

Remote Control Automatic Systems Developmet

Diploma Thesis

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Committee

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Thesis Scope

An *M2M* system that communicates with its administrator through the cellular GSM mobile network using the SMS protocol



M2M Application

- California – Automatic system managing the state water supplies
- Coca Cola – Wireless system that watches the automatic sales machines products stock
- General Motors, OnStar service.



M2M Applications

- PillCam - intrainestinal introspection
- Rentokil – Rat trap and movements prediction



M2M Technology

- Machine-2-Machine
- Man-2-Machine
- Mobile-2-Machine



M2M Idea

- Millions of electronic devices
- Networking Technology
- Device Network Connectivity
- Autonomy Systems
- Power Consumption Save

M2M Architecture

Automatic Systems:

- Microcontrollers
- Activators
- Sensors
- Other Electronic and Electrical devices

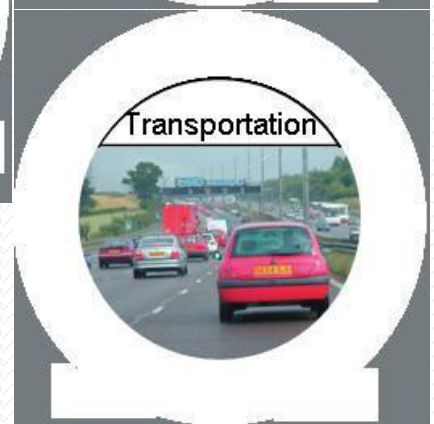
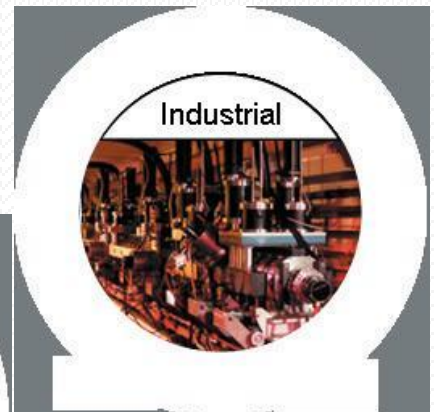
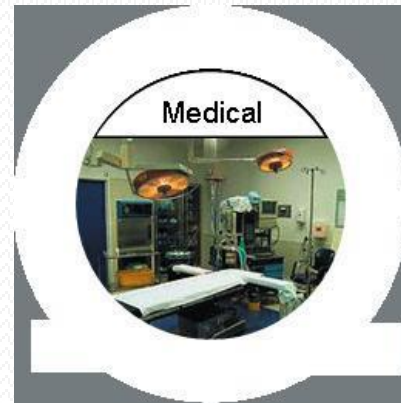
M2M Architecture

M2M Systems:

- Networking Devices (GSM/GPRS Modules, Ethernet)
- Mobile Phones
- Networks
 - Wired (Ethernet)
 - Wireless(WLAN, Bluetooth, GSM, Satellite)

M2M Technology Applications

- Dangerous/Unfriendly Areas
- Medical
- Transport
- Sales Machines
- Smart Buildings
- Industry



M2M Technology Applications

- Surveillance Systems
- Agriculture
- Public Services
- Environmental
- Remote Diagnosis and Repairing
- Decentrallization



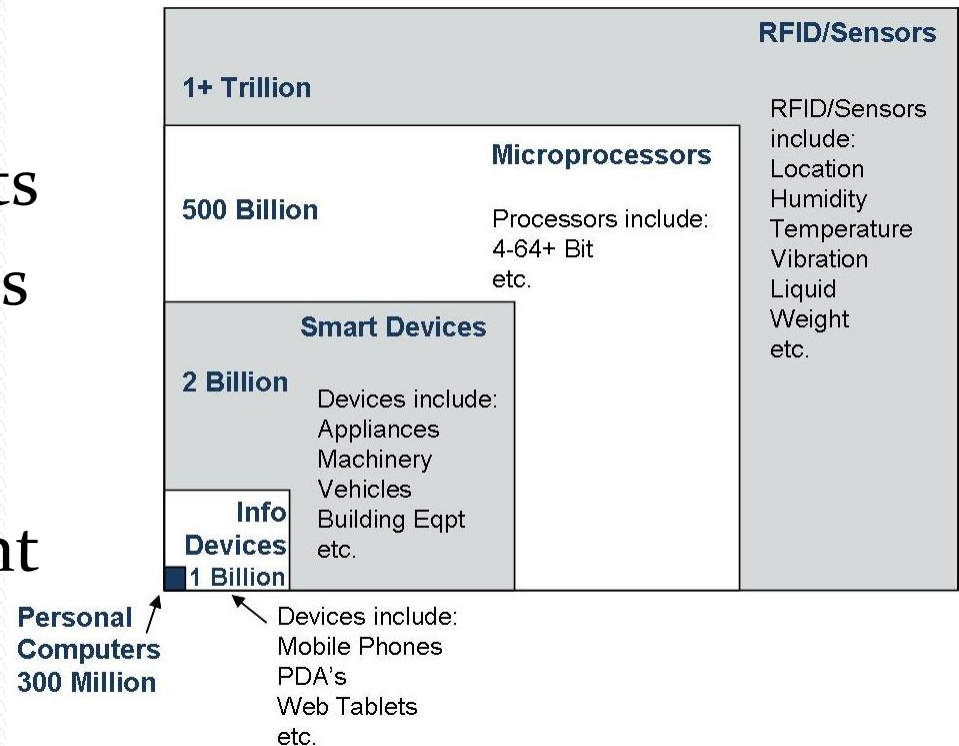
Problems

Networks:

- Reliability
- Delays
- Speed
- Safety
- Costs

Perspectives

- Ready Infrastructures
- Networks Improvements
- Already existing systems transformation
- Electronics devices technology development

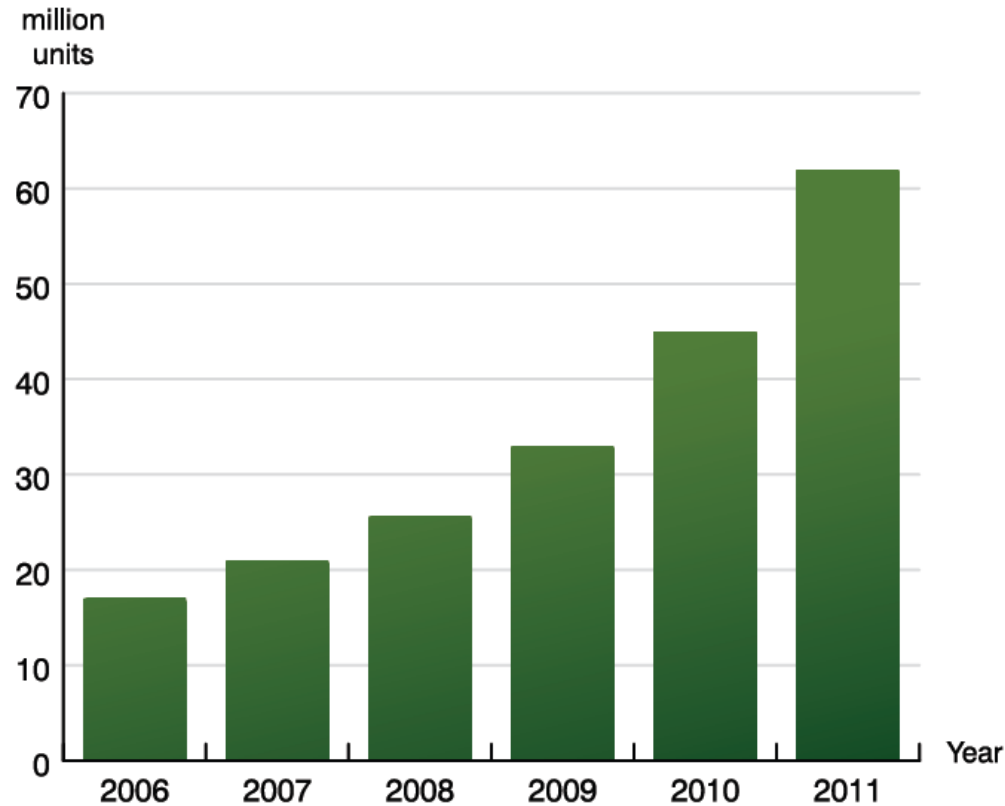


Perspectives

- Network usage costs
- Modules development
- Governments Support



Expected Rise



Πηγή: Berg Insight

Wireless Networks

Cellular Networks:

- GSM
- GPRS (EDGE)
- WCDMA

Local Wireless Networks:

- WLAN
- ZigBee

Cellular Networks

Advantages:

- Always Online
- Ready Infrastructure
- Coverage «Everywhere»
- Great Range of Users
- Worldwide
- Volume Charge

Cellular Networks

Disadvantages:

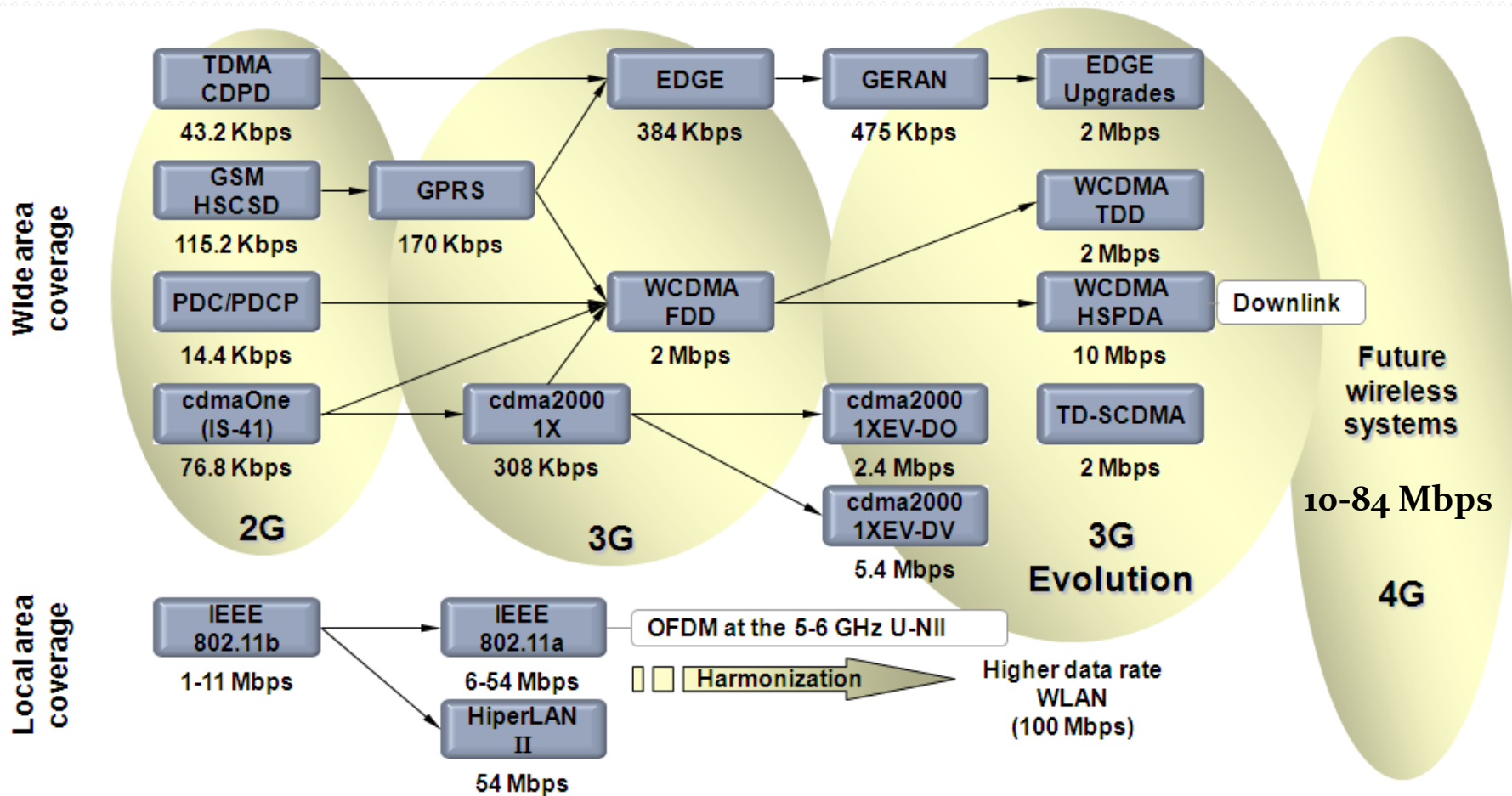
- Low Bandwidth
- Low Signal in internal areas
- Coverage «Everywhere»
- Volume Charge

Cellular Networks

Conclusions:

- Ready Infrastructure
- Everywhere and Anytime
- Bandwidth Continuously Increasing
- Unreliable for Industrial Applications
- Satisfactory for small and non critical Applications

Wireless Networks Bandwidth



Local Wireless Networks

Advantage:

- Reliable and Tested
- Good Connection
- High Bandwidth
- Zero Usage Cost

Local Wireless Networks

Disadvantages:

- Infrastructure and Configuration Cost
- Low Safety Level
- Interferences

Local Wireless Networks

Conclusions:

- Satisfactory for local Applications

Table 1. Wireless Networks

	Cellular Networks		Local Wireless Networks	
technology	GSM (GPRS/EDGE)	WCDMA (HSPA)	WLAN	ZIGBEE
Safety	High (VPN, Cryptography)	High (VPN, Cryptography)	WEP, WAP	SKKE
Bandwidth	GSM – up to 14,4kbps GPRS – up to 48kbps EDGE – up to 384kbps	Up to 84Mbps	Up to 54Mbps	Up to 250kbps
Interferences	Only same networks	Only same networks	Microwave Ovens, Bluetooth devices, etc	Microwave Ovens, Bluetooth devices, etc
Coverage	Good in external areas Medium in internal areas	Good in external areas Medium in internal areas	Up to 100m	Up to 75m

GSM Network

- Most recognizable and famous network
- 80% of the global market
- 4.3 billion users
- 2009 – 20 million M2M applications

GSM Network

- First digital (2G) mobile communication system
- First day of working in 1990
- In Greece came in 1993 by Telestet
- In 1993 at 48 Countries with 1 Million Users

GSM Coverage – Greece



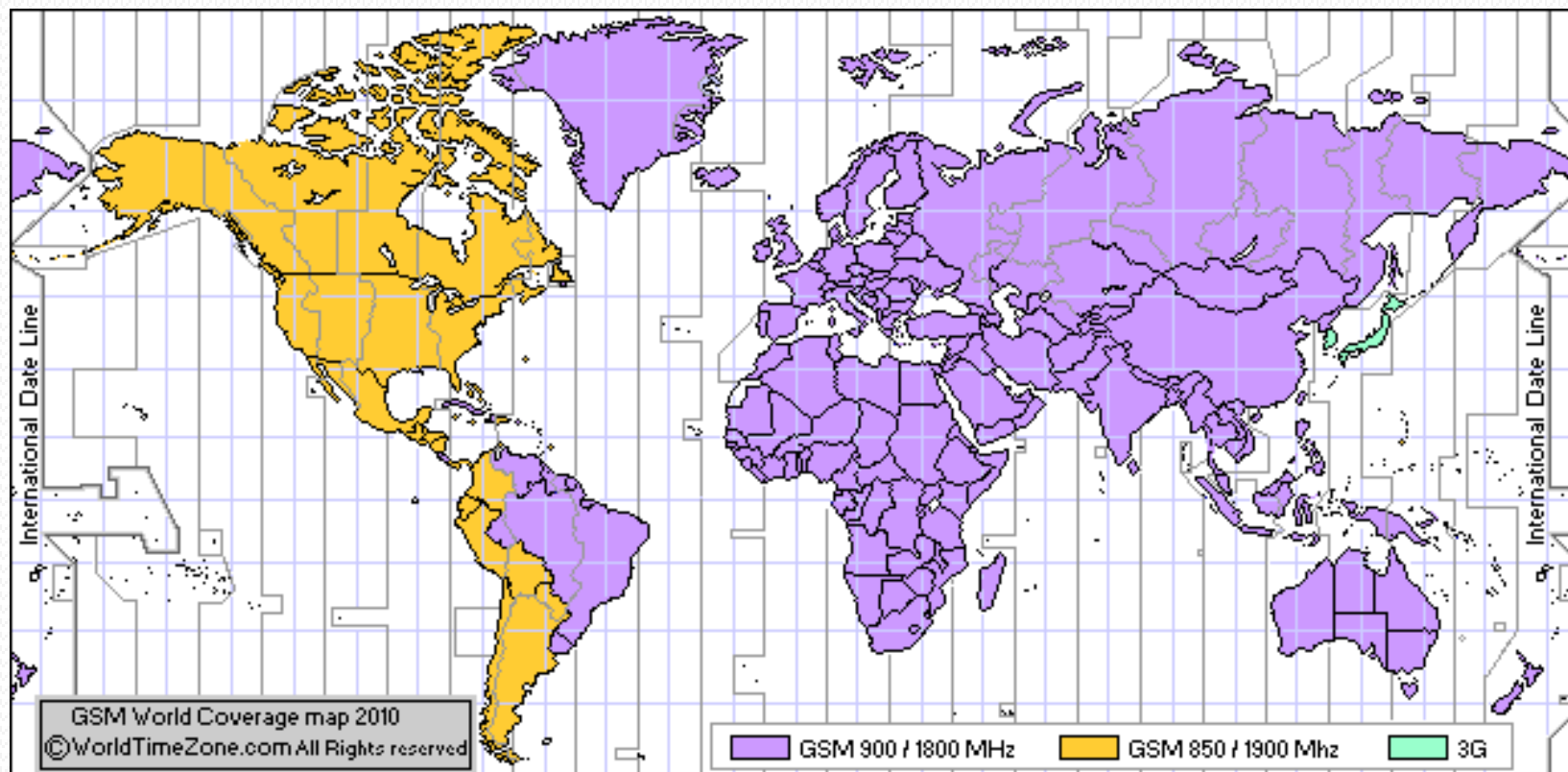
GSM Coverage – Greece



GSM Coverage – Greece

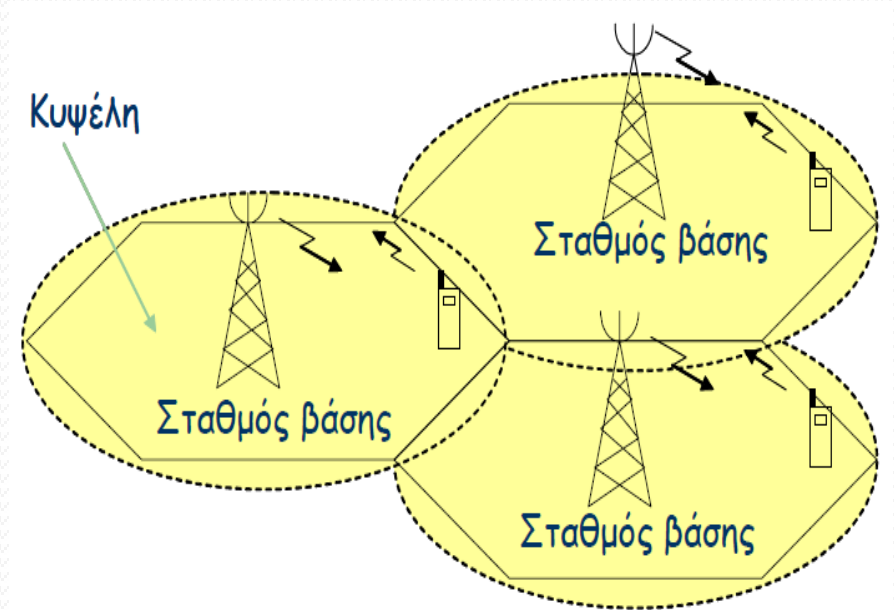


GSM Coverage – Worldwide



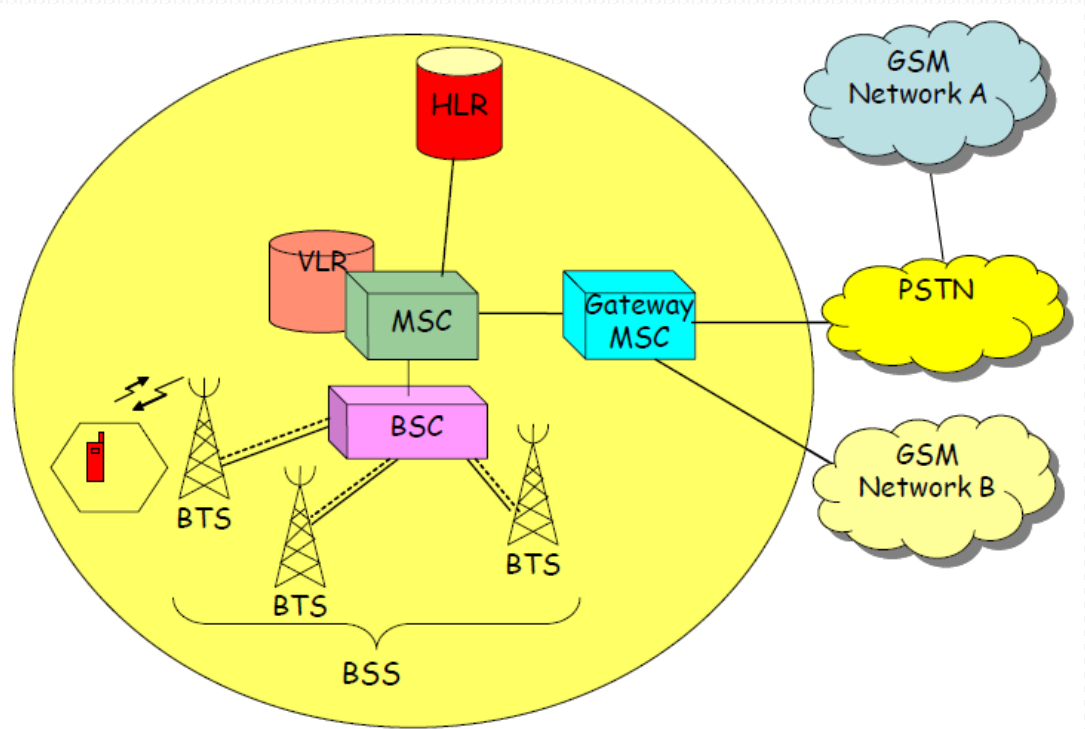
GSM Network Architecture

- Cells Structure
- Base Stations
- Time Slots
- Frequency Re-Usage
- Cell Coverage from 300m to 35km



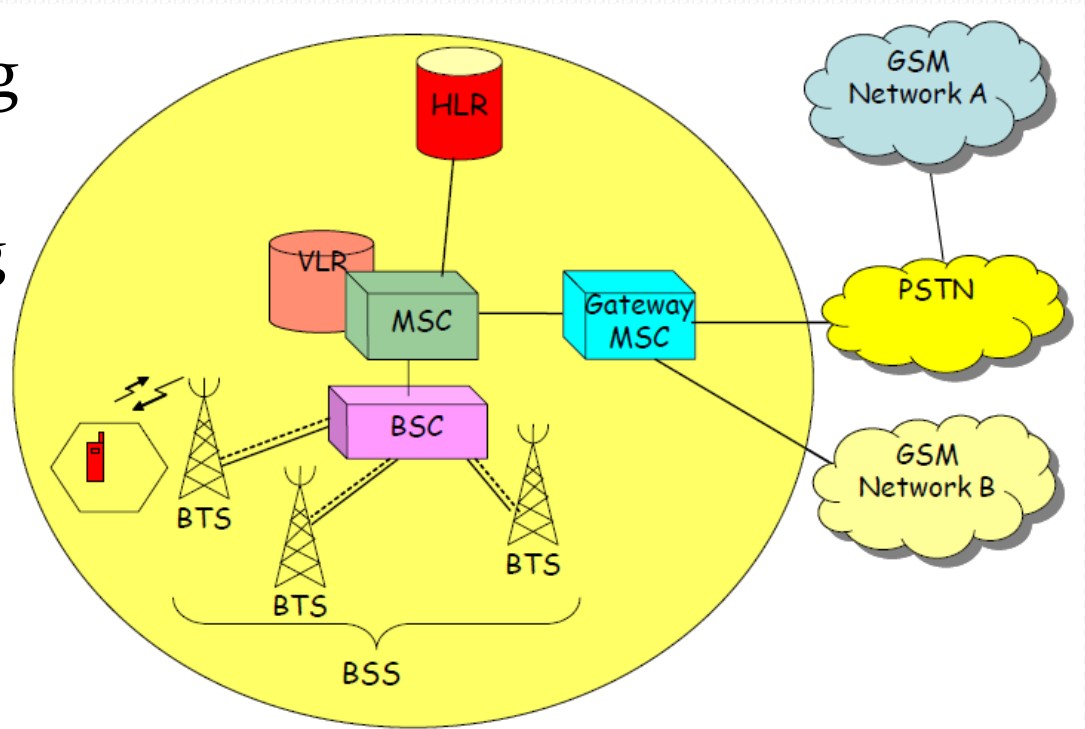
GSM Network Architecture

- Mobile Station
- Base Station System
 - Base Transceiver Station
 - Base Controller Station



GSM Network Architecture

- Network Switching Subsystem
 - Mobile Switching Center
 - Home Locator Register
 - Visitor Locator Register

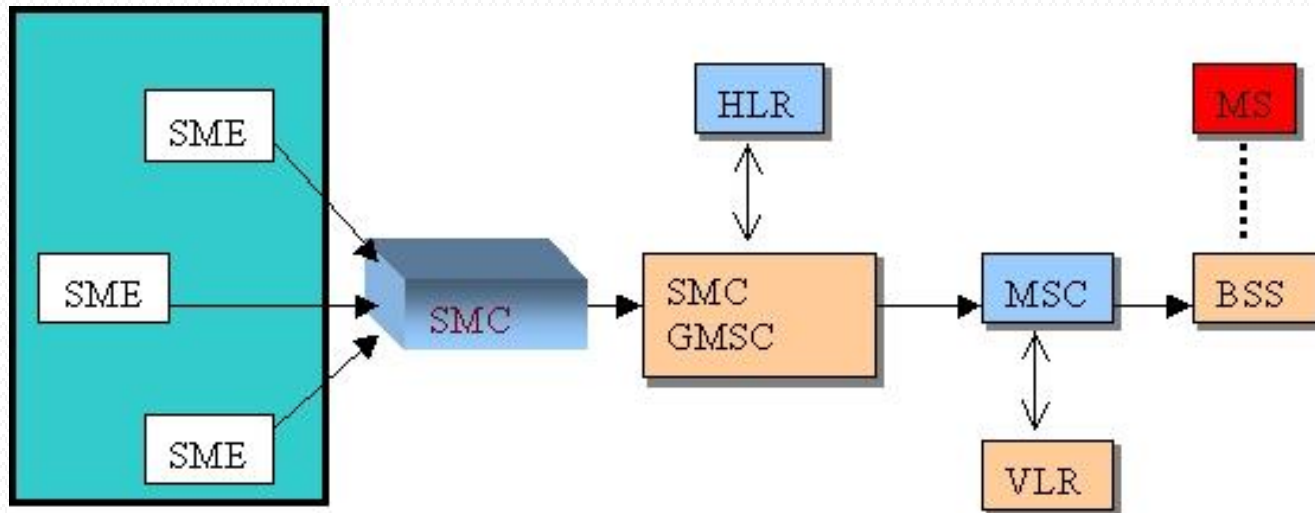


SMS Service

- First used in 1992
- 2.4 billions of SMS message everyday
- 160 characters – 160 bytes
- Low Requirements
- Easy to use, Safe, Low Cost
- Receive References

SMS Service Architecture

- Short Message Center
- SMS Getaway SMC



Equipment

- Wireless CPU Q2687
- Wavecom Development Kit
- 8-1 Multiplexer ST
- Other electronic equipment

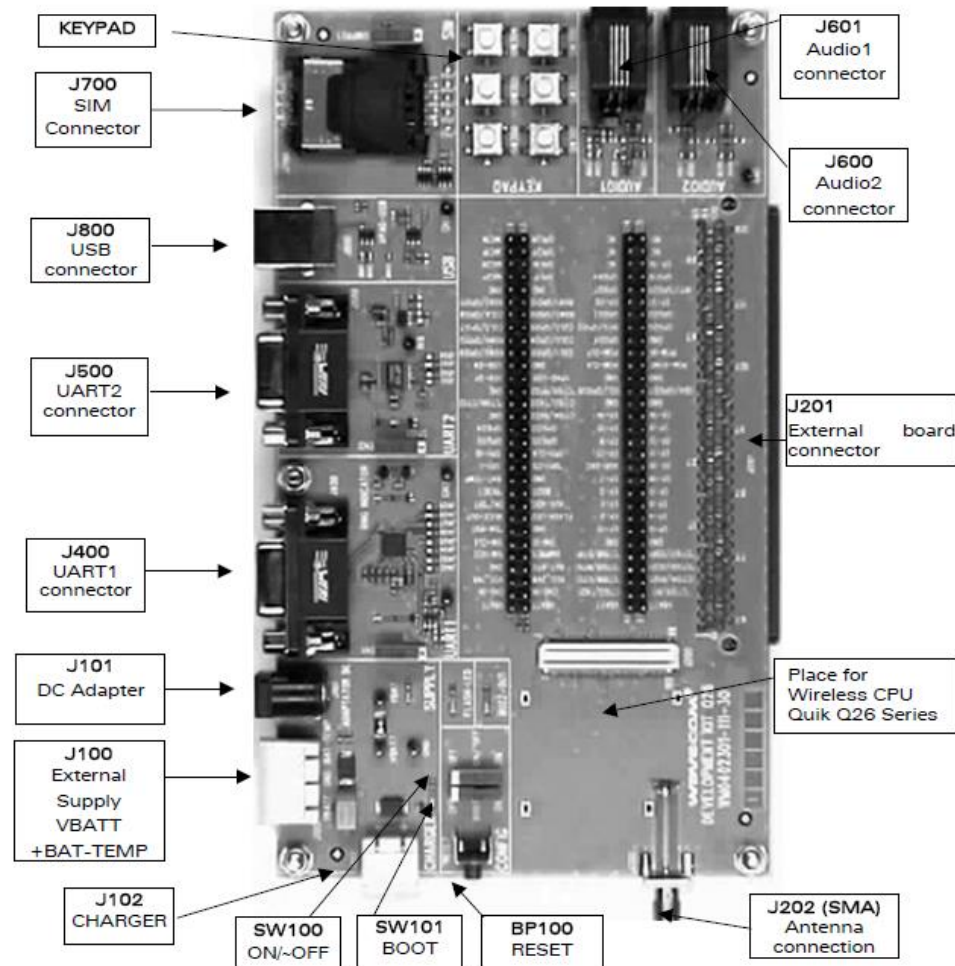


Wavecom Q2687 Wireless CPU

- ARM946 – 32bit – 106MHz
- GSM – GPRS class 10 – EDGE class 10
- 2 ADC - DAC
- 44 GPIOs

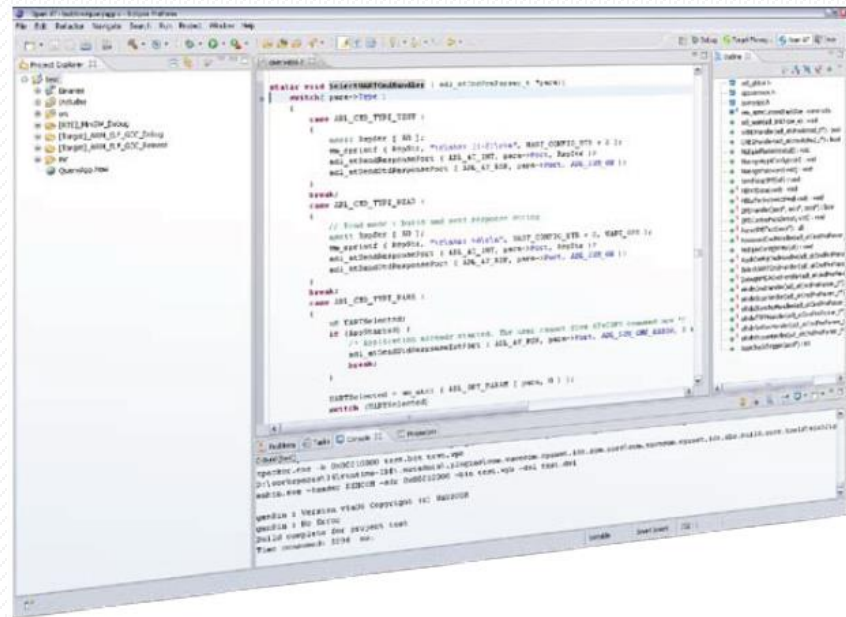


Q26 series WDK



Λογισμικό Open AT

- Wavcom SDK
 - Eclipse
- Open AT OS
 - Multitasking
 - Real-Time
 - Event Programming
 - Varispeed



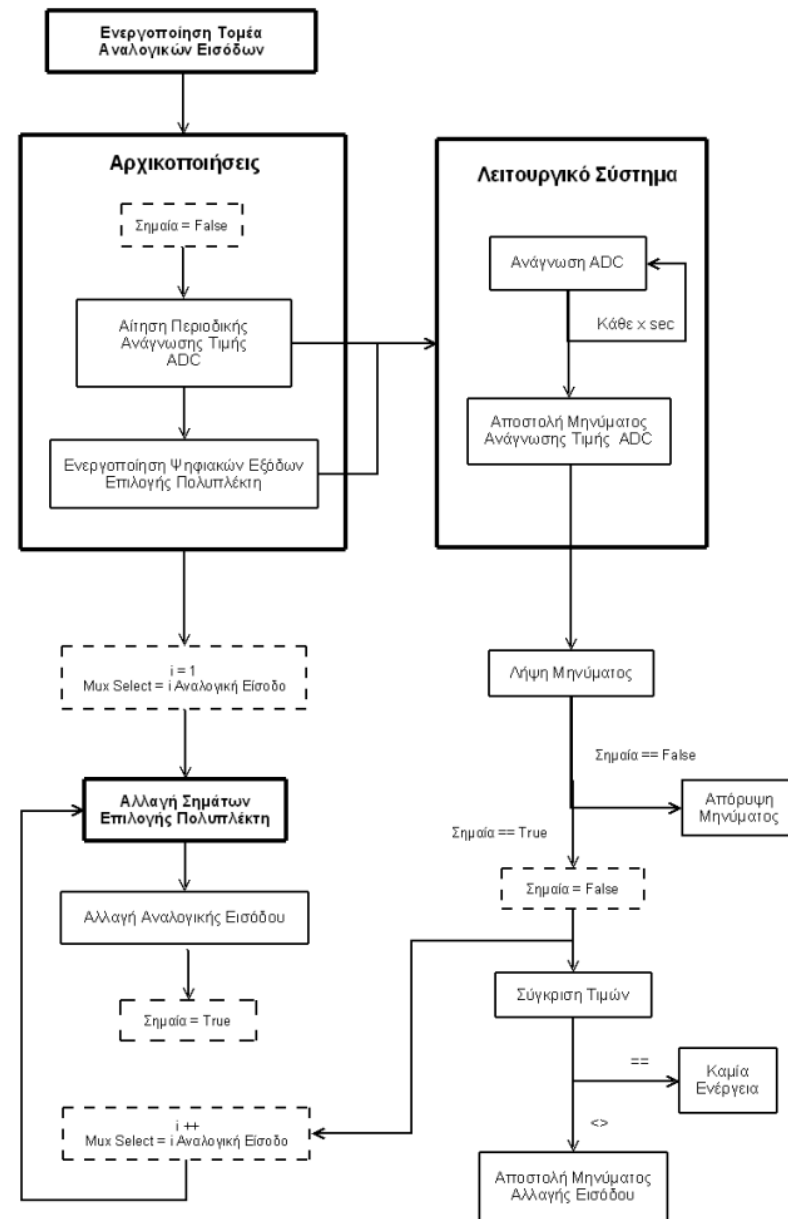
Remote Control Automatic System

- C Programming language
- Wavecom SDK
- Q26 Series WDK & Q2687
- Cosmote GSM Network
- iPhone 2G mobile device

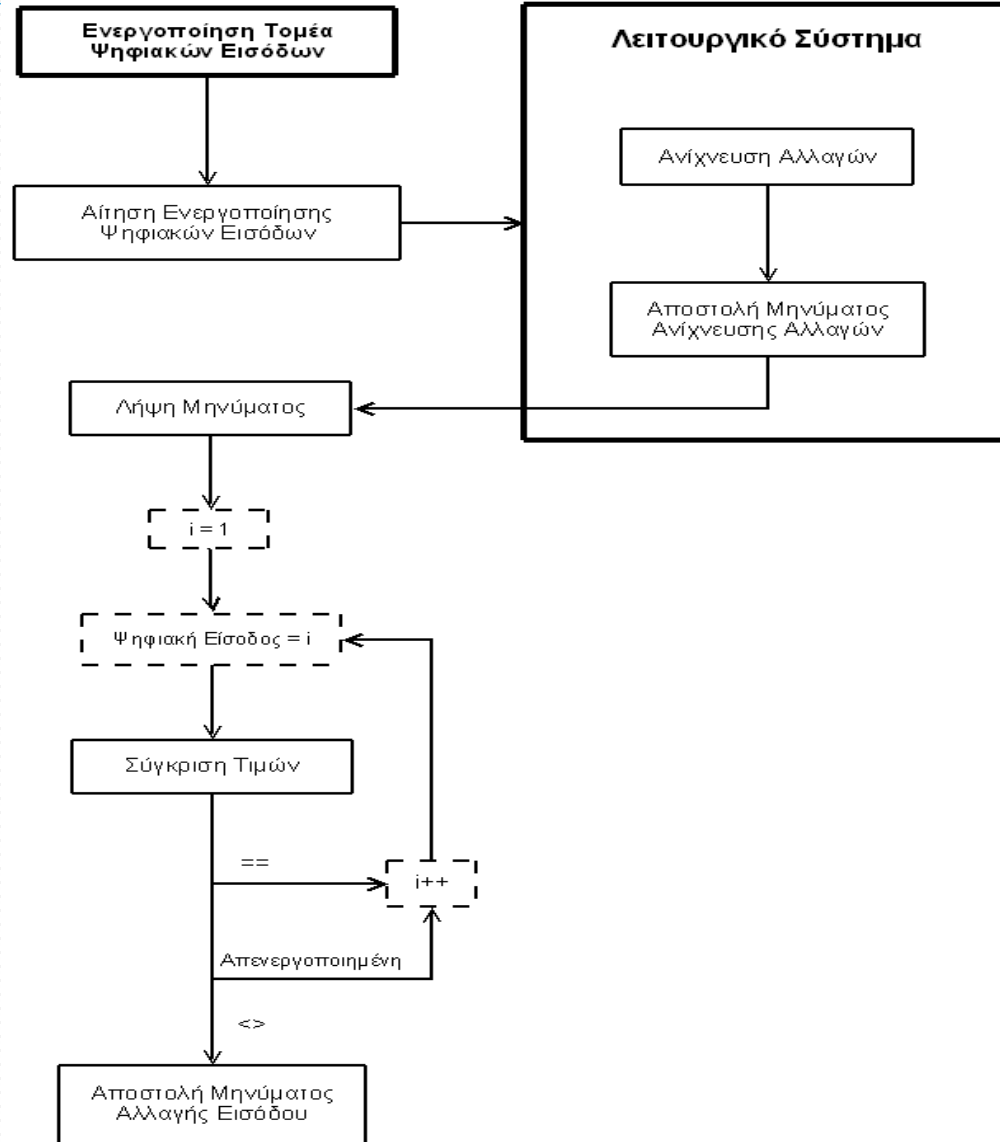
Remote Control Automatic System

- Multiple Sections:
 - Analog Inputs
 - Digital Inputs
 - Outputs
 - SMS
 - Commands
 - Memory

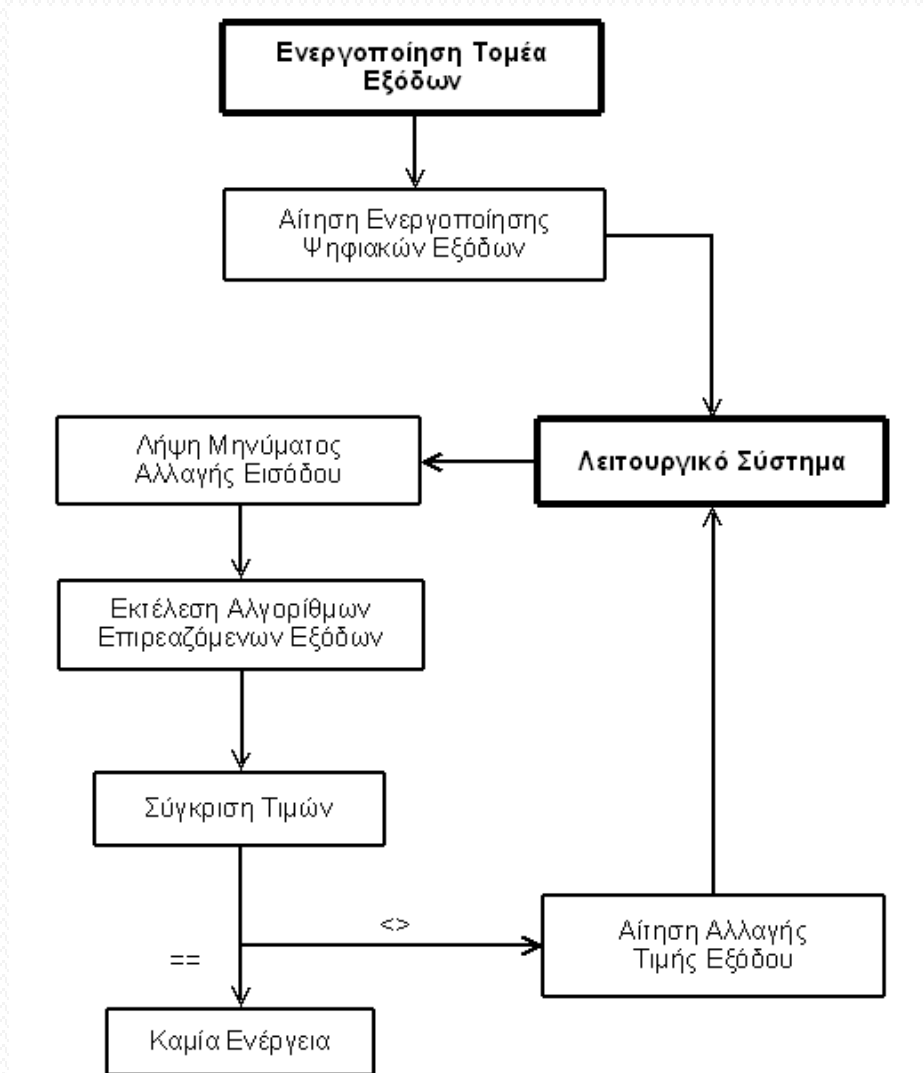
Analog Inputs Section



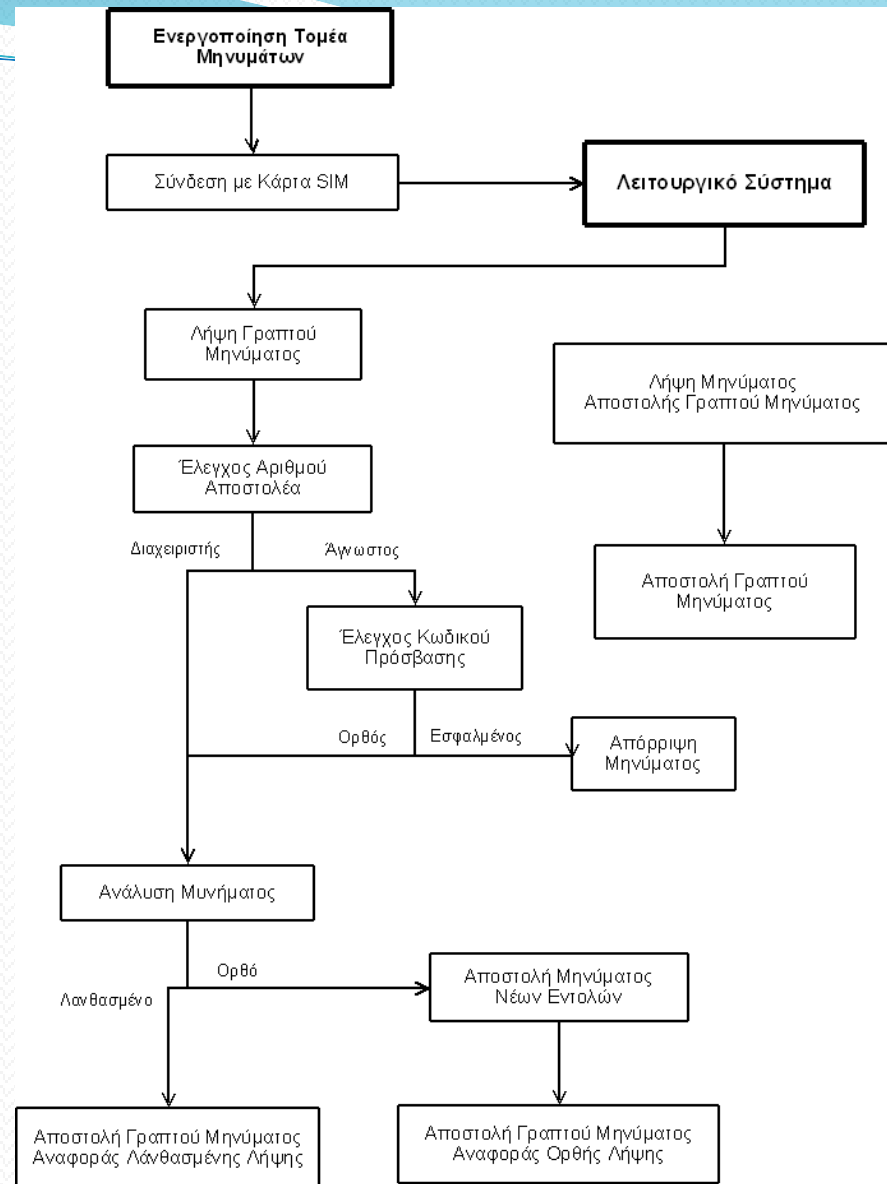
Digital Inputs Section



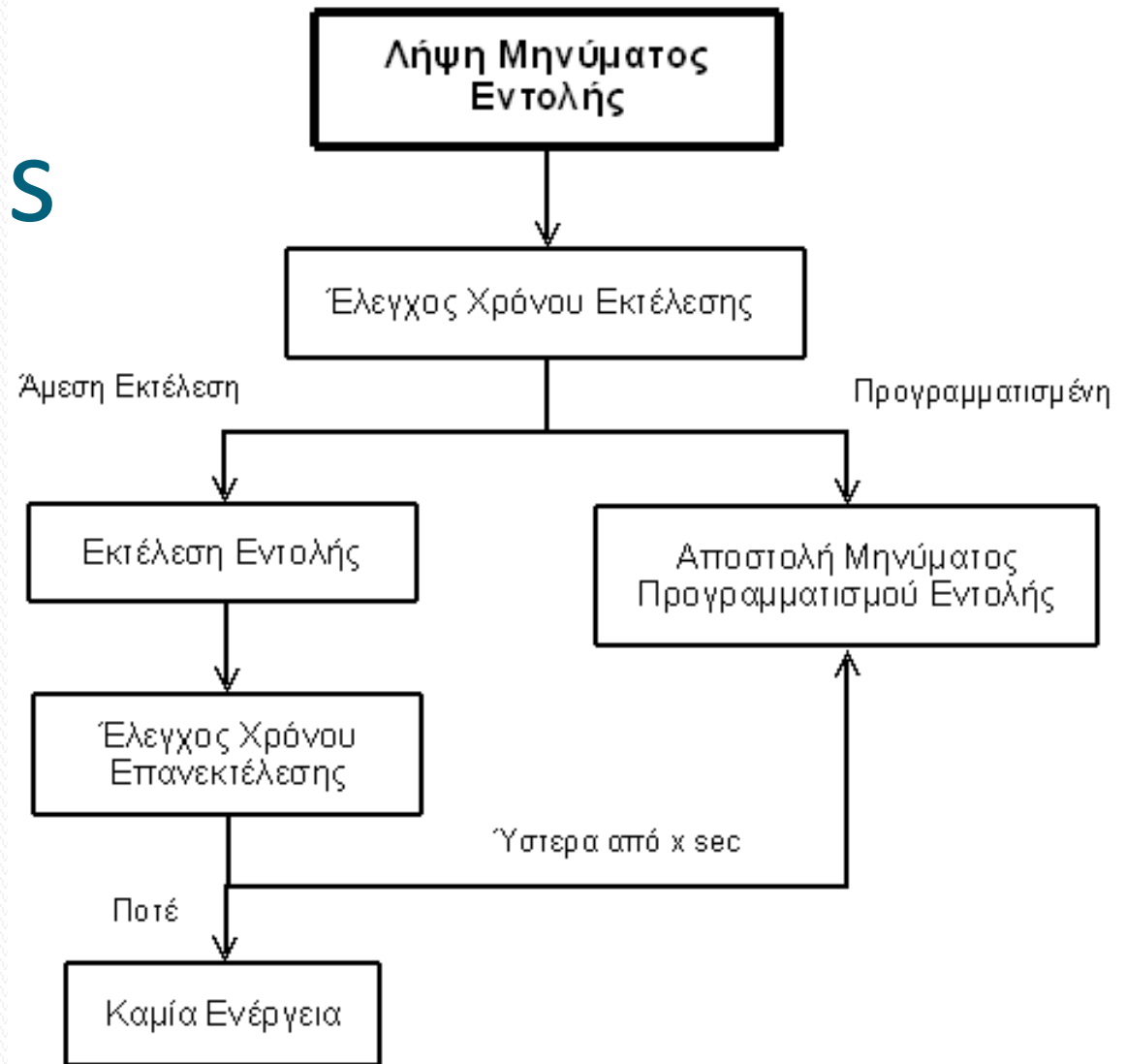
Outputs Section



SMS Section

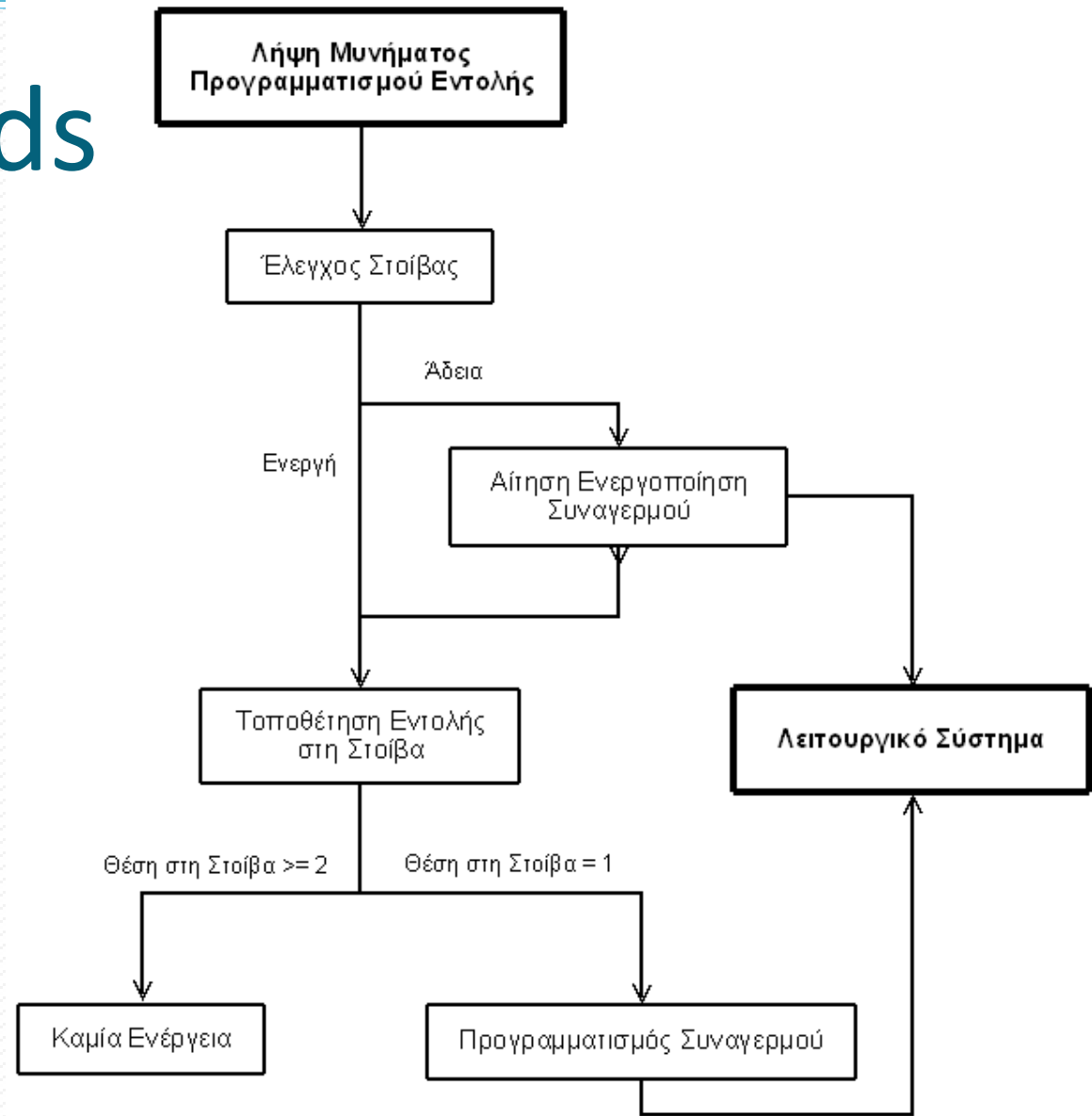


Commands Section



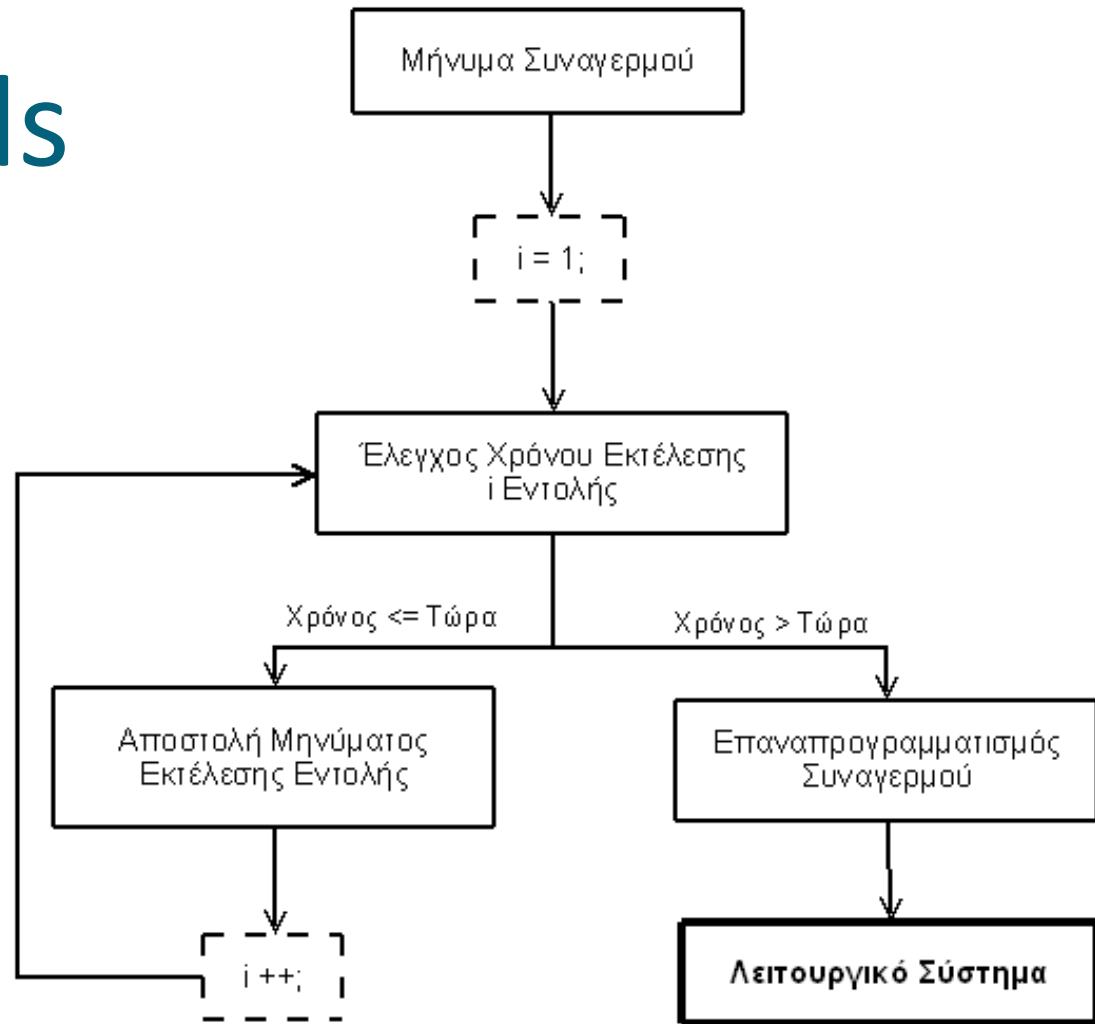
Commands Section

Command Programming

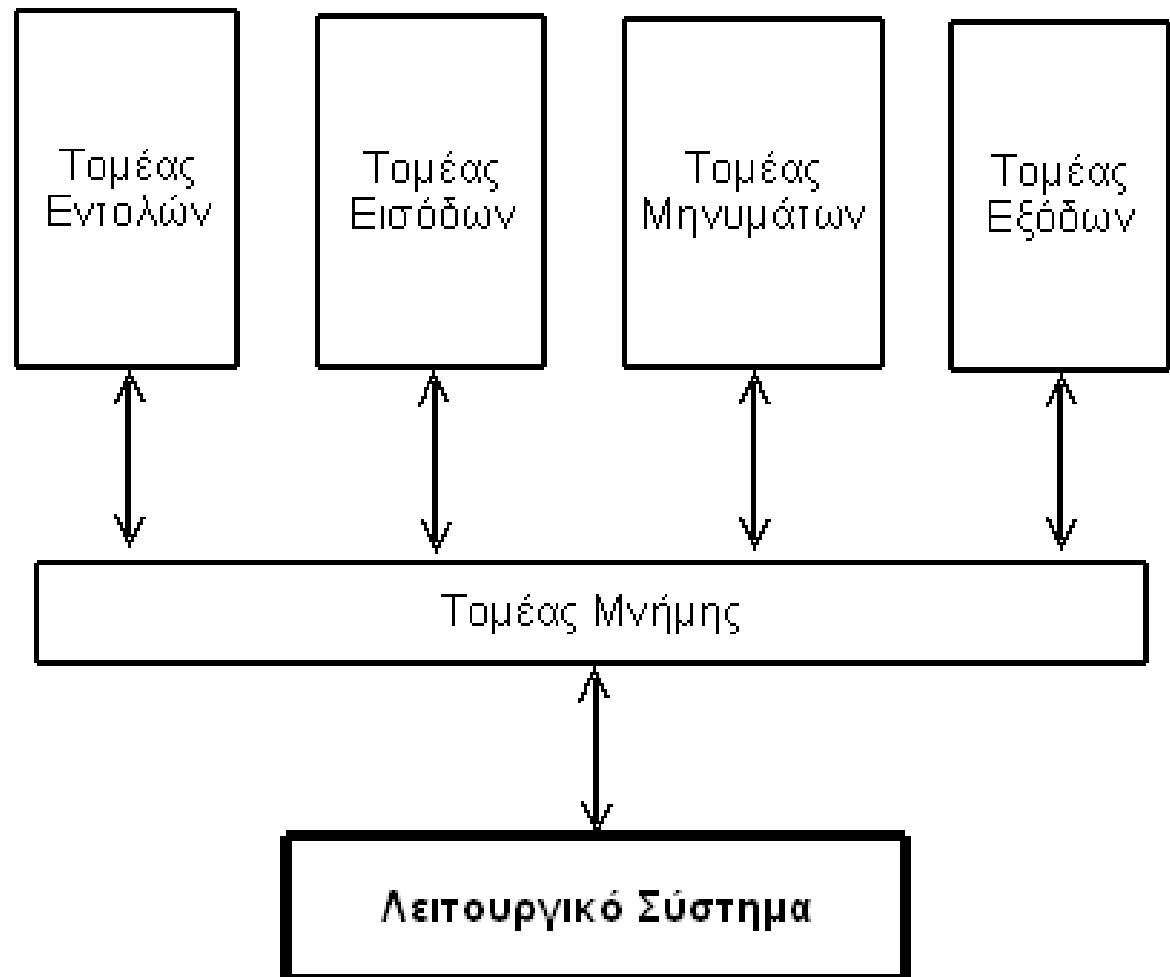


Commands Section

Scheduler



Memory Section




Configuration Application


- PHP programming Language
- Dreamweaver
- Apache Server


- Easy to Use
- Web Interface

Inputs & Outputs Configuration


1^o Step

Digital Input Number : 

Digital Output Number : 

Analog Input Number : 

Multiplexor Select Number : 

User Switches Number : 

Digital Inputs Configuration

2^o Step

Digital Inputs

Digital Input #0

Pin : Gpio 1 ▼

Name :

Enable\Disable : ☒ Enabled ☐ Disabled (Set Value on Disable)

Alert : ☐ On ☒ Off

History :

Digital Input #1

Pin : Gpio 1 ▼

Name :

Enable\Disable : ☒ Enabled ☐ Disabled (Set Value on Disable)

Alert : ☐ On ☒ Off

History :

Analog Inputs Configuration

2^o Step

Analog Inputs

Analog Input #0

Pin : Mux 1 ▼

Name :

Enable\Disable : ☒ Enabled ☐ Disabled (Set Value on Disable)

Alert : ☐ On ☒ Off

History :

Analog Input #1

Pin : Mux 1 ▼

Name :

Enable\Disable : ☒ Enabled ☐ Disabled (Set Value on Disable)

Alert : ☐ On ☒ Off


History :

Digital Outputs Configuration

2^o Step

Digital Outputs

Digital Output #0

Pin : 


Name :

Modes :

Alert : ☐ On ☒ Off

History :

Digital Output #1

Pin : 

Name :

Modes :

Alert : ☐ On ☒ Off

History :

Virtual Inputs Configuration

2^o Step

User Switches

User Switch #0

Name :
Initial Value : (LOW=0, HIGH=1)
History :

User Switch #1

Name :
Initial Value : (LOW=0, HIGH=1)
History :

Multiplexor Configuration

2^o Step

Multiplexor Select Outputs

MuxSel Output #0

Pin : ▼

MuxSel Output #1

Pin : ▼

MuxSel Output #2

Pin : ▼

Outputs Configuration

3^o Step

Digital Output #1 - AirCondition

Mode 1 :

Switch : AirConditionSwitch ☐

Code :

```
if( Temperature > 30 ) AirCondition = HIGH;  
else AirCondition = LOW;
```

Mode 2 :

Switch : AirConditionSwitch ☒

Code :

Conclusions

M2M technology

- A Great Change in Networking and Control Systems
- Great Range of Applications
- Great Perspectives for the future
- Greece is just one step behind

Conclusions

This Thesis:

- Cosmote : Satisfactory
- Wavecom Q2687 : Satisfactory
- Communications: Perfect

Future Extensions

1. More Commands
2. Connection to the Internet
 - Email
 - Web Interface
 - Update through the Internet
 - Multimedia Connection
3. Power Autonomy