNC	<i>Comisión Nacional de Comunicaciones de Argentina</i> (National Communications Commission of Argentina)
COMTELCA	Telecommunications Regional Technical Commission
EMF	Electromagnetic Field
FAM	<i>Federación Argentina de Municipios</i> (Argentinian Federation of Municipalities)
GPS	Global Positioning System
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ITU	International Telecommunication Union
ITU-D	The ITU Telecommunication Development Sector
ITU-R	The ITU Radiocommunication Sector
ITU-T	The ITU Telecommunication Standardization Sector
NIR	Non-Ionizing Radiation
OAS	Organization of America States
PCC.II	Permanent Consultative Committee II, Radiocommunications
PP	Plenipotentiary Conference
RF	Radio Frequency
SAMRNI	<i>Sistema Automático de Mediciones de Radiaciones no Ionizantes</i> (Automatic System for Monitoring Non-Ionizing Radiation)
SAT	<i>Servicio de Asesoramiento Técnico</i> (Technical Advisory Service)
SDO	Standards Development Organization
SECOM	<i>Secretaría de Comunicaciones de Argentina</i> (Secretariat of Communications of Argentina)
SIGET	<i>Superintendencia General de Electricidad y Telecomunicaciones de El Salvador</i> (General Superintendency of Electricity and Telecommunications in El Salvador)
SiNaM	<i>Sistema Nacional de Monitoreo de las Radiaciones No ionizantes</i> (National Monitoring System of Non-Ionizing Radiation)
SG5	ITU-T Study Group 5
SUPERTEL	<i>Superintendencia de Telecomunicaciones en Ecuador</i> (Superintendency of Telecommunications of Ecuador)
UCA	<i>Universidad Centroamericana</i> (Central American University)
URSEC	<i>Unidad Reguladora de Servicios de Comunicaciones de Uruguay</i> (Uruguay's Regulatory Unit of Communication Services)
WHO	World Health Organization



WTSA World Telecommunication Standardization Assembly
WTDC World Telecommunication Development Conference

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CITEL Recommendation PPC.II/REC.40 (XXII-13):
www.citel.oas.org/en/SiteAssets/PCCII/Final-Reports/P2IR-3455r1_i.pdf

COMTELCA Resolution N.1: www.comtelca.int/index.php?option=com_docman&Itemid=100028

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Recommendation ITU-T K.61 (2008), *Guidance on measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations*.
www.itu.int/ITU-T/recommendations/rec.aspx?rec=9139

Recommendation ITU-T K.70 (2007), *Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations*. www.itu.int/ITU-T/recommendations/rec.aspx?rec=9140

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www.itu.int/ITU-T/recommendations/rec.aspx?rec=11037

Resolution 62 (WTDC-14): www.itu.int/pub/D-TDC-WTDC-2014

Resolution 72 (WTSA-12): www.itu.int/pub/T-RES-T.72-2012

Resolution 176 (PP-14): www.itu.int/pub/S-CONF-ACTF-2014

SAT-FAM (available until 2014): www.satfam.org

SECOM: www.secom.gov.ar

SIGET's Continuous Monitoring System: www.siget.gob.sv/index.php/rni and <http://rni.siget.gob.sv/gmap/EISalvador.html>

SUPERTEL's Continuous Monitoring System: <http://suptel-rni.supertel.gob.ec/gmap/ecuador.html>

URSEC: <http://www.ursec.gub.uy/>

WHO, *What are electromagnetic fields?* available at:
www.who.int/peh-emf/about/WhatisEMF/en/

WHO Handbook, *Establishing a Dialogue on Risks from Electromagnetic Fields*, available at:
www.who.int/peh-emf/publications/en/EMF_Risk_ALL.pdf

Sustainable ICT in Corporate Organizations
Sustainable Products
Sustainable Buildings
End of Life management for ICT Equipment
General Specifications and KPIs
Assessment Framework for Environmental Impacts of the ICT Sector
An energy-aware survey on ICT device power supplies
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