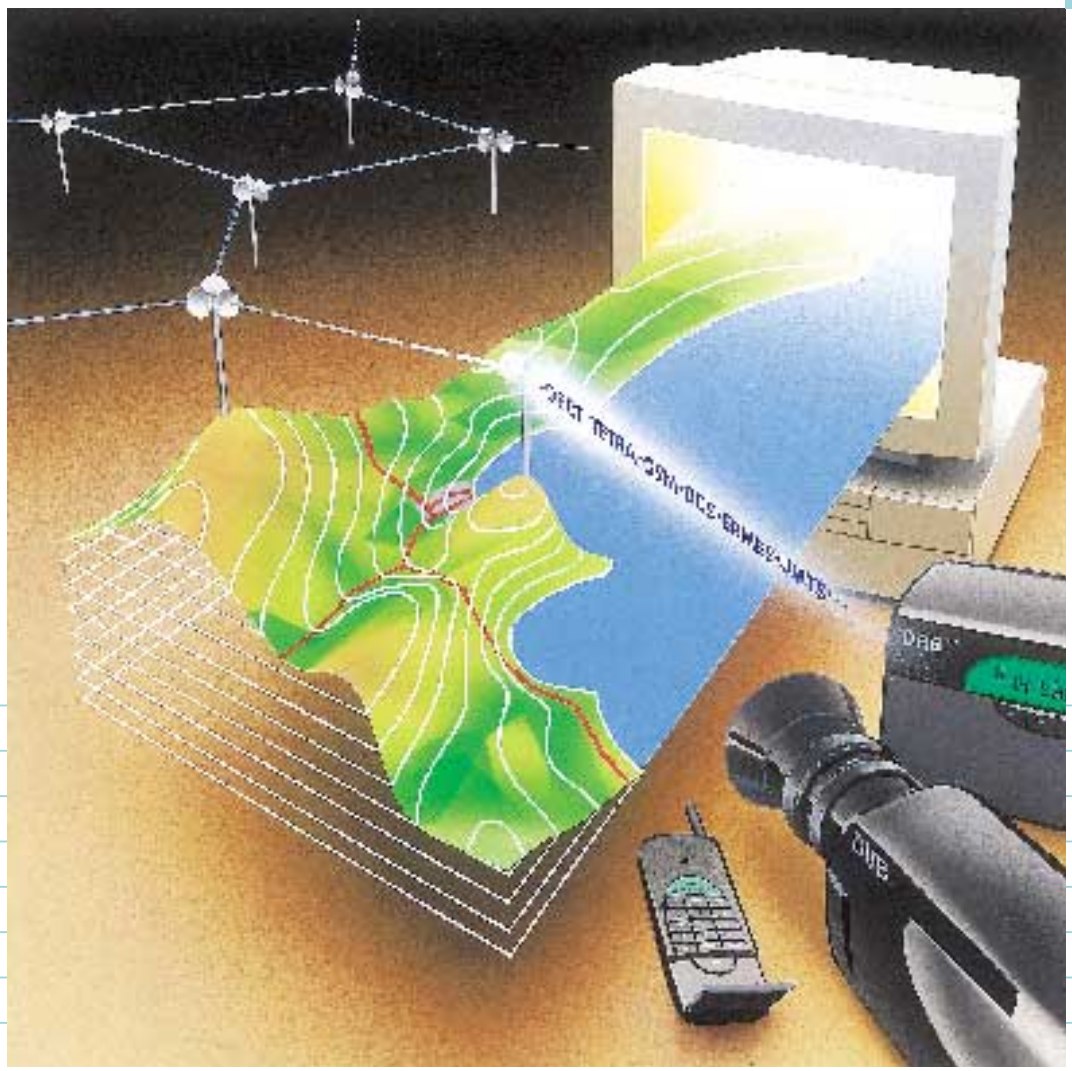
EUREKA PROJECT 1640
SIRENET



AERIAL RECONNAISSANCE

With demand surging for digital broadcasting, mobile telephones, fixed telephone access and so on, the corresponding number of radio transmitters could see Europe's skylines swamped with antennae.
Enter EUREKA project 1640 - SIRENET - whose partners have developed powerful transmitter modelling and mapping software to help network planners optimise signal strength and thereby reduce the resources required. The benefits range from financial through environmental and onto aesthetic - expenditure on transmitters can be cut, energy requirements reduced and vantage points in areas of natural beauty left unspoilt.

Transferring Technology

The 18 month project was launched in October 1996 by Spanish software developers Servicios Generales de Telefusion (SGT), German software experts Ingenieur Buro Reich and the University of Madrid.

SGT, with its background in professional software development and global positioning systems recognised the potential for synergy. "We saw the potential for applying this technology to geographic information systems and radio coverage simulation, so we began negotiations with Reich," says José Rodriguez, divisional manager of SGT and the project leader. Reich is very experienced in the development of mapping algorithms and display software routines

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used in the automotive industry for vehicle simulation. The partnership line-up was completed by Madrid University's Department of Signals, Systems and Radiocommunications, which is heavily involved in radio network planning and frequency management. The Spanish EUREKA office supported this initiative and organised visits between organisations.

The three partners worked on different specific aspects of the project, keeping in close contact via the Internet. The signals, systems and radio communications department of the University of Madrid researched radio propagation and interference. Reich developed software routines to manage the mapping data, while SGT coordinated the process, translated the algorithms into programming code and developed the software modules.

Graphic Demonstrations

These modules model the geographic electric field strength distribution of radio signals produced by one or several transmitters. The results are shown graphically on multilevel displays, which show the topography of the area in question, its infrastructure (roads, railways and buildings), the field strength and - equally important - the extent of interference.

With many transmitters operating in one area it is particularly important to be able to predict the 'crosstalk' from adjacent channels. Powerful algorithms are incorporated to optimise channel selection and minimise interference.

The system predicts the coverage in a particular area, with resolution as high as one metre, if required. "We can account for features such as small hills, and even individual houses or trees. Our system can also handle the 'rain index' - the polarisation changes and signal attenuation brought on by rainfall - and refraction effects due to statistical changes in temperature profiles in the atmosphere," Mr Rodriguez adds.

The resolution and number of features is dependent on the computer power available, though very good results are possible on platforms as modest as a Pentium PC. "We designed the system around 486s so that it would be accessible to a large part of the potential market - you don't need a UNIX station to run this software." The key was the use of novel file compression systems. The results were impressive scrolling speeds for mapping data, 3D views and superb layer transparency.

Twelve Down, Three to Go

The result hit the market in late 1997.
"It is a modular system and so far we have developed twelve of the fifteen expected modules. We exhibited at the Spanish broadcasting trade fair and received positive market reaction.

We have already won orders from local and national TV companies in Spain and there is tremendous interest among the Digital Video Broadcasting (DVB) and Digital Audio Broadcasting (DAB) sectors, which are set for explosive growth in the near future," says Rodriguez.
"The French wireless access systems manufacturer Alcatel ASD is very interested, and we will be exhibiting at CEBIT in Hannover. The global market is huge: our systems are more portable, faster, have more features and lower hardware requirements than our American or Japanese competitors. The feedback we've had is that the management and final presentation of the network data is more user-friendly and more impressive - it is a high quality planning tool for network operators."
Far from resting on their laurels, the project partners continue apace. "We still have the three advanced modules to finish, with urban modelling and field measurement integration frequency assignment features, and we are busy promoting and looking for sales," says Mr Rodriguez. Looking into the future he can also see potential spin-off applications in the real estate sector and in emergency management.

Though Sirenet won't banish transmitters from European skylines, it will go some way to reducing their numbers in the near future, while increasing the coverage of the next century's communications services.

Project Profile

EUREKA 1640	
Acronym:	SIRENET
Title:	Development and Validation of a New Generation Software Tool for the Simulation and Planning of Radioelectric Networks
Participants:	*Germany:* Ingenieurbuero Reich GmbH *Spain:* Servicios Generales de Teledifusión SA / Departmento de Señales, Sistemas y Radiocomunicaciones (Universidad Politecnica de Madrid).
Main Contact:	Dr Eng José Vicente Rodríguez Martín Servicios Generales de Teledifusión SA Tel: +34 1 383 2160 Fax: +34 1 383 9916
Estimated Cost:	0.35 MECU
End Date:	April 1998

EUREKA PROJECT E!1640 - MULTIMEDIA SIRENET

1. General description

Project	E! 1640 - MULTIMEDIA SIRENET	**Status**	Finished - 31-OCT-2002
Title	**Development And Validation Of A New Generation Software Tool For The Simulation And Planning Of Radioelectric Networks**		
Class	Sub-Umbrella	**Technological area**	Communications
Start date	01-OCT-1996	**End date**	01-OCT-2001
Duration	60 months	**Total cost**	0.35 Meuro
Partner sought	No		
Summary	Research, Development And Validation Of A New Generation Software Tool For Simulation, Planning And Management Of Radiocommunication Networks, Using Digital Terrain Models And Geographic Information Systems.		

Budget and duration

Phase	Budget(Meuro)	Duration (Months)
Definition phase	0.03	2
Feasibility phase	0	1
Full Exploitation	0.02	39
Implementation phase	0.3	12
Total	**0.35**	**60**

Member contribution

Member	Contribution	Position	Since
Spain	**75.00%**	**Notified Finished**	**31-OCT-2002**
Germany	25.00%	Notified Finished	31-OCT-2002

Participants

Company	Country	Type	Role
Servicios Generales De Teledifusion S.A.	**Spain**	**SME**	**Main**
Upm/Departamento De Senales, Sistemas Y Radiocomunicaciones Universidad Politecnica De Madrid	Spain	University	Partner
Simotion Im Mtz	Germany	SME	Partner

2. Project outline

Project description

The aim of the project is the research, development, validation and marketing of a friendly new generation software tool for the simulation, planning and management of radio communication networks by using, among other elements, digital terrain models and geographic information systems.
The advanced simulation and planning tool will run under the operating systems UNIX and WINDOWS-95 and it will be developed in C++, making use of state-of-the-art, Computer Aided Software Engineering (CASE) tools and programming environments. The tool will be able to manage large amounts of graphic and alphanumeric information as well as to perform all calculations needed in each radio communication service.
The management of the information will be assured by a dedicated geographic information package called "INTELMAP" which, when developed, will allow for instantaneous management of any number of raster layers combined with an efficient use of vector elements, multimedia entries and standard relational databases.
The raster technology will make use of real-time compressed files, which will reduce both time to display and disk use.
No powerful graphic station will be required since the system is able to manage files of up to several GB at a single time with a minimum Random Access Memory (RAM) size of about 8 megabits, automatically recognising the number of colours to use depending on the graphic card.
Cartographic layers will be in raster or vector format.
Examples of cartographic layers are:
* altimetry (digital terrain models),
* planimetry (roads, rivers, railways, administrative boundaries, place names),
* land cover,
* building heights,
* ground conductivity,
* rain intensity, etc.

The alphanumeric databases will contain information about the installed networks (sites, transmitters, receivers, frequencies, antennas, etc.), catalogues of components (radiation systems, couplers, amplifiers, etc.) and technical standards (protection ratios, channel spacing, usable fields, etc.).
So far as the radio-electric calculations are concerned, on the one hand the tool will allow the simulation of radio coverage of one or more transmitters, considering the possible interference of other transmitters. The coverage will be shown radially, zonally or as a polygonal line taking into consideration the effect of variations in the troposphere refractive index, the presence of bushes or even the buildings of a town. On the other hand, it will also allow the planning of the frequencies of the transmitters by considering intermodulation effects, simulating spectral analyses and calculating the interference due to the new transmitter. Lattice planning for cellular-like systems will also be implemented.
Simulated predictions will be corrected by in-the-field measurements which will be stored with the aid of a

navigation software system connected to a differential GPS and a spectrum analyser. The navigation system will also be developed together with "INTELMAP" in order to benefit from the advantages of graphic compression and instantaneous panning.
The proposed development will help to plan efficiently the new digital and urban radio communication services envisaged for the future, like community FM, local TV digital broadcasting, digital private and public access mobile radio, digital radio paging, digital public mobile radiotelephony (microcells), digital cordless systems, point-to-multipoint systems, etc.

Technological development envisaged

The technological developments can be grouped into three categories:
* Geographic Information System (GIS),
* mapping data, and
* computation routines.
The GIS will be a customised package that we will denote in the future as "INTELMAP", which will take into consideration the requirements of a radio planning tool not properly met by standard packages. These requirements are, for example,
the need to:
* access large volumes of raster data,
* perform fast computational sweeps of zonal areas,
* extract millions of profiles in a short time,
* zoom and pan instantaneously over raster files of several gigabits in size,
* restrict calculations to specific zonal masks,
* superimpose several raster layers (hypsometric inks, terrain shading, planimetry, electric field, etc.).
Another important innovation is that the GIS package will be capable of running on low-range computers of the 486 family, with not more than 8 megabits of random access memory (RAM) and simple VGA graphics cards. The use of data compression will allow the use of standard portables, for example during in-field planning and measurement.
The GIS will manage both raster and vector data and will allow display of both types of information simultaneously. All layers will be geocoded so that each geographic point is related to a set of information values which can be queried at will. The vector management will enable the selection, query and edition of punctual, linear and surface entities. The road network will be topologically structured in order to search places by indicating the kilometric point in the road or to calculate the shortest or fastest path between two places. Punctual entities will be represented as icons, organised hierarchically. The user will be able to select the layers to display and to apply specific filters to the categories of icons. When the icons are very close, the GIS will optionally substitute them by a single one of higher category. The icons will be optionally associated to additional multimedia (video, sound), graphic (pictures) or alphanumeric (reports) information.
The generation of mapping data will also include some technological innovations. The altimetry and shading layers will be generated by more powerful work stations

with algorithms of solid modelling and triangular irregular networking. Additional functions will be developed to convert data formats from raster to vector (edge recognition) and vector to raster (polygon filling), especially important in land cover, building height, conductivity or rain intensity layers. Land cover and building height information will be obtained from photogrametric flights or satellite images. A very detailed planimetric layer for professional reports and final presentations will be generated by applying techniques of image processing. The latter will result in a quality similar to that of printed paper maps (but making use of the lower screen resolution) and will allow management of a single seamless file with plain colours.
From the point of view of the computation routines, the main innovations are the consideration of buildings and bushes together with the terrain height for the planning of the new digital urban radio communication services in the presence of many interfering transmitters. This will enable the tool to simulate the propagation channel, both in magnitude and in phase, which will allow for an efficient planning of broadband digital systems by using ray-tracing techniques.
The navigation software package developed for the measuring unit will also be highly innovative, since it will be able to present high-quality maps loaded on portables which will scroll smoothly following the position indicated by the GPS signal and will store the coordinates and the electric field measurements of the spectrum analyser on the appropriate file.
The environmental effect of the development of the tool will be highly positive since it will help to save the transmitting energy and reduce the number of transmitter sites and related infrastructures in environmentally protected areas.

Markets application and exploitation

Typical customer profiles:
- Owners of private mobile radio networks which represent a vast market covering public utilities (electricity, water, gas), public security (police, national guard, private surveillance), emergency services (fire brigades, rescue groups, ambulances), transport (truck fleets, taxis, railways), national defence;
- Network operators such as mobile radio companies, PAMRs or TV and radio carriers;
- Radio system manufacturers which offer turnkey projects;
- Radio and TV broadcasters, including municipal FM, local TV and the new digital standards;
- Engineering consultants and installation companies, responsible for network planning;
- Spectrum management agencies, divided sometimes into broadcasting, civil and military bodies.

Of special important is the planning of the new digital radio communication services which are sometimes restricted to urban environments which makes the simulation even more challenging.
Initial exploitation by:
SPAIN, FRANCE and GERMANY.

Project codes

BSI

BMM	simulation
COP.H	radiofrequencies
EGO	cartography
LLD.D	radio networks
MU/MX	computer software
MYG	computer graphics

NACE

40102	Electricity transmission, distribution and supply
60	Land transport; transport via pipelines
64	Post and telecommunications
7524	Public security, law and order activities
7525	Fire service activities
851	Human health activities

3. Main participant

Company	**Servicios Generales De Teledifusion S.A.** Avenida De Manoteras, 22-Alfa2 28050 Madrid Spain Tel +34 91 383 2160 Fax +34 91 383 9916
Contact	**Dr. Eng. Jose Vicente Rodriguez Martin** Division Manager Tel Fax jrodrig@sgt.es
Organisation type	SME
Participant role	Main

Contribution to project

Project leader. Will carry out most of the software development, including functional analysis, technical design and system construction.

Expertise

The Information Systems Division of SGT has a credited experience in software developments of simulation systems making use of mapping information. Its references cover all market segments, from radio regulatory bodies to small engineering companies, going through radio and TV broadcasters, mobile operators, equipment manufacturers or private mobile radio networks (public utilities). It has also developed innovative systems of map management for CD-ROM map publishers and GPS-navigation OEMs.

4. Partner

Company	**Upm/Departamento De Senales, Sistemas Y Radiocomunicaciones Universidad Politecnica De Madrid** Ciudad Universitaria, 28040 Madrid Spain Tel +34 91 336 7346 Fax +34 91 336 7350 www.upm.es
Contact	**Dr. Eng. Jose Maria Hernando Rabanos** Professor Tel Fax

Organisation type	University
Participant role	Partner

Contribution to project

Will propose algorithms for radiowave propagation, noise estimates, interference combinations, equipment response, planning parameters, etc. These will be properly tested in prototypes and fed back with measurements.

Expertise

The UPM is the oldest technical university in SPAIN and the Professor Hernando's group has been involved in the past in many research projects dealing with the simulation of radiowave propagation and the efficient planning of new radiocommunication services. Professor Hernando is a member of the Working Party 6A and 5B of the Radiocommunications Sector of the ITU and has written many books and technical papers on radio network planning and spectrum management.

4. Partner

Company	**Simotion Im Mtz** Frankfurter Ring, 193 A 80807 Muenchen Germany Tel +49 89 3245 5530 Fax +49 89 3242 5366 www.simotion.com
Contact	**Dipl.-Ing. Franz Markus Reich** General Manager Tel +49 89 3245 5530 Fax +49 89 3242 5366 f.reich@simotion.com
Organisation type	SME
Participant role	Partner

Contribution to project

Responsible for the development of computer simulation algorithms, graphic data processing, mapping data generation GPS signal measurement feedback and customization of the package to German frequency licensing procedures.

Expertise

Has long experience in software developments related to computer graphic simulation and CAD technologies as well as in the monitoring of signal measurements using GPS navigators and mapping data. It has recently

participated in a BRITE-EURAM project for the simulation of motor cycles.