DEVELOPMENT OF MOBILE APPLICATIONS AND FREE WIRELESS COMMUNITIES

SCIENCE IN MOTION

FOUNDATION FOR DEVELOPMENT AND RESEARCH IN SCIENCE AND TECHNOLOGY
MEDELLIN, COLOMBIA - SOUTH AMERICA

ICTP - School on Radio Based Computer Networking for Research and Training in Developing Countries
February 7 – March 4 of 2005

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http://cienciaenmovimiento.hazlorealidad.com

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Overview - Objetives

- To form researchers with great capacity for individual and collective work, to respond to the present necessities of Science and Technology
- To lead the present and future processes of change applying in the society
- To propel the national scientific and technological development in close collaboration with the society.
- To offer researchers a scientific and technological formation so that they contribute to the changes in innovations of Science and Technology
- To allow students with economic difficulties to take higher education courses.

Overview – Academic Links

Developed works with Universities of the Antioquia Region

- University of Antioquia
- University Santo Tomas
- University San Buenaventura
- Approach to University Tecnológica del Chocó

UNIVERSIDAD SANTO TOMAS
PRIMER CLAUSTRO UNIVERSITARIO DE COLOMBIA
MEDELLÍN

UNIVERSIDAD DE ANTIOQUIA
1803

UNIVERSIDAD DE SAN BUENAVENTURA

Outline

- Developing Mobile Applications
- Introduction to Cellular Networks
- Mobile Applications Development
  - Java 2 Micro Edition
  - Wireless Application Protocol (WAP)
- Applications We Built
  - Wap Portals
  - Telemetry Applications
- Other Applications
- Collaborative Work (ALTRED.NET)
- Q&A

Wireless Solutions

- Wi-Fi, Wi-Max
- VSAT
- HF, UHF, VHF
- Mobile Phone Networks

Mobile Applications Utilities

- Wireless Communication solution allowing mobile phones and devices to interact with information contained in wired networks (Intranet, Extranet and Internet):

- Consulting Data Bases. Internet + Wireless = Mobile Internet
- Information Services (PCS)
- Location Based Services
- Data, Voice, Audio, Video….
- SMS, MMS, E-mail, Games
- Telemetry, User – Machine Interaction

Developing Mobile Applications

- The mobile market is one of the fastest growing markets in the world. Users needs has grown beyond Voice Communications and they are asking for new services available trough their Mobiles Phones.

- Developing countries are no exception The geographical conditions of most of these countries presented a challenge for service providers to install fixed networks, a challenge not very often met. That's why cellular network became an alterative to these fixed lines in countries like Nigeria, and some other African countries, and even islands countries in the pacific

Mobile Telephony

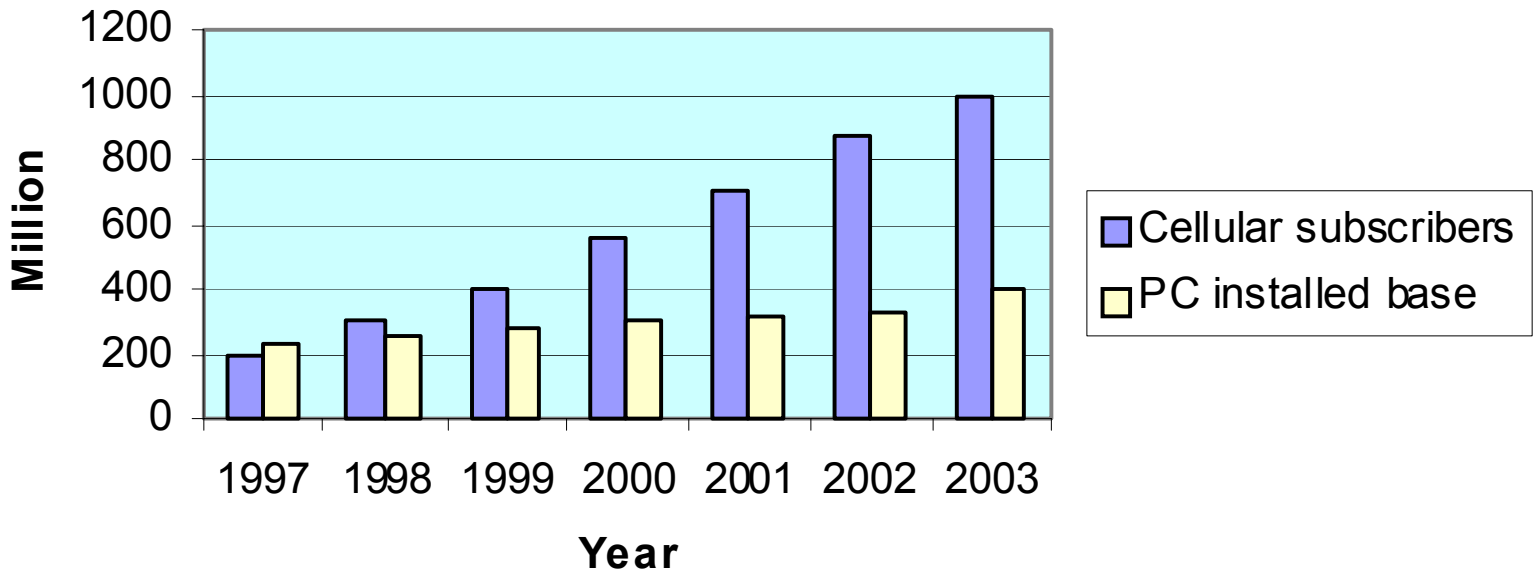
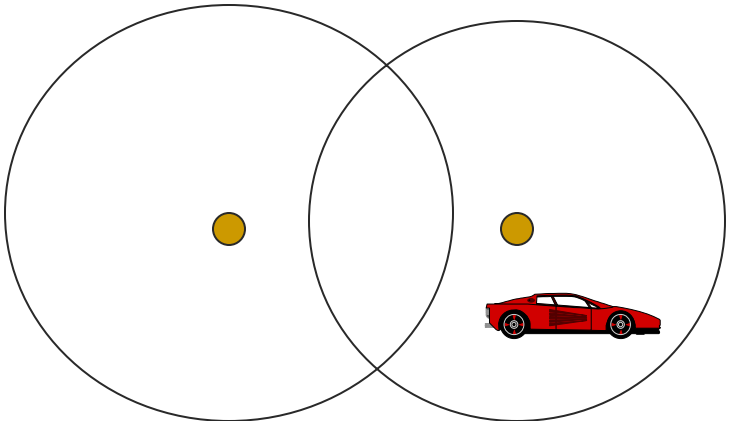


Figure 1: Cellular subscribers vs PC installed base

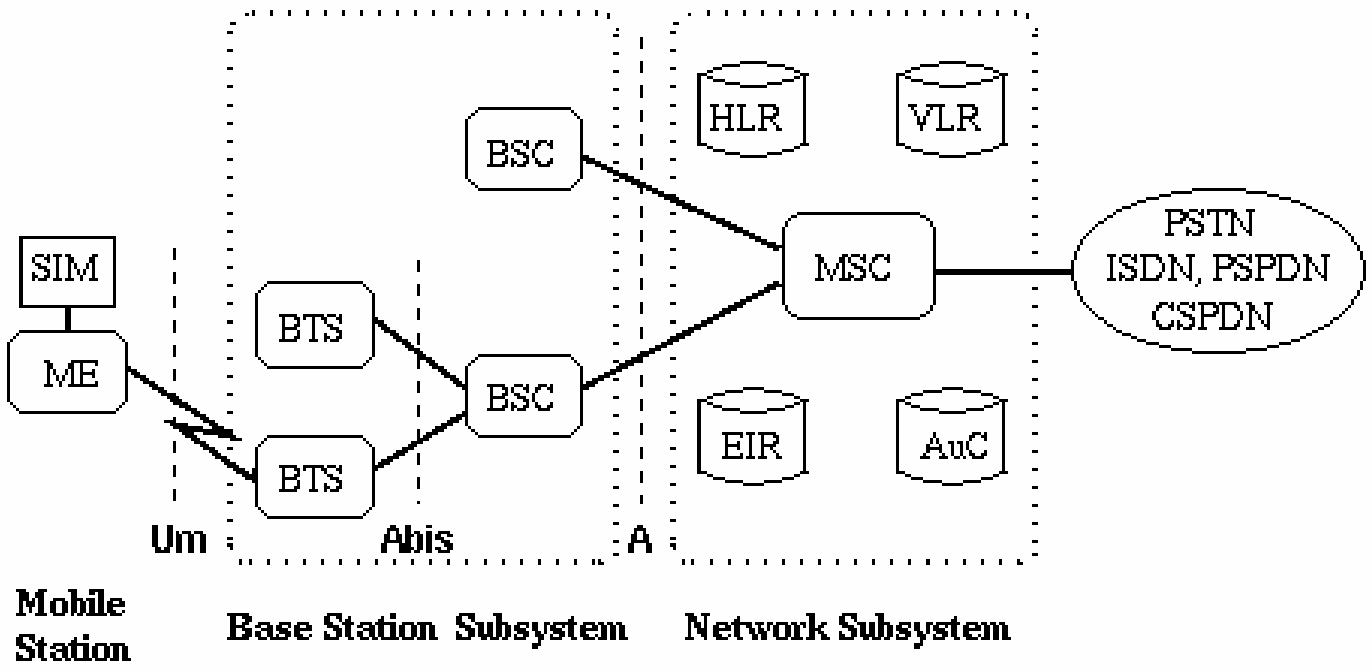
Client appliances

Cellular Wireless

- Space divided into cells
- A base station is responsible to communicate with hosts in its cell
- Mobile hosts can change cells while communicating
- Hand-off occurs when a mobile host starts communicating via a new base station



Mobile Network Architecture

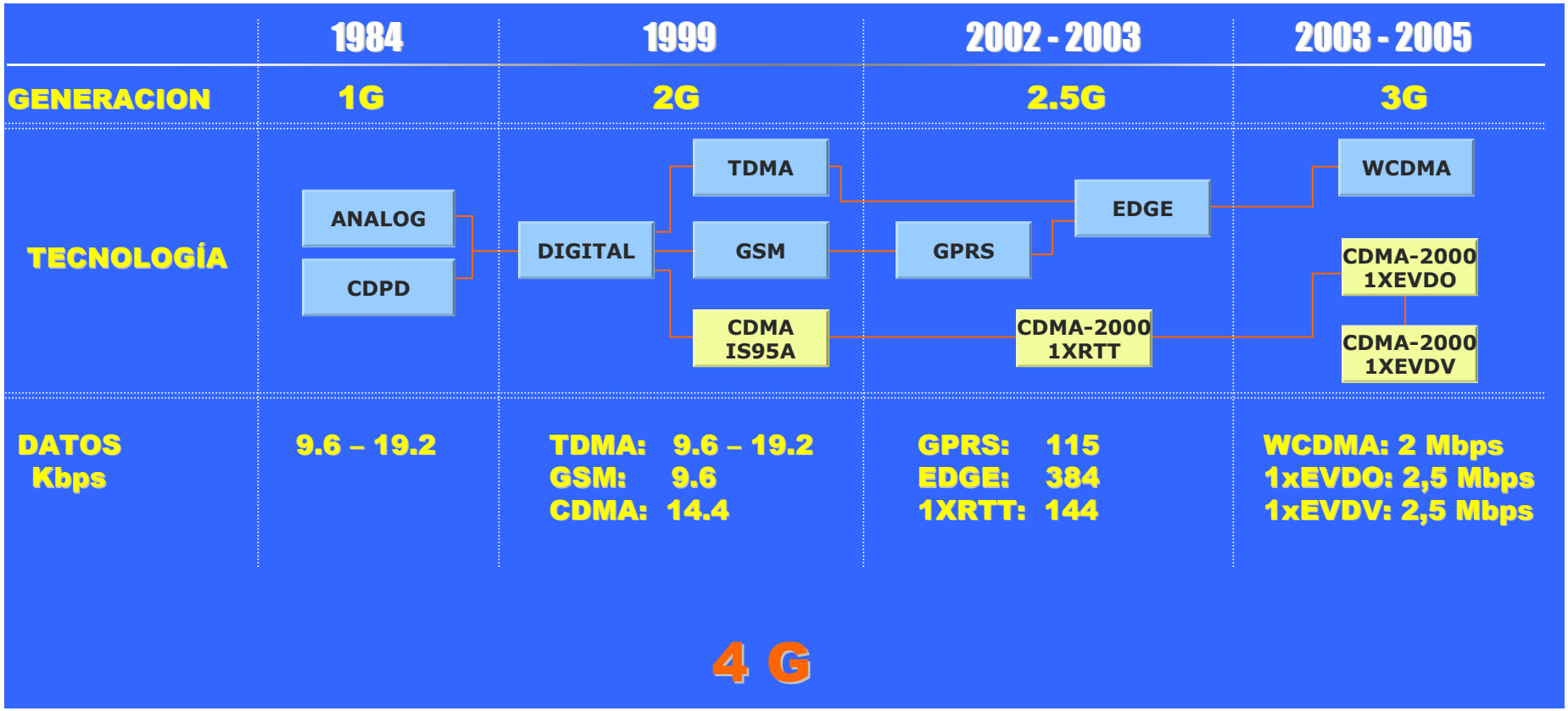


SIM Subscriber Identity Module
ME Mobile Equipment
BTS Base Transceiver Station
BSC Base Station Controller
HLR Home Location Register
VLR Visitor Location Register
MSC Mobile services Switching Center
EIR Equipment Identity Register
AuC Authentication Center

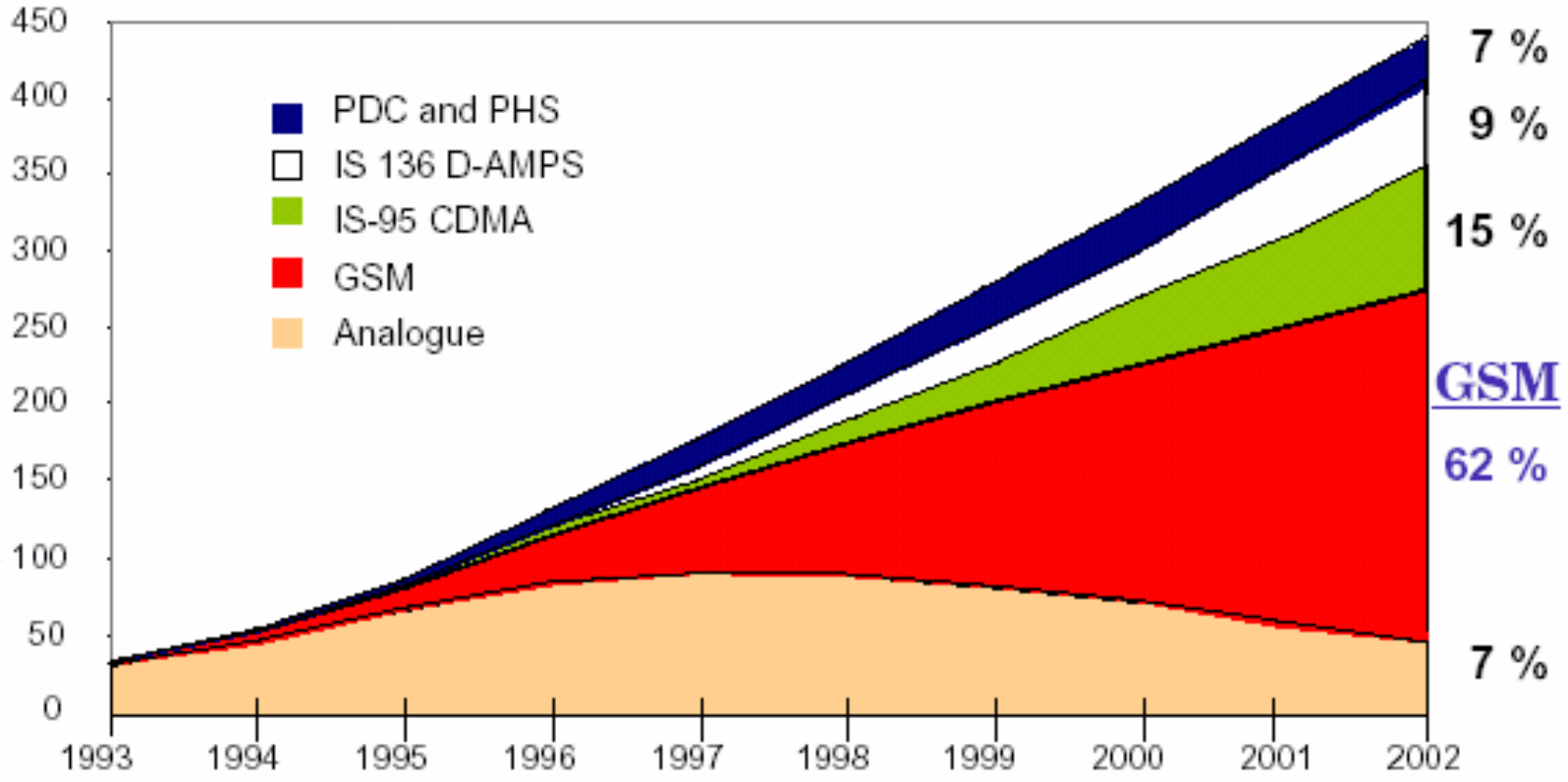
PLMN (Public Land Mobile Network)

- Components
  - MS (mobile station)
  - BS (base station)
  - MSC (mobile switching center)
  - LR (location register)
- Subsystems
  - RSS (radio subsystem): covers all radio aspects
  - NSS (network and switching subsystem): call forwarding, handover, switching
  - OSS (operation subsystem): n/w management

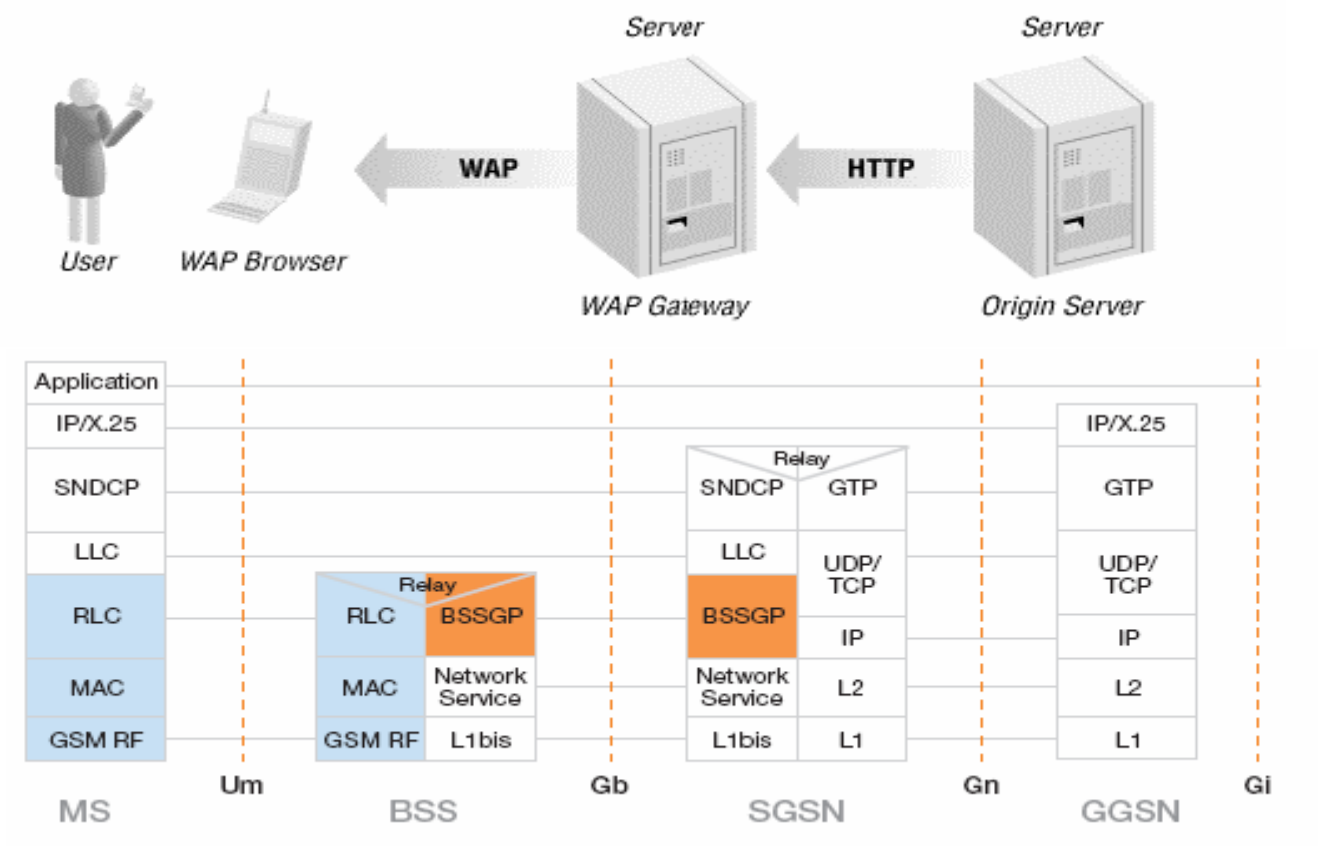
Technology Evolution Path



Users by technology

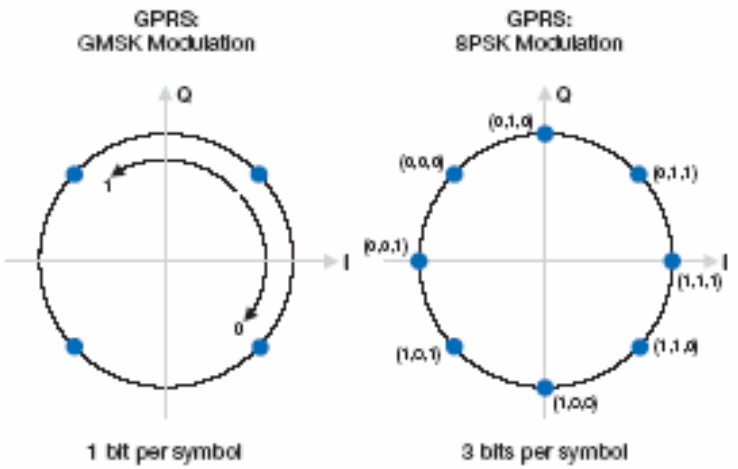


Protocol Stacks GPRS/EGDE



Protocol Stacks GPRS/EGDE

	GPRS	EDGE
Modulation	GMSK	8-PSK/GMSK
Symbol rate	270 ksym/s	270 ksym/s
Modulation bit rate	270 kb/s	810 kb/s
Radio data rate per time slot	22,8 kb/s	69,2 kb/s
User data rate per time slot	20 kb/s (CS4)	59,2 kb/s (MCS9)
User data rate (8 time slots)	160 kb/s	473,6 kb/s
	(162,4 kb/s)	(553,6 kb/s)

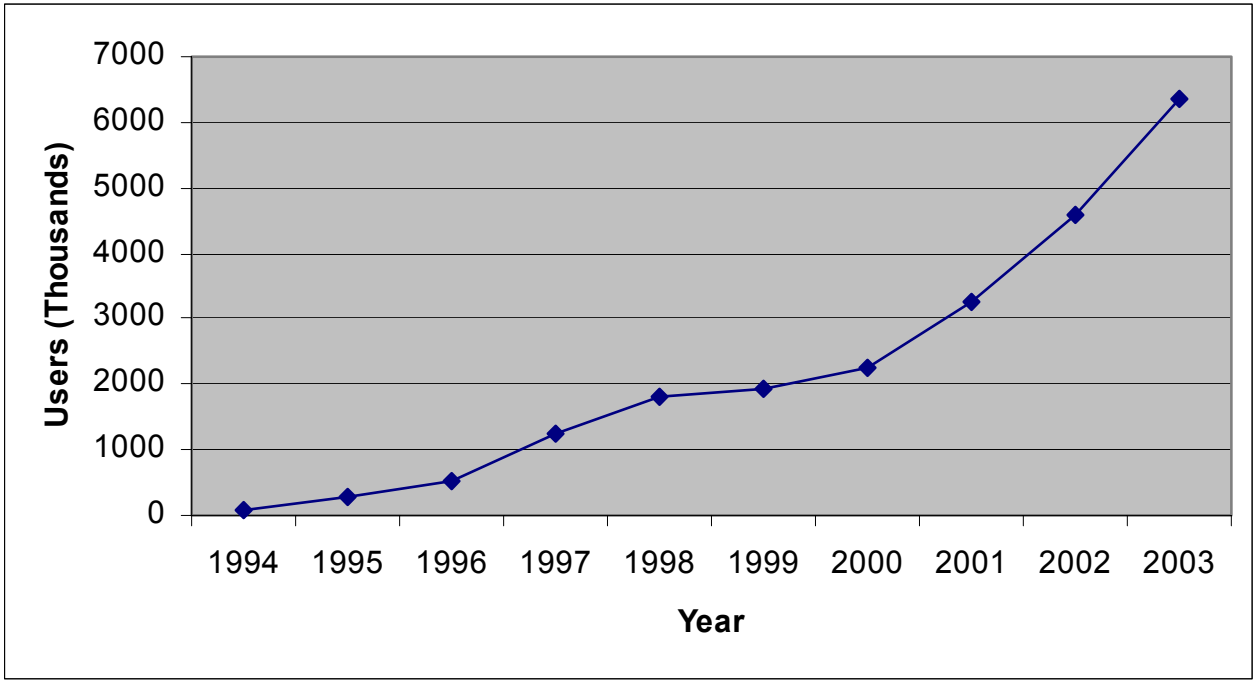


To improve data capacity of mobile networks a new stack of protocols was developed, giving to Mobile Networks more capability to support information interchange between mobile devices inside the same network and also through external data networks like Internet

Mobile in Colombia

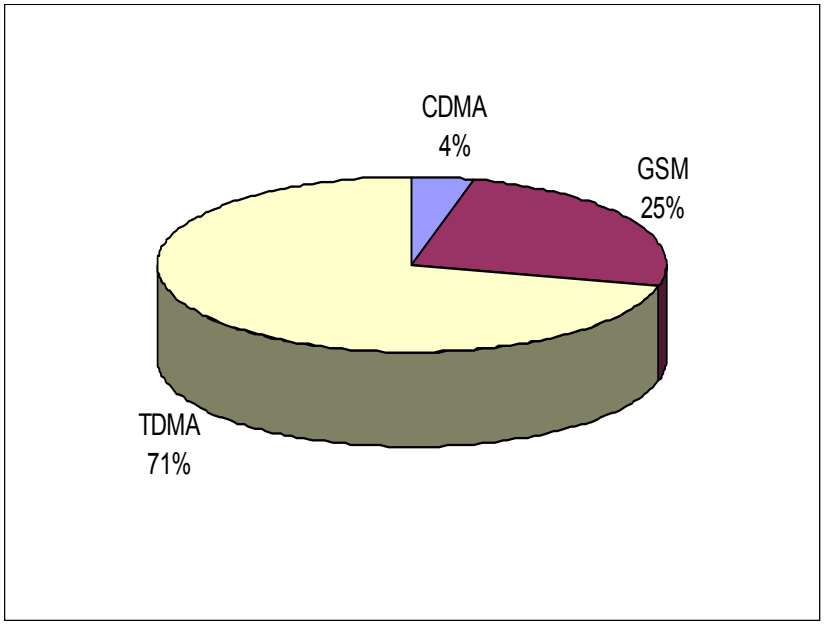
- Growth of Mobile phones with browser capabilities
- 2.5 G Networks implemented recently
- Opportunity to develop Mobile Applications

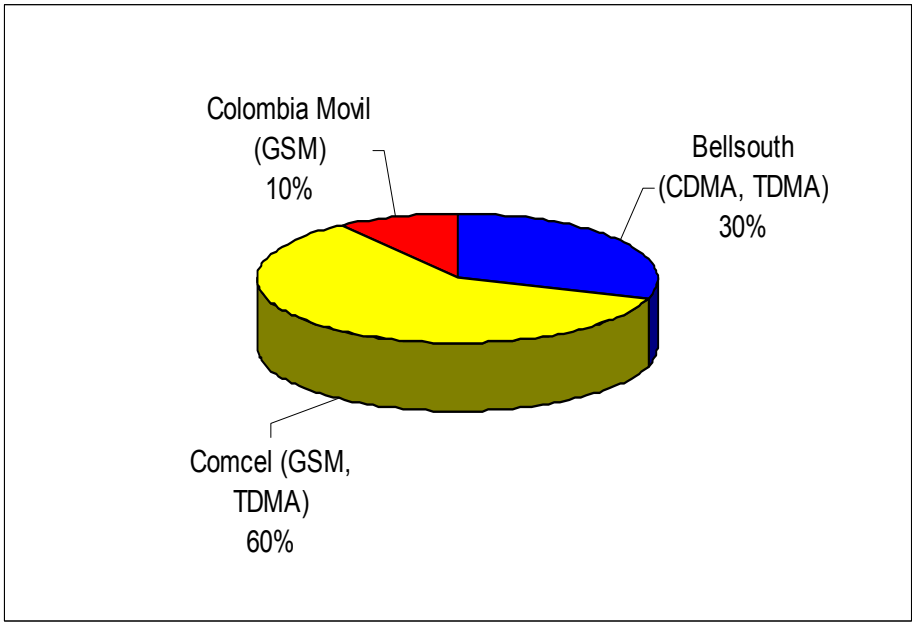
Mobile Users in Colombia



14.4% of the total population of the country have a mobile phone

Mobile technologies in Colombia





Mobile Applications Development

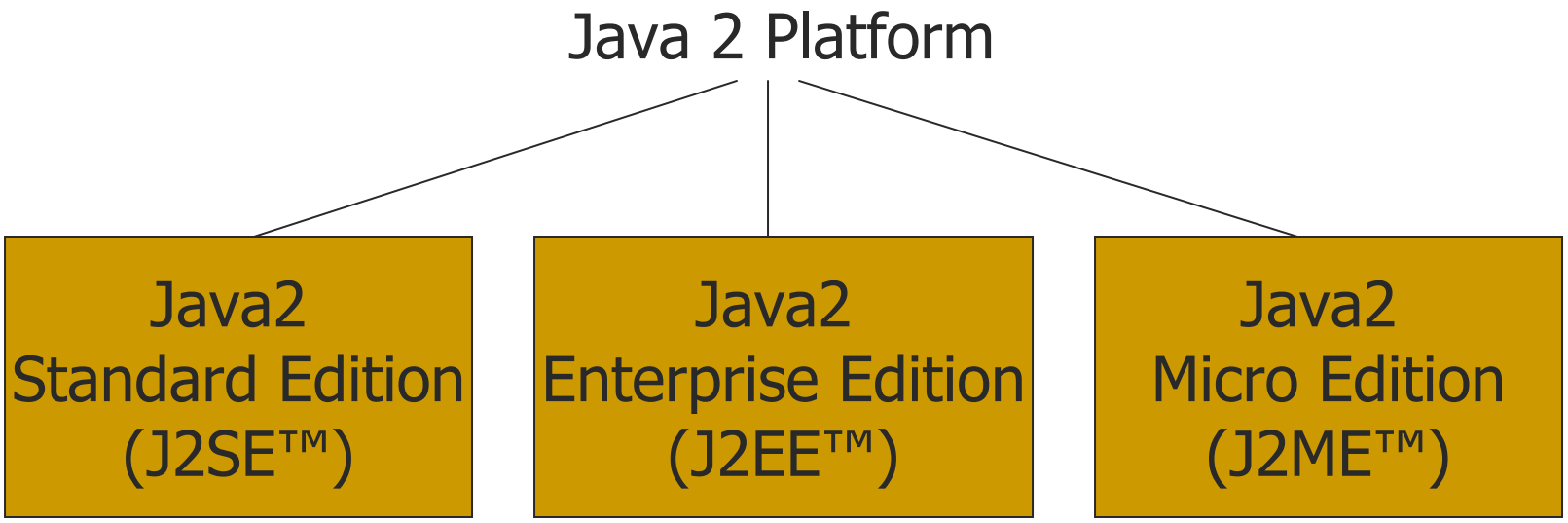
When we are developing mobile applications we have two choices:

- Executable files (J2ME)
  - Limited to device resources
  - Large files
  - Access to phone capabilities (API's)
- Mobile Web Applications (WAP)
  - Powered by server resources
  - no installation needed
  - Limited to browser capabilities

Java 2 Micro Edition

- The Java 2 Platform is split into three editions.
- Each edition provides a complete environment for running Java-based applications, including the Java virtual machine (VM) and runtime classes.
- The three editions target different kinds of applications running on different kinds of devices.

Java Editions

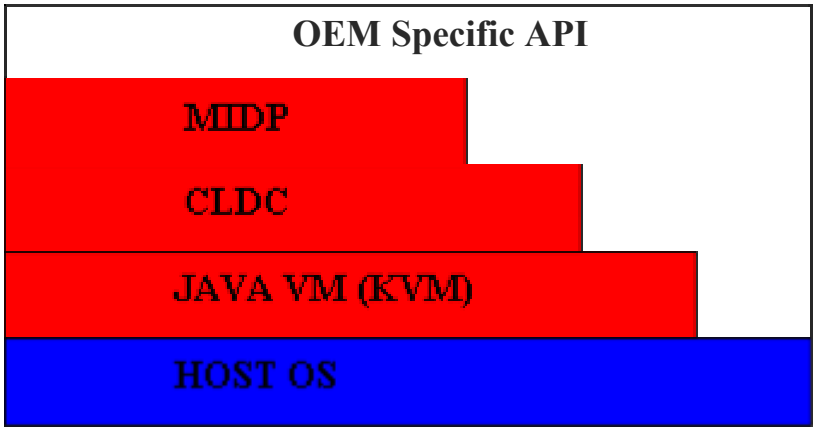


Standard desktop & workstation applications

Heavy duty server systems

Small & memory constrained devices

J2ME Architecture



- KVM - Kilobyte Virtual Machine
  - 40 – 80 KB in size
  - For devices with 160 KB of memory and 16 or 32-bit RISC/CISC microprocessors

Configurations

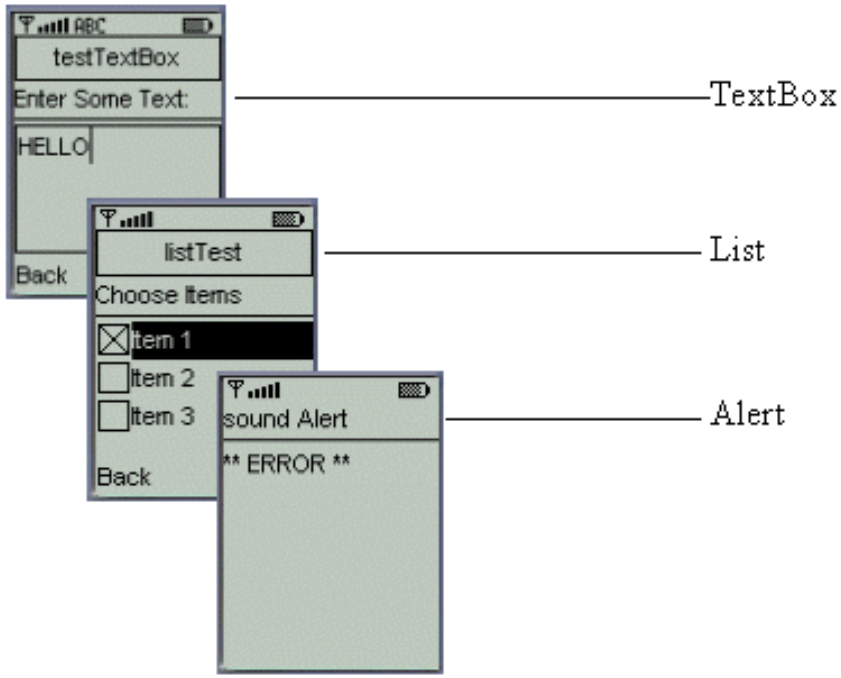
- Connected Device Configuration (CDC)
  - 512kb memory for Java
  - 256kb for runtime allocation
  - Network connectivity
- Connected, limited Device Configuration (CLDC)
  - 128kb memory for Java
  - 32kb for runtime allocation
  - Restricted UI (User Interface)
  - Low bandwidth network connectivity, intermittent access
  - KVM is reference implementation (40-80kb)

MIDP – MID Profile

- MIDP is targeted at a class of devices known as *mobile information devices* (MIDs).
- Minimal characteristics of MIDs:
  - Enough memory to run MIDP applications
  - Display of at least 96 X 56 pixels, either monochrome or color
  - A keypad, keyboard, or touch screen
  - Two-way wireless networking capability

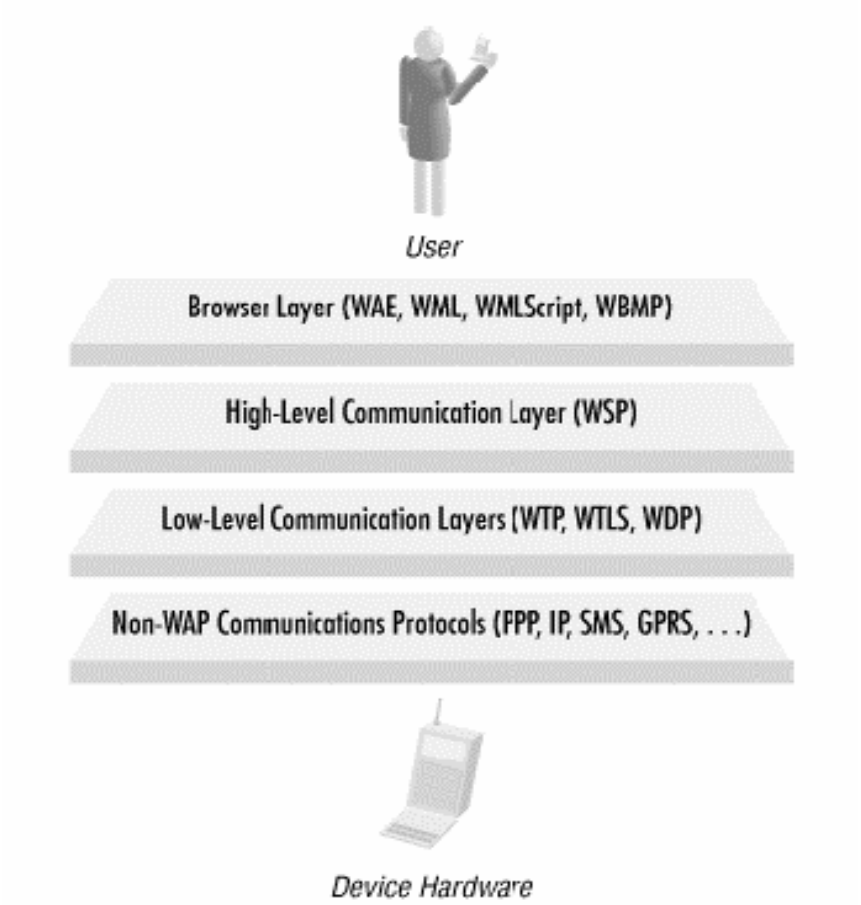
J2ME UI

- MIDP provides some limited UI elements
  - Form
  - Alert
  - Choice and ChoiceGroup
  - List
  - StringItem
  - TextBox
  - TextField
  - DateField
  - Guage
  - Ticker



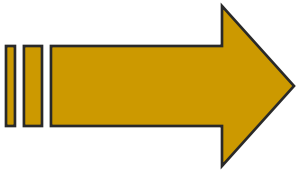
WAP (Wireless Application Protocol)

It's a set of standard protocols that define Web applications development for mobile devices, allowing Phones and mobile devices like PDA's to interact with information contained in wired networks (Intranet, Extranet and Internet). Wap by itself it's not mobile Internet.



Benefits

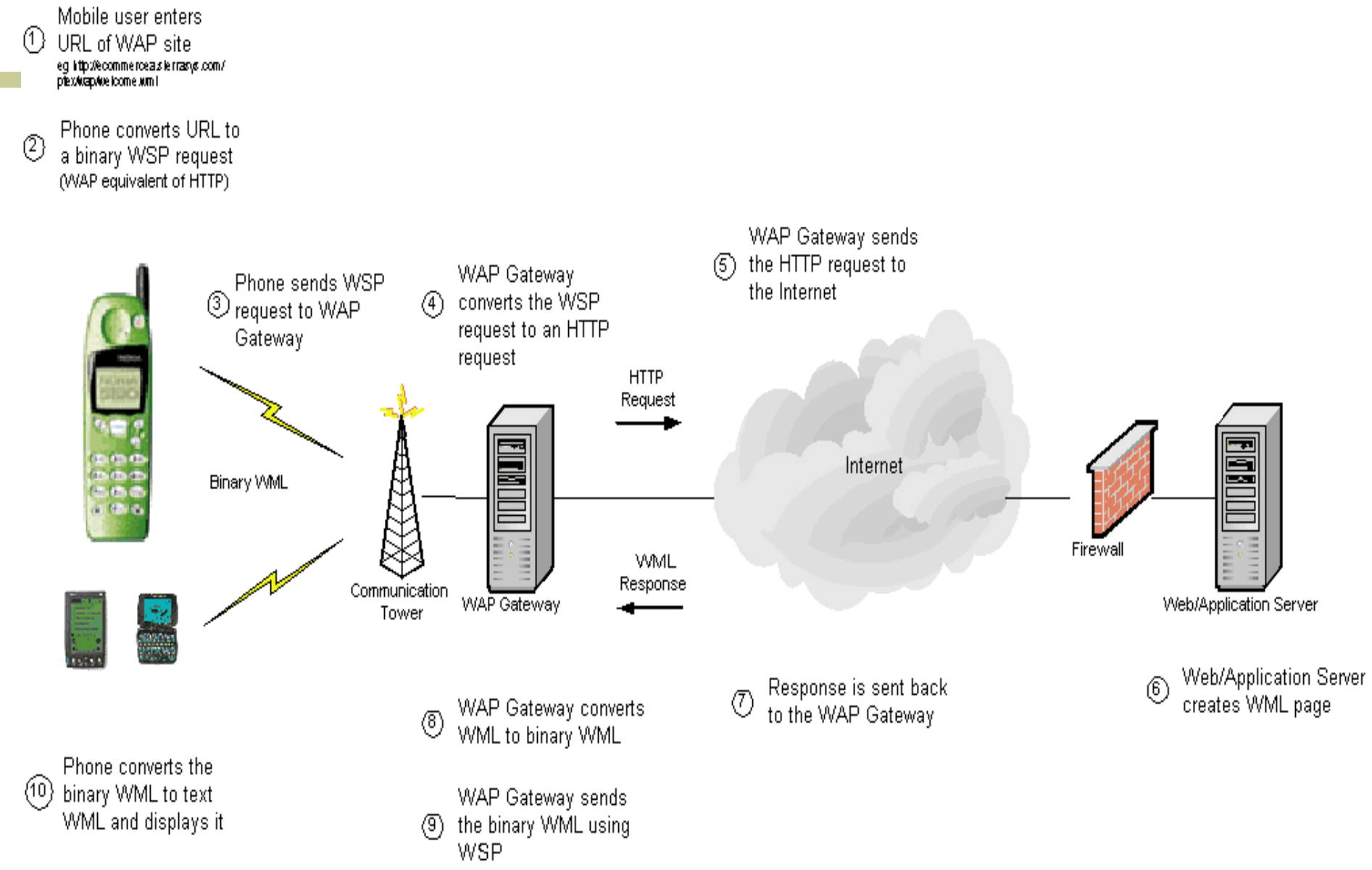
- Bearer independent
- Device independent



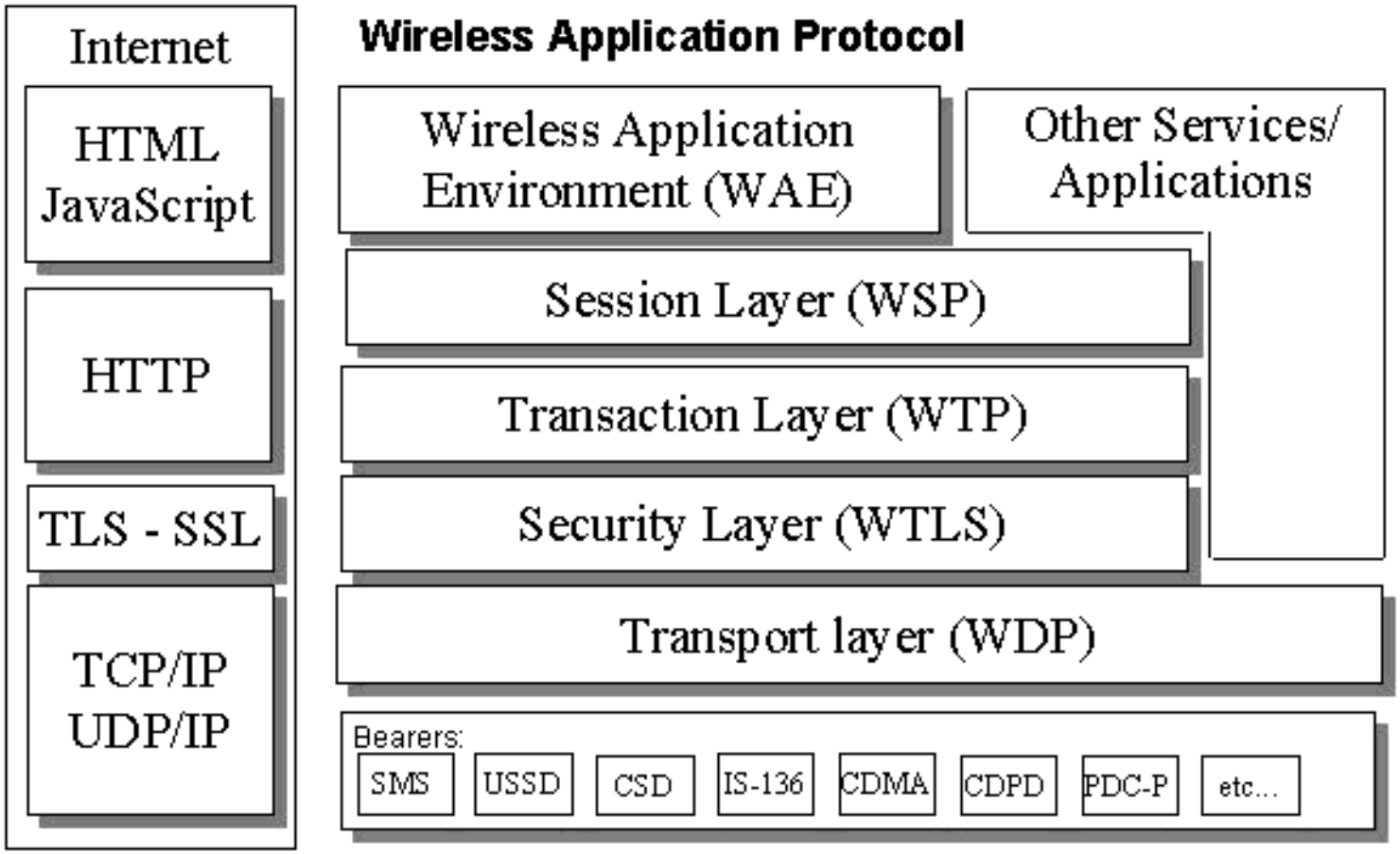
Microbrowser available for many devices

- Push and pull support

WAP Architecture



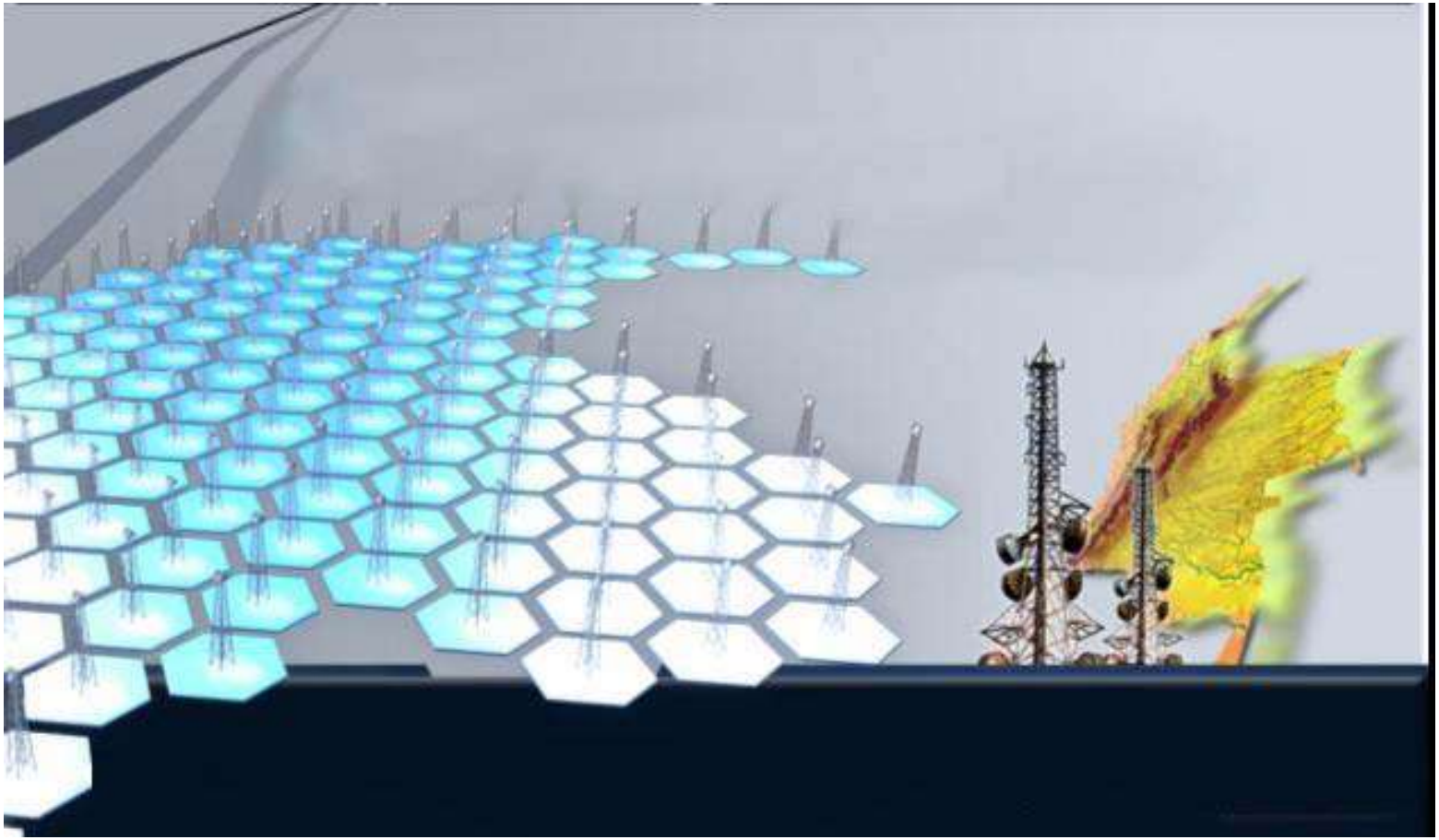
HTTP/WAP Architecture



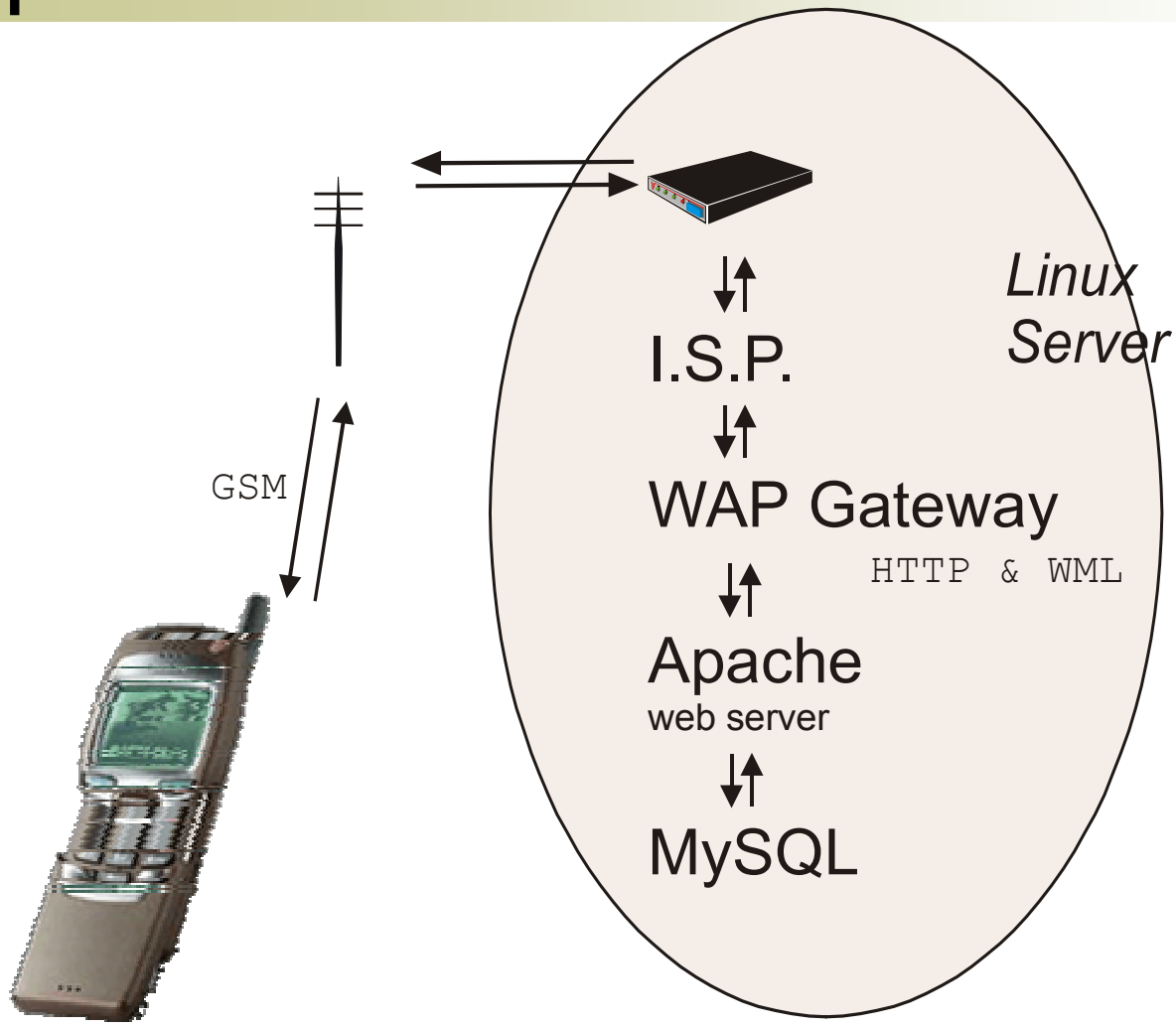
WAP Components

- WML (Wireless Markup Language)
  - An XML-based markup language that describes how WAP content is presented on a wireless terminal
- Differs from HTML in the following
  - WML was **specifically designed for wireless terminals** with a target screen that is only a few lines long and about an inch wide.
  - WML is **case sensitive**, and all tags and attributes should be in lowercase.
  - Unlike HTML, WML is **unforgiving** of incorrectly nested tags.
  - WML doesn't assume that a keyboard or a mouse is available for user **input**.
- Based on these differences, WML provides a smaller, telephony-aware set of tags that make it more appropriate than HTML for handheld wireless terminals.

Applications We Built



Open Source Architecture



First Application

- The first IDE (Integrated Development Environment) we used was Nokia Mobile Internet Toolkit 3.1 back in 2002
- Our First App was a WAP Portal for Santo Tomas University.

Interactive application

- WAP Portal for University of Antioquia at: http://electronica.udea.edu.co/~gita/wap/udea.wml
- Next step was to make the portal “interactive”.
- We needed a server side script to exchange data between the mobile and the server.

Interactive Portal = “Services”

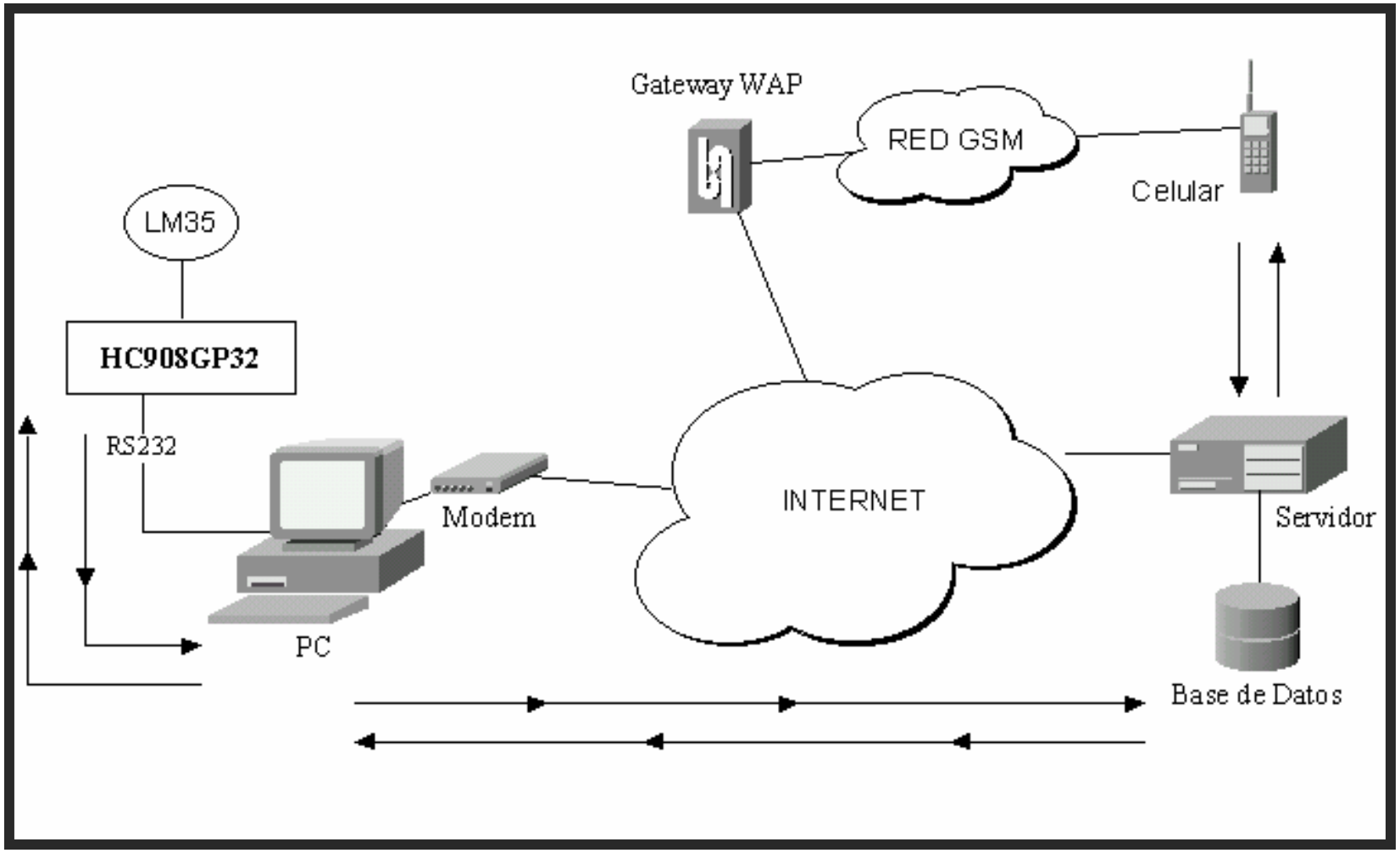
- Thanks to Server Side Scripts (JSP, PHP, Pearl) we were able to deliver Services, like news and entertainment and even E-Mail Services.
- We could also perform authentication against our DB, to control access to some services.

Autenticathion Portal

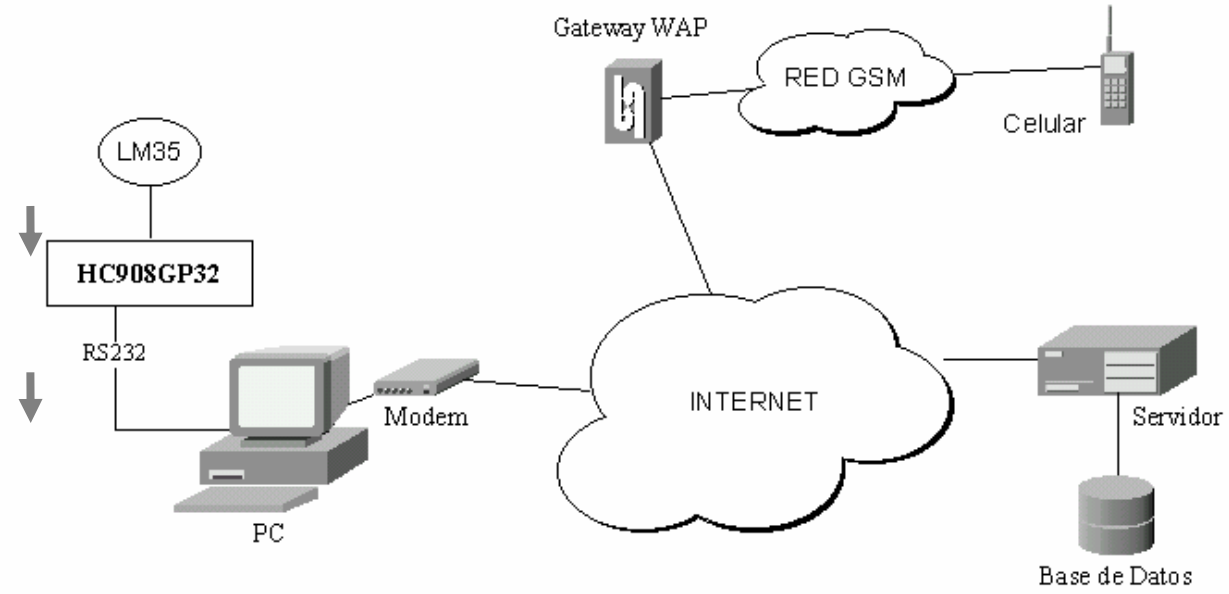
Telemetry Project

- Now that we could interact with our servers we wanted to be able to control things from the mobile phone.
- Telemetry: The capability of transmitting or retrieving data over long distance communication links, such as satellite or telephone.

Telemetry Project Architecture

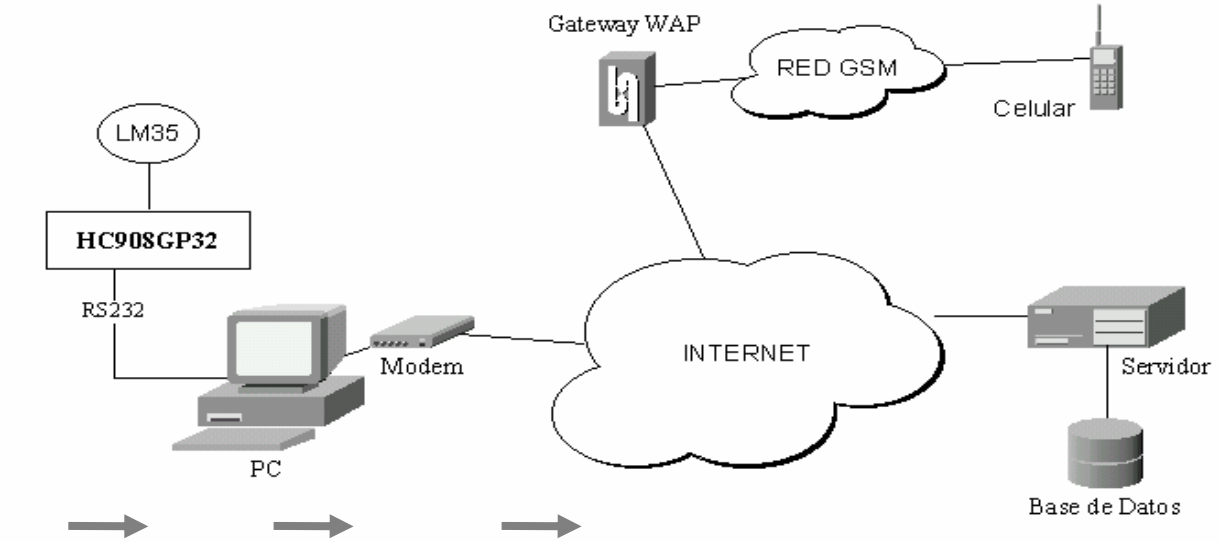


Data Acquisition Stage



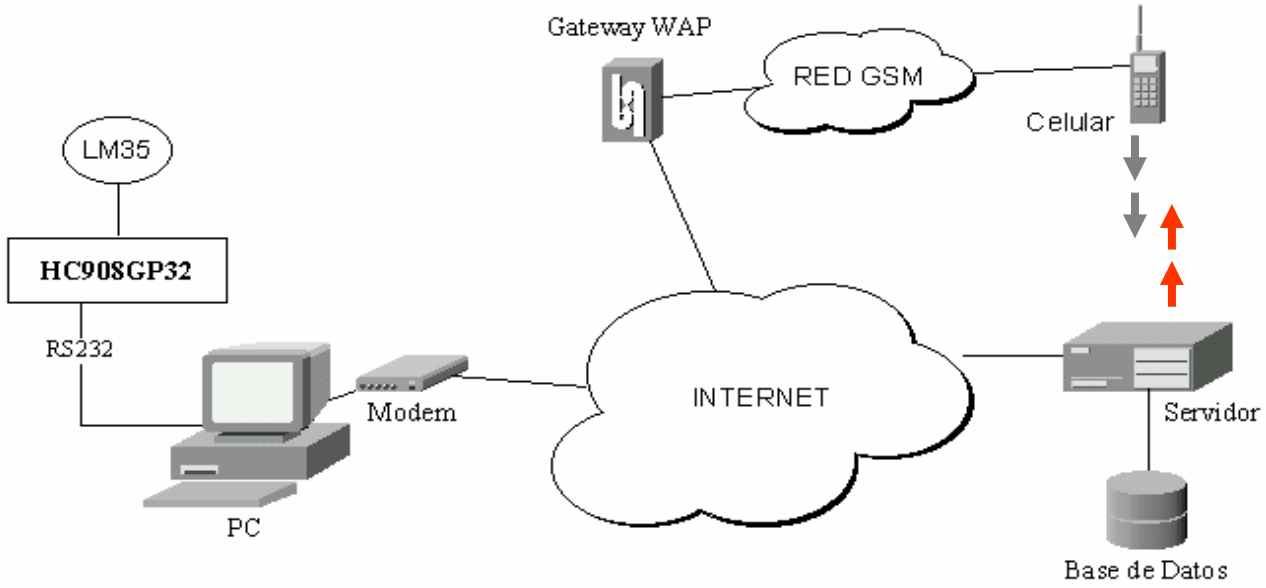
- First we had to measure a physical variable, we chose temperature and we used a heat sensor (LM35) connected to a microprocessor (HC908GP32) to transmit the data serially to the PC where it's read by a Java app listening to the serial port.

Data Persistence Stage



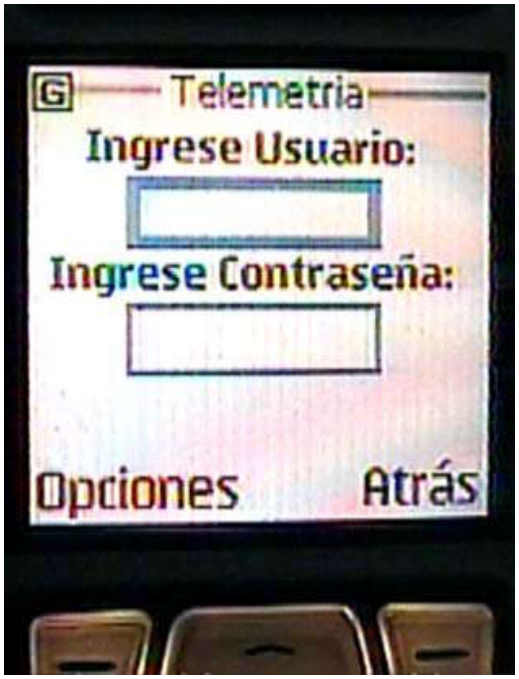
- The measured data is stored in a Data Base (like MySQL or Postgre) where it can be consulted by a web application (JSP, PHP), hosted on a Web Server (Apache) with a public IP address and maybe a domain name.

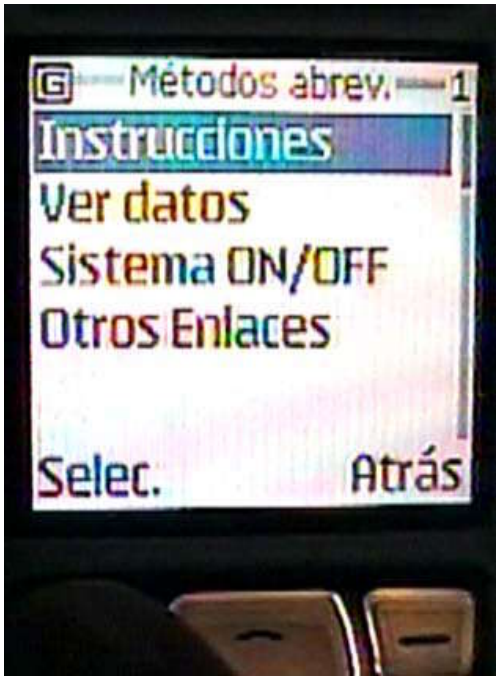
Mobile to Server Communication



- The URL of the Web Application it's written in the Micro browser on the Phone, this generates a request to the server, where the server side script retrieves the values saved in the DB and creates a WML page to display the collected data.

User's prospective





- First there's a welcome screen, then a Log-On page, and finally you can choose from a menu if you want to get instructions, or "see the data" and even turn the system ON/OFF.

Displaying Data on the Mobile

- You can access a table with the last 20 measurements and even see a history graph of the system's behavior.

Collaborative work – AltRed

ALTED is a project started in Medellin, Antioquia, to create a reference and integration point for all projects related with wireless networks and free communities

http://www.altred.net/

http://bogotawireless.net/

PopayanWireless.net

http://www.popayanwireless.net/

http://medellinwireless.da.ru

In Peru is beginning

Punowirelesswireless

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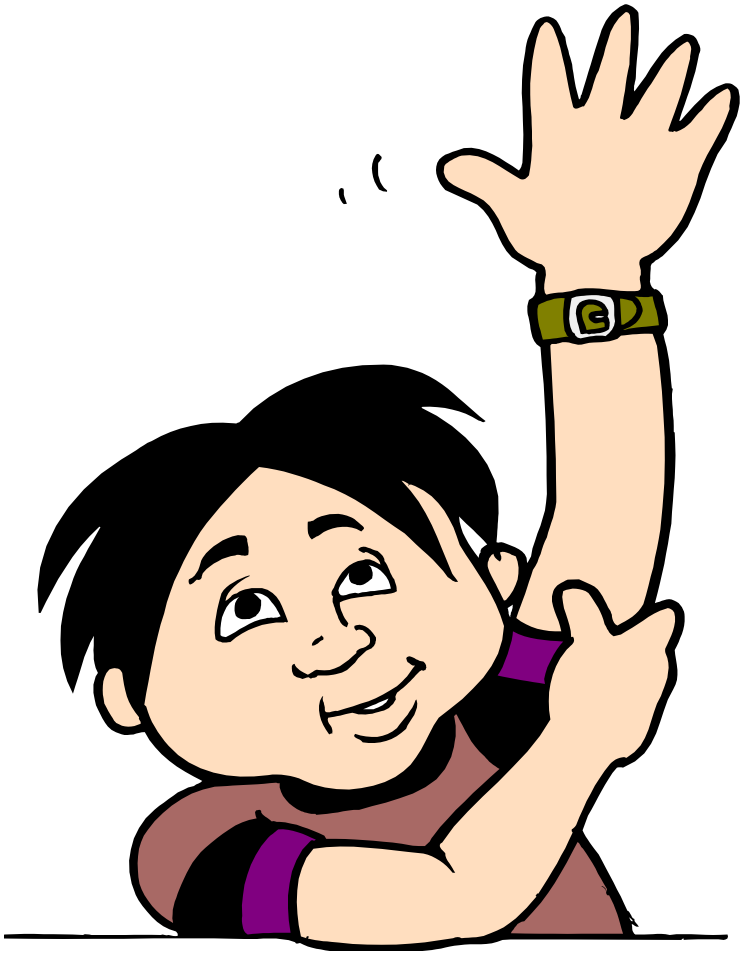
Questions?



Thank you for your attention

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- Universities of Antioquia, Santo Tomas and San Buenaventura
- AltRed.Net
- All participants of the School 2005

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