**White Paper**

# YDREAMS

**Location Based Services (LBS)**

**LBS Software Platform**

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# Introduction

## The Nature of Location Based Services

Maps are symbolic representations of real spaces. The gap between reality and its symbolic representations has been shortened in recent years with digital multimedia information systems. Such systems have included maps, aerial and ground photos, video and sound. Mobile devices and particularly Internet enabled mobile phones are helping to further bridge that gap by enabling the confrontation of reality with their digital representations in real time.

They are opening opportunities for new location-based services (LBS). These services rely on having a spatial background usually in map form with geo-referenced points-of-interest and other relevant information. LBS also depend on knowing the position of the user in space. LBS applications for the common mobile phone user include personal and car navigation, point-of-interest search, commerce, emergency services and entertainment.

The number of mobile Internet users will grow substantially in the next few years with the emergence of the 2.5G and 3G mobile phones. By 2005, Motorola expects them to outnumber the fixed Internet users. The market for LBS is expected to grow by a factor of 100 in the next five years.

## The YDreams Solutions

YDreams has developed solutions to support mobile LBS following four basic principles:

- Spatial representations for mobile phones may be maps, images, text, and voice. These representations have to be processed considering the media and should be used depending on the context. Maps and images have to be designed for small monochromatic screens. Text is useful for labelling and to offer directions. These should be provided by voice while driving.
- Mobile LBS require micro-detailed geo-referencing to satisfy the growing needs of users. It is not enough to geo-reference a building if the position of objects inside the building is also relevant.
- The use of anchor points complements positioning solutions outdoors and it is the solution indoors.
- Each mobile location based service should have an associated Web site. In some cases this site should also be tailored for Interactive Television access.

Three key technologies were developed based on these principles:

- LiveAnywhere Maps, that enables the production of maps, and the calculation of routes and nearest points for desktops and mobile phones in the HMTL, WML and VoiceXML formats.
- MobileIP, a system to process images in real time and deliver them to WAP, GPRS and UMTS phones.
- DiWay, an approach to navigation and mobile commerce based on the use of anchor points.

These technologies have been applied in the YDreams LBS. They are being currently integrated in the YDreams LiveAnywhere Mapping platform discussed below.

# YDreams Services

YDreams current location based services include:

- LiveAnywhere Maps for the Web, WAP and PDA that are based on the YDreams own technology.
- LiveAnywhere Traffic that sends traffic information for mobile phones using the MobileIP technology.
- FluidShopping, Fluid Events and Fluid Museums for indoor navigation and mobile commerce applications. These services rely upon the DiWay technology.

The LiveAnywhere Mapping platform that integrates these technologies, may incorporate third party solutions and enables the access to heterogeneous data sources.

## LiveAnywhere Maps

*If you are lost in the Lisbon traffic the new Vodafone 's Map Channel available on your WAP mobile phone will help you. The tiny maps will show where you are.  The directions from corner to corner will take you then to your destination.*

YDreams offers a mapping service for the fixed and mobile Internet. This service is based on LiveAnyhwere Mapping technology that enables the rapid development of multimedia spatial information systems.   LiveAnywhere Maps has a modular architecture that includes a Map Server, a Routing Server and a utility to geo-reference multimedia content. It requires map, road network and multimedia content databases.

The service enables point-of-interest search, and nearest point and shortest path calculations. It includes traditional map navigation functions such as zooming and panning. LiveAnywhere Maps also manages geo-referenced photos.

LiveaAnywhere Maps are currently available for the Web, WAP and Pocket PC or PDA platforms. The Map Channel of Vizzavi illustrates the application of the technology. Fig. 1 displays a screen shot of the Web version (http://mapas.vizzavi.pt). Fig. 2 shows screens of the WAP version and Fig. 3 includes a screen taken from the PDA version. This version is now implemented also on the new Java phones used in Vodafone Live.

Fig.1 - Map Channel, Vizzavi, Web version

Fig. 2 - Map Channel, Vizzavi, WAP version
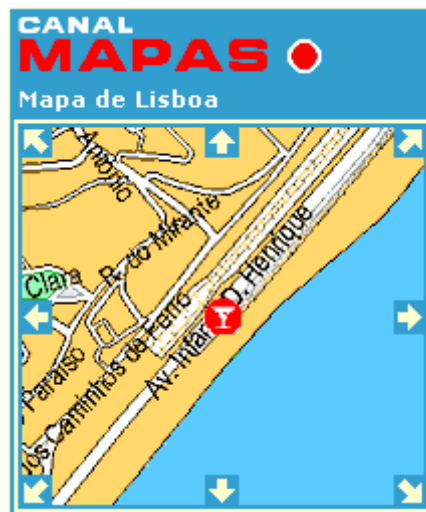


Fig. 3 - Map Channel, Vizzavi, PDA and Vodafone Live versions

Innovative features for the mobile phone solutions consist of:

- The widespread use of anchor points. Anchors may include landmarks, major roads or key arteries, rivers and railways.
- Adaptive zooming. Without adaptive zooming low density urban areas may be represented by blank spaces; mobile maps of high-density areas, by contrast, may be illegible.
- Numerical labeling. Key streets may be labeled on the screen with their names. Secondary streets are labeled with numbers that are then associated to the street names in a scrolling text attached to the map.
- The use of diagrammatic maps. These are used to provide a contextual view of the city applying two to three levels of detail (see Fig. 2).

## LiveAnywhere Traffic

*The LiveAnywhere Traffic system allows users to consult real or synthetic images that show traffic flow, predict commuter duration time and advise drivers as to which lanes to use at problematic locations. The system also enables the user to create a profile which displays programmed alerts and selected information when requested. Drivers en route into Manhattan from Queens may for example verify which artery, the Midtown Tunnel or the Queensboro/59th Street Bridge, is the best option for entry into the city.*

The LiveAnywhere Traffic service provides on the fly information on traffic conditions to mobile phone (SMS, WAP, GPRS) and Internet enabled PDA users. The information for WAP, GPRS and PDA users consists of images processed from traffic cameras and text.

LiveAnywhere Traffic is based on Ideias Interactive MobileIP technology. This technology includes:

- Image Streamer that produces streams from videos captured by strategically placed traffic cameras.
- Image Analyzer that analyses the video streams and provides information for the Image Producer.
- Image Producer, that based on the video streams received from the Image Streamer and the data provided by the Image Analyzer, develops real, contour and synthetic images for the mobile platforms.

Fig. 4 (a) and (b) illustrated how images from traffic cameras are analyzed, produced and displayed on a WAP phone.

LiveAnywhere Traffic has a Calculation Data module that based on the processed images determines traffic statistics such as average speed by lane, and time to destination. This module feeds the Traffic Status Generator that may be coupled to the LiveAnywhere Mapping technology to suggest alternative routes.

YDreams developed a customized service called MyTraffic that enables the creation of user profiles. TStat, that makes available traffic information on key areas around the clock, is another LiveAnywhere Traffic based service.

The system will be deployed for the first time in the Lisbon area in a joint project with Vodafone in early 2003.
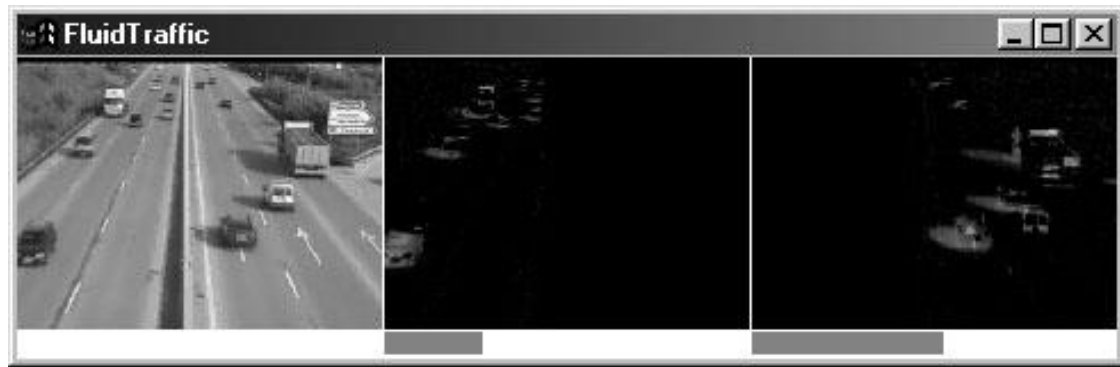
(a)



(b)

Fig. 4 - (a) Real and contour images are analyzed and processed to generate (b) synthetic images for WAP handsets.

## FluidShopping, FluidEvents and FluidMuseums

FluidShopping, FluidEvents and FluidMuseums are indoor navigation and mobile commerce services based on the DiWay technology. This technology relies upon three basic concepts:

- Anchors. An anchor identifies a place or an object that is geo-referenced. It may be a tag (see Fig. 5) or an emitter. For the third generation mobile phones, this will be probably a Bluetooth based emitter. This concept solves the positioning problems in indoor spaces where both satellite and radio frequency triangulation systems are often inadequate.
- Spatial code bar. The tag or the emitter has an associated code that identifies uniquely an object anywhere in the world. To each code there are corresponding URLs for the fixed and mobile Internet.
- Phonemarks. By using the Phonemarks feature the user stores anchor points for later exploration in the Web or mobile Internet platforms. If those anchor points reflect commercial items this feature may be used for mobile commerce.

Fig. 5 - Code on a tag. Tag placed on store in Colombo Shopping Center, Lisbon,
        Portugal

FluidShopping, FluidEvents and FluidMuseums and future implementations of DiWay
use the basic LiveAnywhere Mapping technology. They all have also three additional
capabilities:

- Casual Encounters, to facilitate the meeting of people with identical profiles.
  These profiles are filled voluntarily upon entrance on the shopping center,
  event or museum.
- Emergency Alerts possible by pressing E after dialing the nearest spatial
  code (or in the future receiving it by activating its emission from the nearest
  Bluetooth chip).
- Information on transportation to and from the center, event and museum.
  This feature includes an automated service to request taxis.

YDreams has agreed with Geodan to further develop and market applications of the
DiWay Technology in the European market.


**FluidShopping**


*Fluid Shopping was designed to reduce the anxieties of shoppers through the use of
Internet enabled mobile phones: helping find the product they want to buy;
enabling its purchase after hours from the shopping window; and finally locating
the car among the thousands standing in the parking lot.*

The FluidShopping system allows for the rapid development and installation of spatial information systems that will aid visitors of large shopping centers. Specialized features of the system include:

- Store and Product Finders, to find stores that sell a particular product. These are displayed on diagrammatic maps of the shopping centers. Paths from origin to destination are provided on those maps and by textual directions using key anchor points.
- Product Interaction, to enable the visualization of detailed product information and facilitate its mobile purchase (Fig. 6).
- Parking Place Finder. Using the Phonemark feature the visitor stores the spatial code of the place where he or she parked the car. The Parking Place Finder will later help him or her in finding the way back to the car (Fig. 7).

This system is being implemented for the Colombo Center, the largest shopping center in the Iberia Peninsula. It will also include, in the near future, mobile entertainment features.



Fig. 6 - Product Interaction using Fluid Shopping

Fig. 7 - User stores the position of his car in Colombo Center's parking lot

**FluidEvents**

*FluidEvents takes the Web sites of large events to the mobile phone. By bridging the gap between the digital and the real, it will help the visitor and the organizer.*

FluidEvents is an application of the DiWay technology tailored for large events. FluidEvents is available on the Web, PDAs and WAP and GPRS mobile phones. Specific features include:

- StandSiteMaker enabling the rapid development of Web sites and WAP decks to provide information on companies, products and activities affiliated with a stand.
- StandFinder helping to locate stands based on search elements such as the mentioned above.
- GeoCalendar displaying the location of scheduled events.
- Ebooking to facilitate the scheduling of appointments.
- EventForuns divided by topic.
- EventGuides to companies, products and activities.

FluidEvents was introduced in the Sevilla Fair in 2001. 10 million visited this fair. 250.000 of those had WAP enabled phones. Fig. 8 displays illustrative screens of the product that is available at http://www.wapferia.com.

Fig. 8 - Illustrative screens of WAPFeria, a FluidEvents application in Sevilla, Spain

**Fluid Museums**

*Develop your own digital memories of the museums of this world with the help of a mobile phone.*

FluidMuseums is a multimedia geo-referenced information system based on the DiWay technology that assists visitors at museums or cultural centers. Basic features include:

- WorkLocator. This system enables the location of a work of art, manuscript or other exhibited object by specifying type, author, epoch, year, technique or artistic movement.
- Augmenter. A system that provides additional information on the work being viewed.
- Production of personalized merchandising. Allows users to graphically assemble merchandise to be retrieved upon leaving (see Fig. 9).

The use of Phonemarks is particularly relevant in this service. They can be used as a replacement for taking photos (which often are forbidden in Museums). Storing Phonemarks of the most relevant pieces of art enables their later review on the Web site of the Museum.

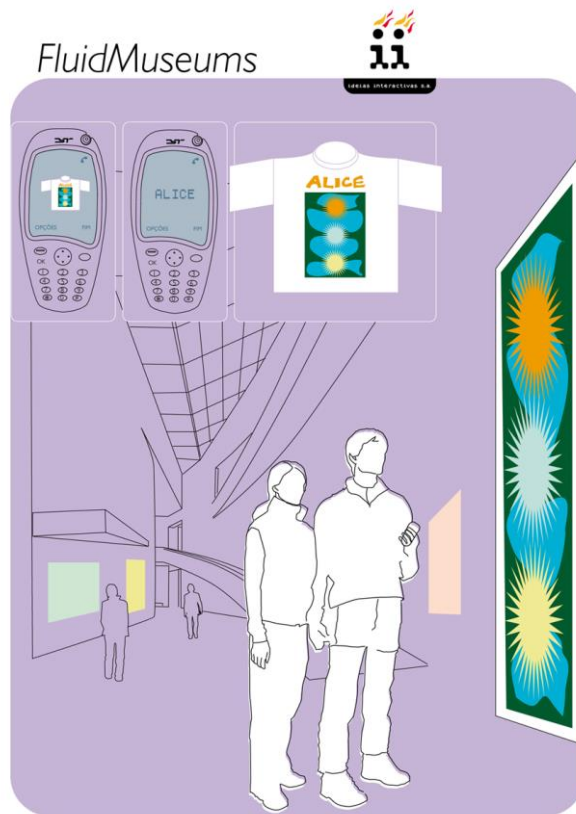An application of FluidMuseums was developed for Centro Cultural de Belem in Lisbon, Portugal (http://www.ccb.pt).

Fig. 9 - Production of personalized merchandising while visiting a museum

# YDreams Software Platform for LBS

YDreams software platform for Location Based Services is called LiveAnywhere Mapping. This platform includes three tiers: Data Tier, Logic Tier and Presentation Tier (fig. 11). They have been designed to:

- Handle heterogeneous sources of information (Data Tier).
- Be incorporated into locally executed applications (classic architecture), client/server environments (three-tier architecture), or distributed environments (distributed three-tier, or n-tier) (Logic Tier).
- Allow the stratification of products (LiveAnywhere Maps, FluidShopping, FluidEvents, FluidMuseums) using different combinations of modules (Logic Tier).
- Allow the presentation of the services in all wired and wireless devices (*SMS*, *HTML*, *WML*, *DHTML, XHTML, VoiceXML* and *SOAP*) (Presentation Tier).

## Data Tier

There are four types of information that are essential for location-based services: user location, road information, background maps and the services (or contents) themselves.

**User Location**

The user location is what differentiates the location-based services from the traditional wired services. The location can be found by automatic technologies or simply supplied by the end user.

The current automatic methods can only give an area of where the user is located; they still can not provide the street corner or door number. If the service needs a more accurate position, the user still has to type it or say it, depending on the device he or she is using. Future outdoors solutions will minimize this problem. DiWay type propositions, based on Bluetooth code emitters, will solve the positioning problem indoors.

**Road Information**

The Road Information database includes all the information for the roads including its category (highway, street, round-about), type (for pedestrians or vehicles), directions (one or both senses), door numbers and turn permissions. It is used for the calculation of the route between two points, the determination of the nearest point and to find the geographic position of a point given its address (geo-coding).

**Background Maps**

The Background Maps are used for the graphical visualization of the route and position of a point. These maps are related to the road information but are handled separately. For example, WAP uses black and white maps, while the Web may use colored maps. However, the road information can be exactly the same.

The background maps can be stored as bitmaps (orthophotos, custom-drawn maps) or as vector information.

**Services**

The Services databases include the contents that will be geo-coded and made available to the end user. The LiveAnywhere Mapping framework only needs the address of the points of interest to handle the contents automatically.

The operator usually controls the User Location, Road Information and Background Maps databases.  Third-party companies usually supply the Services databases through syndication. This means that the operator may not have control over how the data is supplied.

As a result there can be a great variety of transportation protocols, query methods and data structures involved. The conversion and integration problems are usually significant.

To minimize these problems, LiveAnywhere Mapping adopted the Microsoft BizTalk Server solution (http://www.microsoft.com/biztalk/). BizTalk provides powerful and easy to use tools to control the flow of information and its conversion into formats that the YDreams platform can interpret. The use of this product considerably reduces the time necessary to integrate a new third-party data provider.

The Data Tier framework of LIveAnywhere Mapping is developed on top of the latest generation of Microsoft database-access components called ADO.NET. These are very generic components allowing a common data retrieval method for all types

of databases, static files or data generated dynamically by other components, simplifying the code of each component.

## Logic Tier

The Logic Tier framework consists of several modules. Key modules are shown in Fig. 11 and discussed below. These components use XML to communicate between them and the customer has total control over the data flow. This data can also be redirected, at any place, to third-party components.
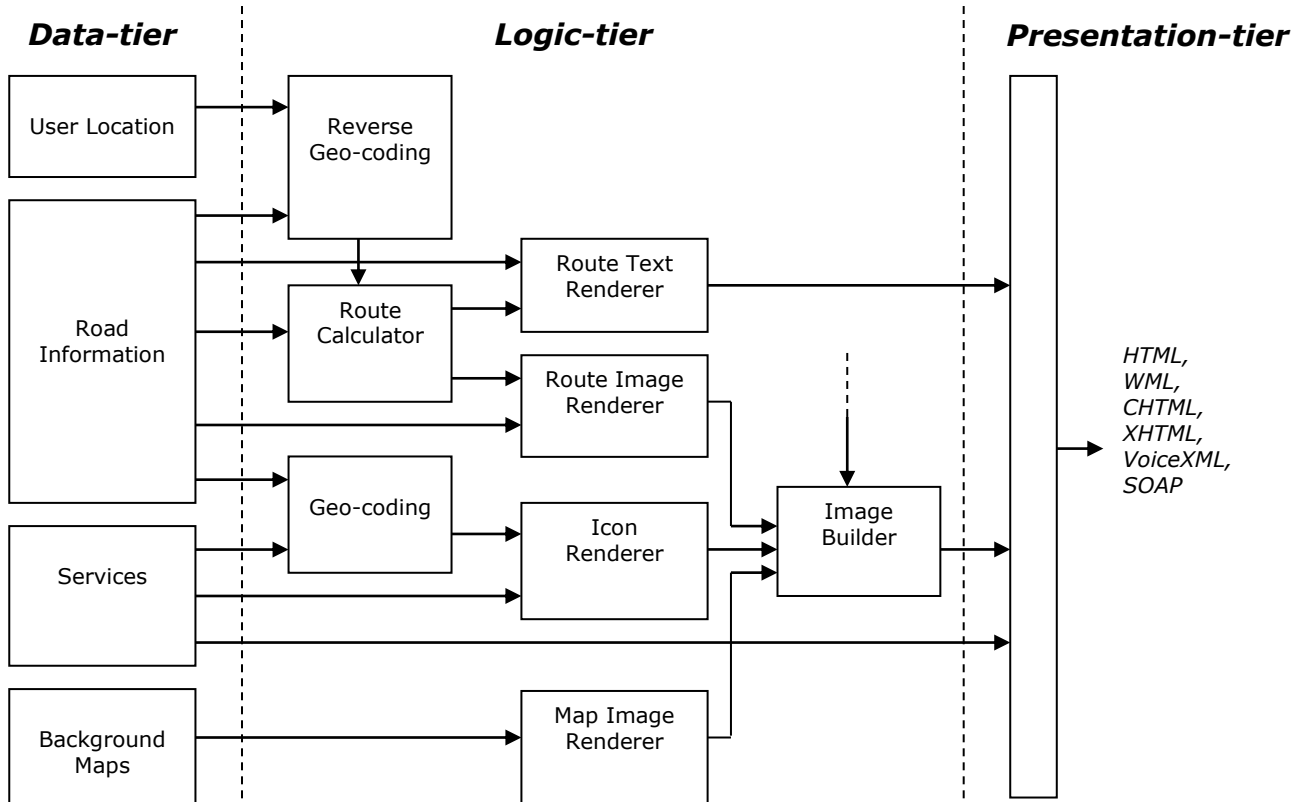
Fig. 11 - Example of a typical application architecture using the LiveAnywhere Mapping Platform

### Geo-coding

The Geo-coding module uses the road information database to convert an address into geographical coordinates.

### Reverse Geo-coding

The Reverse Geo-coding component uses the road information database to convert geographical coordinates into an address.

**Map Image Renderer**

The Map Image Renderer generates the background map image, given the geographic coordinates, images size and source.

**Route Calculator**

The Route Calculator calculates the route between two geographical points. The different methods of calculating routes (shortest, fastest, cheapest) are implemented in different modules so that they can be sold separately, depending on the product that it is integrated. These modules share the same interfaces so their interchange is simple.

**Route Text Renderer**

The Route Text Renderer processes the route calculation result so that the name of the roads, direction changes and other useful information are added to it.

As for all the other components the output of this module is in XML. For example, the direction changes are coded as tags, instead of text, so that it can later be translated into any language using a simple XSLT rule.

**Route Image Renderer**

The Route Image Renderer draws the route so that it can be super-imposed on the background map. It provides total control over the line color, style and width.

**Icon Renderer**

The Icon Renderer calculates the relative position of the icons to be super-imposed on the background map image. It gives total control over the icon design.

**Image Builder**

The Image Builder allows the combination of several layers of images. It gives total control over the layer order, position, size and opacity. This module also enables the addition of other elements to the image like, legend, copyright notice and watermark.

The image can be saved in any of the Web file formats (PNG, JPG, WBMP and GIF) and other graphical formats.

**Integration**

The Logic Tier framework is currently implemented on the Microsoft.NET framework (http://msdn.microsoft.com/net/) and can take advantage of all the related technologies on the Windows 2000, Windows XT and Windows CE platforms.

On client/server architectures, the end user does not need to have any of these platforms to be able to access the services. The framework is located on the server and only the output is sent to the client, meaning that it is independent from the client's platform.

Devices that use the Windows CE platform, like Pockets PCs and Auto PCs (http://msdn.microsoft.com/library/default.asp?URL=/library/wcedoc/apcintro/apcintro.htm), can run locally the framework in connection with the Microsoft SQL Server 2000 Windows CE Edition (http://msdn.microsoft.com/library/default.asp?URL=/library/wcedoc/sqlce/portal_6ol0.htm). If the device has a wireless connection, it can automatically download updates to its database. The framework can also be wrapped in a SOAP compatible Web-service that allows its access to third parties through a custom API.

## Presentation Tier

The use XML on the framework allows the customization of its output to almost any device, from regular HTML for Web browsers, passing by several wireless flavors such as WML, CHTML and XHTML, to VoiceXML, that allows the use of voice on a regular cellular phone.

# Conclusion

YDreams has approached the Location Based Services market with a mobile phone orientation. This orientation led to the development of a software platform named LiveAnywhere Mapping that is based on a three-tier architecture:

- The Data Tier handling heterogeneous data sources.
- The Logic Tier which supports the development of LBS using one or more its modules.
- The Presentation Tier allowing the customization of output to a variety of fixed and mobile Internet enabled devices.

LiveAnywhere is used by YDreams to support its key services: LiveAnywhere Maps for mobile mapping; and FluidShopping, FluidEvents and FluidMuseums for indoor navigation and mobile commerce.

LiveAnywhere Traffic, providing traffic information to mobile phone users, may also be used in connection with the platform to offer alternative routes.

# About YDreams

YDreams is a joint-stock company that started its operations in June 2000. It is located at Madan Park, Monte de Caparica, Portugal, and its electronic address is www.ydreams.com.

Its founders are internationally recognized Portuguese scientists and engineers. They have been associated to universities such as MIT and Cornell University and

have had key roles in projects such as Expo98 (http://www.parquedasnacoes.pt), the National System for Geographical Information (http://snig.cnig.pt) and the Portuguese ATM system.  YDreams current technical staff has also worked in projects such as the Formula 1 Simulator developed for Digital and Intel's Virtual Real Estate application.

YDreams partners include Vodafone, Alcatel, Siemens, NOKIA, Ericsson, Microsoft, Geodan (from Amsterdam, Holland), SONAE (the largest Portuguese economic group), Media Capital (the second largest Portuguese Media group), João Lagos Sports (the most important organizer of Sports Events in Portugal) and Endemol.