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Departamento de Lenguajes y Sistemas Informáticos

Universitat d'Alacant
Universidad de Alicante

Delivering location-based services using GIS, WAP, and the Web: two applications

Sergio Luján-Mora

Contents

Introduction

- The Web has changed the way we work
- One of the main advantages of the Web: “universal access”
- Global System for Mobile Communications (GSM) → Mobile digital communications
- The GSM network can be used to establish the position of the user

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Delivering location-based services using GIS, WAP, and the Web:
two applications

Introduction

- Wireless Application Protocol (WAP): Mobile phone ↔ Web server.
- Universal access from everywhere
- WAP: a group of specifications to develop applications and services that operate over wireless communications networks
- Convergence of wireless communications and Internet

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Introduction

- Two WAP applications for mobile phones
- Provide location-based information to the user
- Geographical Information System (GIS) → Geographical information to the user

Introduction

- Application 1: resource searcher and locator → User can obtain information from the GIS
- Application 2: data acquisition system → User can obtain information or can also introduce information into the GIS.

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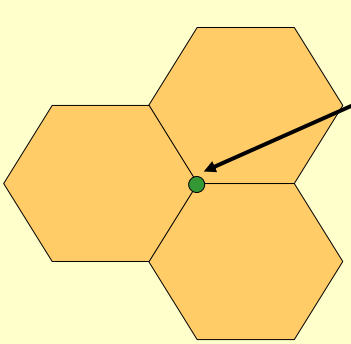
- Introduction
- **Mobile positioning**
- Architecture of the system
- Application programming
- Applications 1 & 2
- Summary and future work

Mobile positioning

- The position of a mobile phone can be located using information from the GSM network
- When a call is established, the phone is connected to a base station
- The distance from the base station can be approximately calculated (Timing Advance)

Mobile positioning



- A cell is the basic unit of a mobile system → The area where the radio coverage is given by one base station
- A cell is represented simplified by a hexagon

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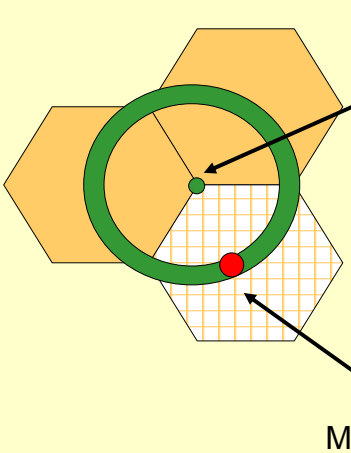
Mobile positioning



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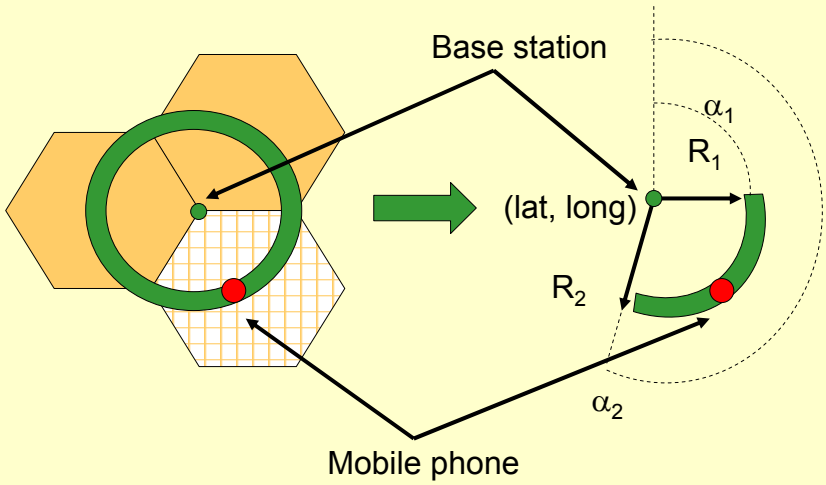
Mobile positioning



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Mobile positioning

- Timing Advance is a server-based solution that allows positioning services to be used with current mobile phones
- It is not possible to give a specific value for the accuracy, since it depends on several factors: the size of the cell, the kind of the cell, the distance to the base station, the topology, etc.
- Tens of meters … Hundreds of meters

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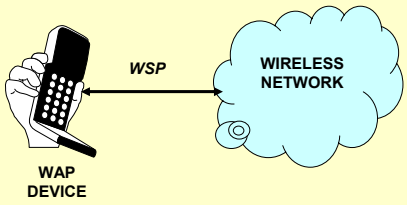
Mobile positioning

- European Telecommunications Standard Institute (ETSI):
  - Time of Arrival (TOA)
  - Enhanced Observed Time Difference (E-OTD)
  - Assisted GPS (A-GPS)

Contents

Architecture of the system

- Ericsson's Mobile Positioning System 3.0 (MPS 3.0): Timing Advance
- It can be used with current mobile phones with no further change



•The WAP Device (mobile client or mobile station)

•Connects to the wireless network by means of the Wireless Session Protocol (WSP)

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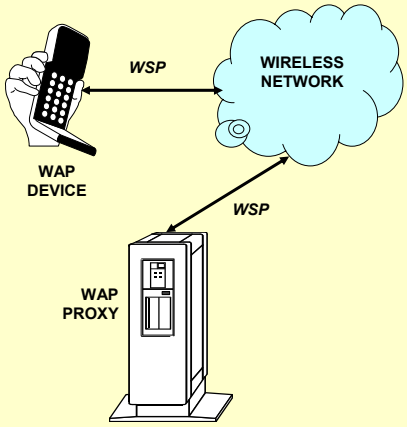

•The WAP Proxy (Gateway) translates WAP requests to Web requests and vice versa

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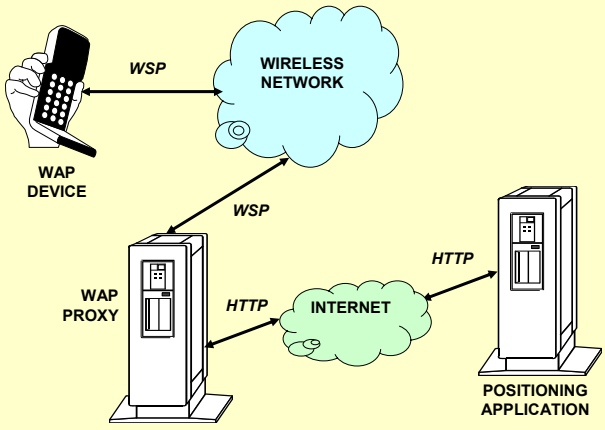

•The WAP Proxy converts the WSP requests into HTTP requests and forwards them to Internet

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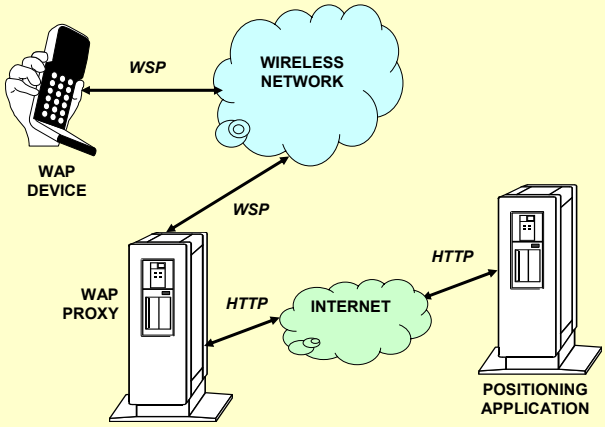

The WAP Proxy allows the WAP Device to submit requests to the Web server that hosts the Positioning Application

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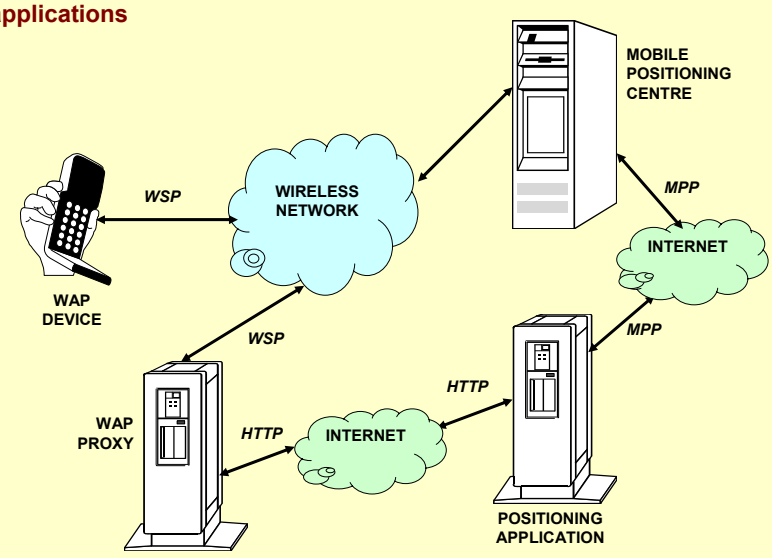

•The Positioning Application requests the position of the WAP Device to the Mobile Positioning Centre by means of Mobile Positioning Protocol (MPP)

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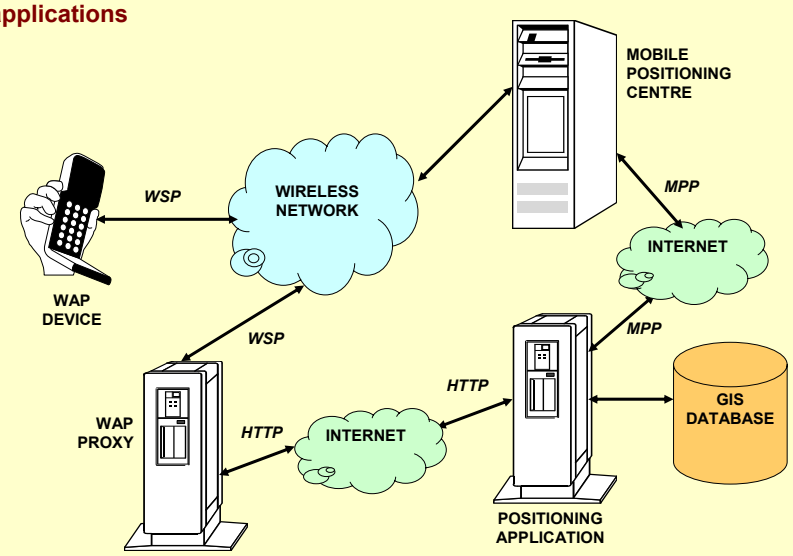

•The Positioning Application uses the position of the WAP Device to query the GIS database and provide localized services

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Application programming

- Client/server model
- Server:
  - ASP → Personal Web Server or Internet Information Server
  - Visual Basic Script
  - Access database

Application programming

- Client:
  - Application → WAP device:
    - Wireless Markup Language (WML)
    - The correct operation of the application has been proven with different mobile phones: Nokia, Ericsson, Phone.com WAP browser, etc.
  - Administrative tool → Web browser:
    - HyperText Markup Language (HTML)
    - JavaScript

Application programming

- Narrow bandwidth →Transmission of GIS files is time-consuming
- Limited display → Geographical images can be hardly showed
- Applications provide geographical information based on text

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Application programming

- Ericsson Mobile Positioning System Software Development Kit 3.0 (MPS SDK 3.0):
  - MPC Emulator: positioning server that accepts MPP requests and emulates positioning answer
  - MPC Map Tool: mobile network building tool

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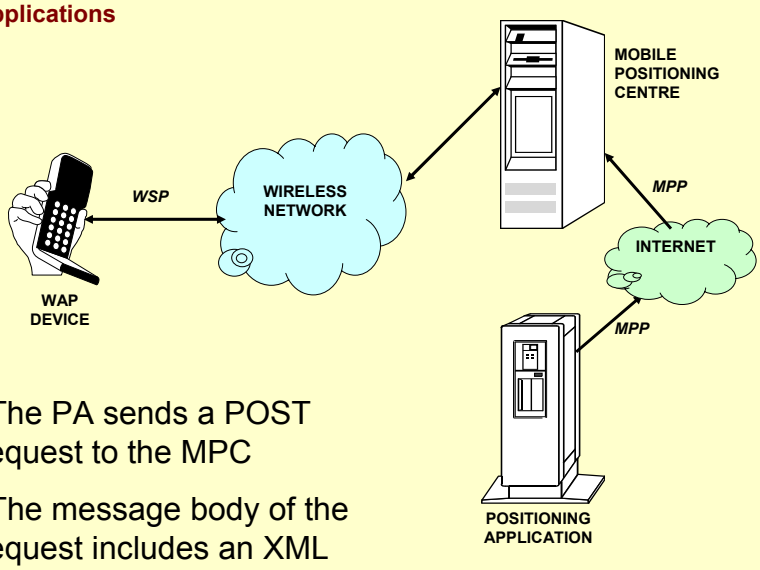

- The PA sends a POST request to the MPC
- The message body of the request includes an XML formatted request

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Application programming

```
<?xml version="1.0" encoding="ISO-8859-1"
 standalone="yes"?>
<REQ ver="3.00">
 <CLIENT><ID>TheUser</ID><PWD>ThePassword</PWD>
 </CLIENT>
  <LIR>
    <GEO_INFO>
      <COORD_SYS>LL</COORD_SYS>
      <DATUM>WGS-84</DATUM>
      <FORMAT>IDMS0</FORMAT>
    </GEO_INFO>
    <MSIDS><MSID>461011334411</MSID></MSIDS>
  </LIR></REQ>
```

Latitude and longitude

Geodetic datum

Mobile Station

Direction indicator, degrees, minutes, seconds, and precision

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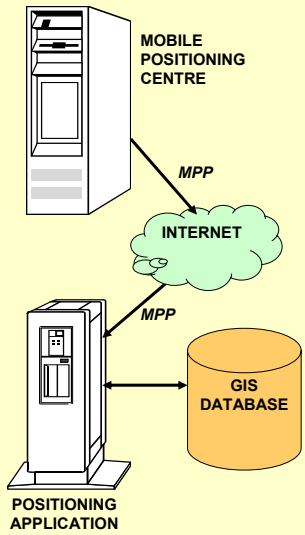

- The MPC responds with either an error message or with the position of the WAP Device
- The PA uses the answer to query a GIS database

Application programming

```
<?xml version="1.0" encoding="ISO-8859-1"
 standalone="yes"?>
<ANS ver="3.00">
  <LIA><GMT_OFF>+0100</GMT_OFF>
    <POS msid="461011334411">
      <PD><TIME>20020128090000</TIME><ARC>
        <LL_POINT>
          <LAT>N391628.3</LAT>
          <LONG>E010001.5</LONG>
        </LL_POINT>
        <IN_RAD>1200</IN_RAD>
        <OUT_RAD>1500</OUT_RAD>
        <START_ANGLE>120</START_ANGLE>
        <STOP_ANGLE>180</STOP_ANGLE>
      </ARC></PD></POS></LIA></ANS>
```

Mobile Station

Point of origin

Radius

Angle

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Application 1

- Resource searcher and locator
- The user can locate the nearest resource (gas station, theatre, etc.) to his/her position
- It is not necessary to know the exact position (latitude and longitude coordinates)

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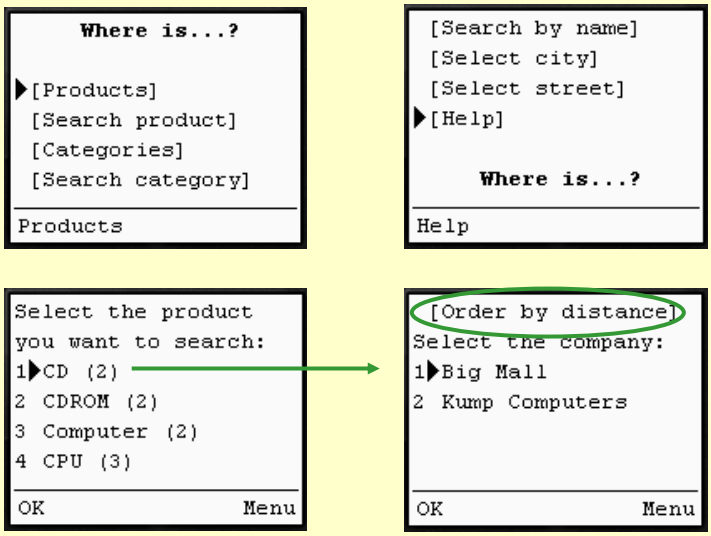
Application 1



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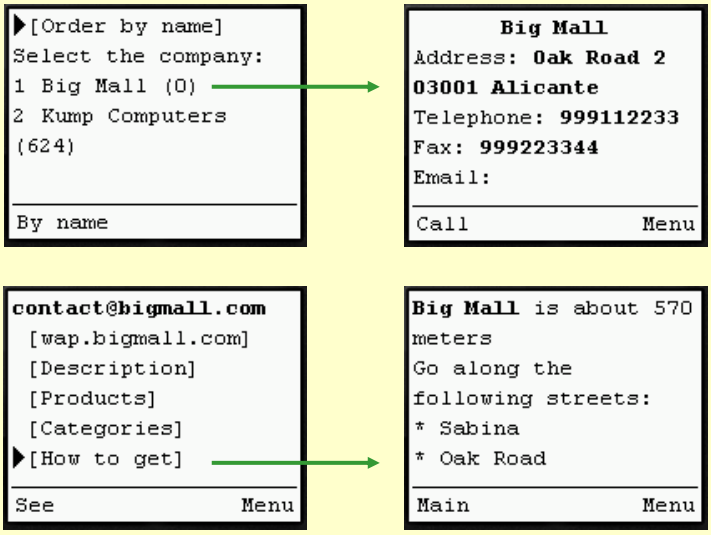
Application 1



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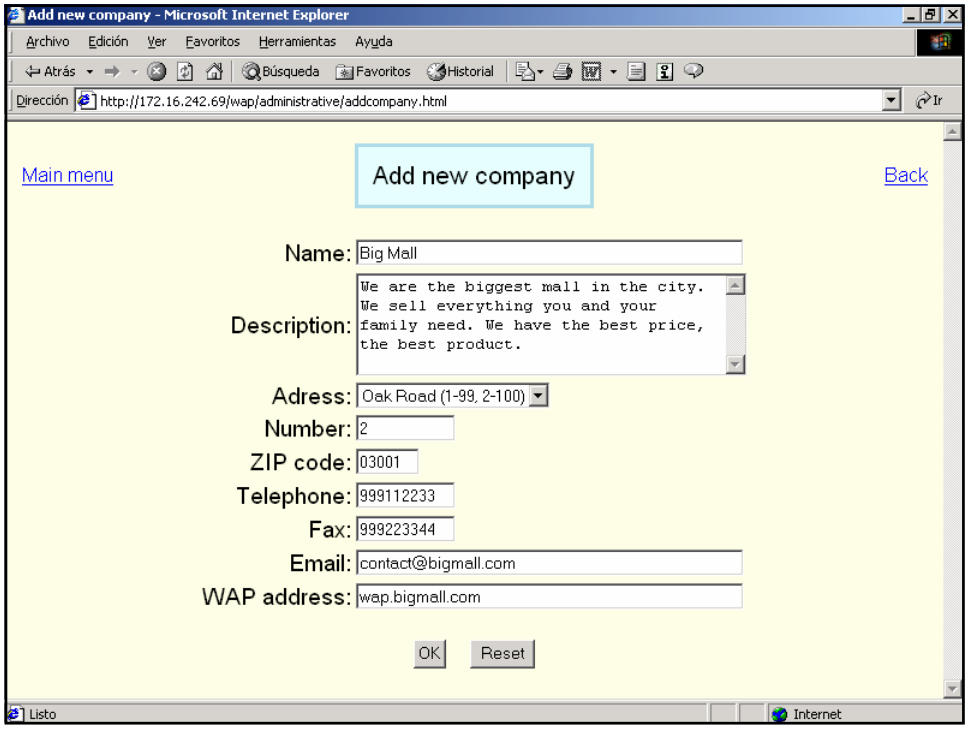

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Application 2

- Data acquisition system → The user can introduce information into the GIS
- The application is oriented to gather data about agriculture: terrain quality, plants that grow, etc.

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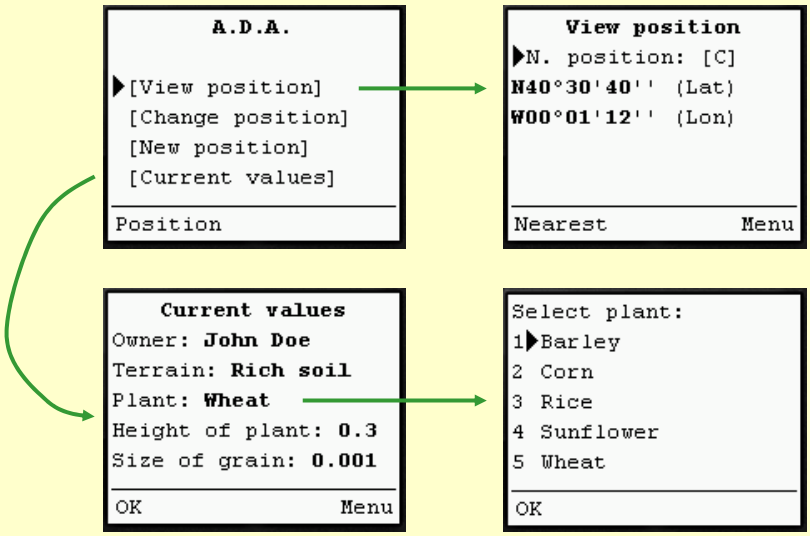
Application 2



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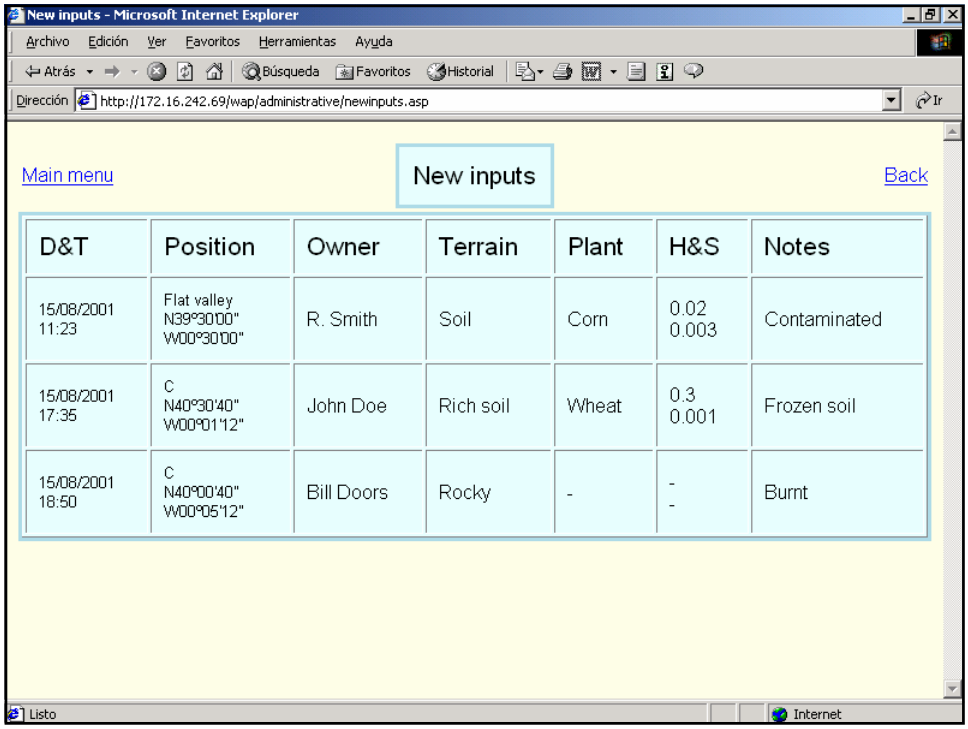

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Summary

- WAP → The *de facto* standard for wireless applications
- Two WAP applications → Mobile positioning system → Location-based services
- Information can flow two ways:
  - GIS database → User
  - User → GIS database
- Standard technology

Future work

- New applications: news, weather and traffic reports, recommendation systems, etc.
- Generate dynamic images that represent maps from GIS database

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