“Winds of Aiolos”: How connect the Greek Schools in Internet

N. Adamopoulos, C. Bouras, P. Ganos, D. Karaiskakis, M. Paraskevas

Abstract

In this paper, we present the first Greek School Network, which is implemented by the project "*Winds of Aiolos*”. This project is subsumed in the framework of the European Community Action "Operational Program for the Education and Initial Vocational Training - *Odysseia*". Computer Technology Institute (CTI) has the responsibility for the design and the implementation of the project. On the basis of the influence of the networking technologies to the educational activities and according to the international experience, the usage of the network to the educational procedure acts as knowledgeable object, information source, learning tool and communication tool. The main object of the project is the implementation of a network infrastructure for the interconnection of school laboratories and educational administration offices and the provision of network services in a wide range. It forms a closed educational network, which is based on the Greek educational and research backbone network (GRNET). The Greek school network statistics show that the students prefer the Greek Domain. The educational units of the Greek School Network still act more as consumers than as creators in the information society.

1. Introduction

Current developments in the field of networking technologies in Europe, U.S.A., Canada, Australia and many other countries have a significant effect on the educational procedure (California Department of Education, 1999), (Rothstein, 1996), (Lamont, 1996), (European Schoolnet, 1999). On the basis of the influence of networking technologies on the educational activities and according to the international experience, the usage of the network on the educational procedure (NGfL, 1999), (U.S. Department of Education, 1999), (Cisco, 1998) acts as:

- Information resource of certified pedagogical data (Richardson, 1997)
- Learning tool (Pelgrum, 1992)
- Communication tool (Collis, 1994)
- Knowledge objective (Journal of Interactive Media in Education, 1999)

For the creation of a network, which provides educational services to the schools and on the basis of political, economical and technological criteria, the following choices are offered:

- The usage of an existing backbone network (National & Research Network): The main features of a backbone network are the great number of points of presence in all over the country, which support the geographical dissemination of the educational units as well as the targets’ relevance of the carrier that manages the backbone network.
- The right choice of Internet Service Providers (ISPs) for the access to the Internet as well as for the communication and collaboration between educational units.

The usage of an existing backbone network has the following advantages:

- Usage of a backbone network oriented to research and education, which has distributed nodes in many different regions of the country.
- Central planning and administration developed by the Ministry of Education of every country.
- Quality of Service control of the provided network services and possibility to upgrade the quality of the provided network services whenever is required.

- The exploitation of know-how and infrastructure that have been developed through former actions.
- The use of the advanced network services.
- The formation of a flexible administrative scheme, which can ensure the minimum acceptable Quality of Service level for the education.

The incorporation of Greek Schools in the "*Information Society*" relates with the "Operational Program for the Education and Initial Vocational Training" which is an operational program of the Greek Ministry of Education (Greek Ministry of Education and Religious Affairs, 2000), (Pelgrum, 1992). The Computer Technology Institute implements the action "*Odysseia* - Greek Schools in the Information Society" (Odysseia, 2000), which targets to the utilization of the educational technology in the daily teaching process in a great number of Greek schools. The project "*Winds of Aiolos*" is subsumed in the framework of the action "*Odysseia*" and its main object is the design and implementation of a networking infrastructure for the interconnection of all Greek schools in a private educational network. This network has points of presence (primary nodes) in 29 Greek prefectures. In the first semester of 2000, 362 school laboratories and 30 administrative offices have been interconnected with modern computational equipment. Additionally, this network offers Internet access and basic network services to 1.600 educational units approximately. The total amount of the interconnected units will be increased to 2000 since the end of this year.

In this paper we present the architectural structure, the provided network services and the pedagogical exploitation of the Greek school network, which has been developed by the project "*Winds of Aiolos*". In section 2, issues concerning the design of the network architecture are described. In section 3 the provided basic and advanced network services are presented. In section 4 some statistical data obtained from the network utilization are analyzed. In section 5 the implementation procedure of the Voice over IP service is described. Finally, the conclusions of the network's implementation are mentioned.

2. The Network

2.1 Network Architecture

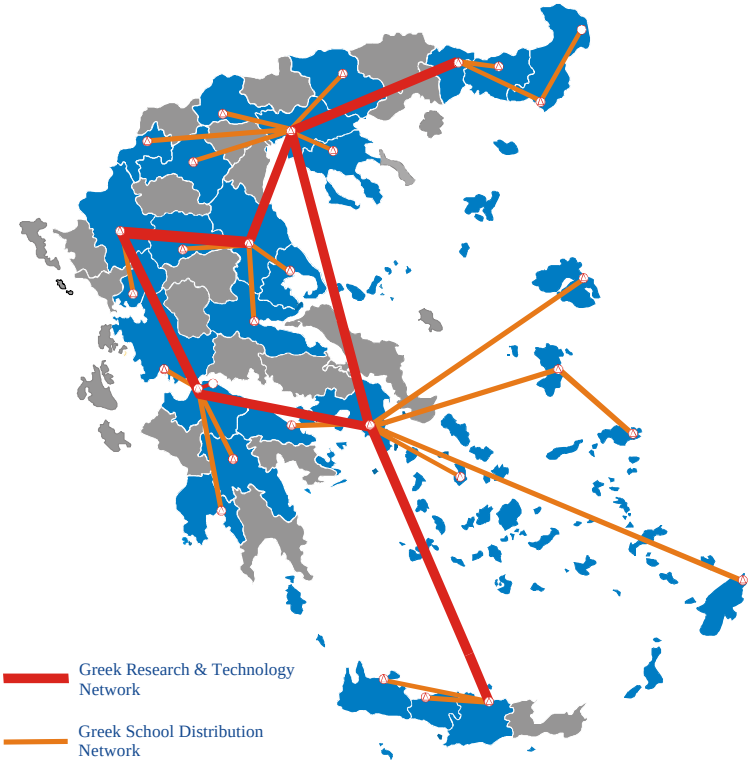
During the network's design some crucial factors were taken into account that affect its implementation and its future development. Special care was given to users' specific needs, the interconnection speed and the basic and advanced services provided to the users of the school network.

For the architectural design of the network the following factors were considered:

- The geographical areas - regions that the network covers.
- Technological issues (available networking technologies, provided applications, expansion possibilities).
- Financial factors (cost of equipment, installation cost of telecommunication circuits, network operating cost, Internet access cost, housing cost in the points of presence, cost for the pilot running, management and operation cost, equipment depreciation and backup system implementation cost).

In Fig. 1 the Greek school network topology is shown. The dark color shows the 29 prefectures where the network has points of presence.

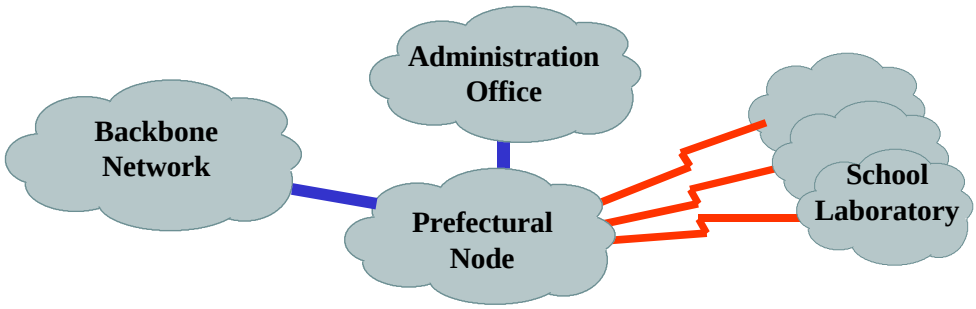
Fig. 1: Map of the Greek School Network



The design model and the operational specifications of the Greek school network are based to the networking technology (Cisco, 1998) that has been developed in the framework of the wide extension of Internet in all over the world and is based on the Internet Protocol family, known as TCP/IP.

The network's topology (Fig. 2) has hierarchical structure and consists of the following levels: Backbone Network, Distribution Network, Access Network and Local Network Units.

Fig. 2: Architecture of the Greek School Network



2.2 Backbone network

The project does not develop a new backbone network but it uses the existing Greek Research & Technology Network (GRNET, 2000) with 6 entrance points and total capacity 8.5 Mbps. The specifications of the backbone network provide the possibility to create an efficient closed educational private network, which ensures Quality of Service (QoS), security and integration in the educational procedures.

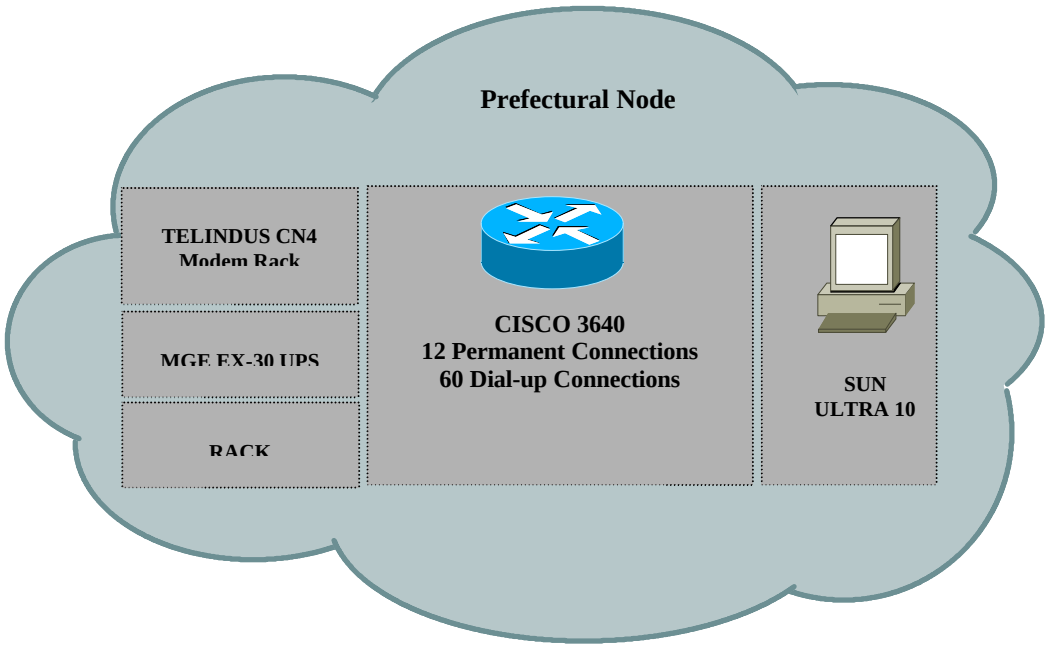
2.3 Distribution network

Distribution network is the part of the network that interconnects points of presence (nodes) with the backbone network. The topology has such design in order to preserve the operational cost in low levels, which is particularly critical in large geographical region networks. These points of presence (nodes) are distinguished in two categories:

- *Regional Nodes*: Points of presence interconnected directly with the corresponding point of presence of the backbone network.
- *Prefectural Nodes*: Points of presence interconnected indirectly with the backbone network through connections with the nearest regional node.

The nodes of the Distribution Network have been located in central installation points of the Hellenic Telecommunications Organization in each prefecture. These nodes have special networking devices (router, etc.) that provide the interconnection of the educational and administration units in the area of each prefecture as well as the interconnection between the nodes (Fig. 3). Each regional and prefectural node includes a server with the appropriate software packages that provide the network services to the users and the administration tools.

Fig. 3: Regional – Prefectural Node



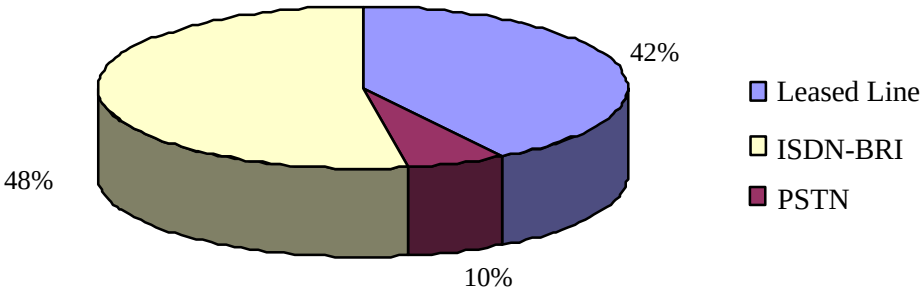
2.4 Access Network

The Access Network is the part of the network, which interconnects educational and administrative units with the nearest points of presence. The types of interconnections listed with decreasing order of the usage frequency, are:

- Digital interconnections using ISDN-BRI lines at the ends of the units (64 Kbps - 128 Kbps) and ISDN-PRI lines at the ends of the nodes.
- Leased interconnections using analog leased lines, 128 Kbps – 1.1 Mbps.
- Analog telephone interconnections using common PSTN circuits (56 Kbps transmission – 33.6 Kbps reception).

In Fig. 4 the proportion among ISDN lines, analog leased lines and common PSTN circuits in the Greek School Network is shown.

Fig. 4: Circuit types of the Access Network



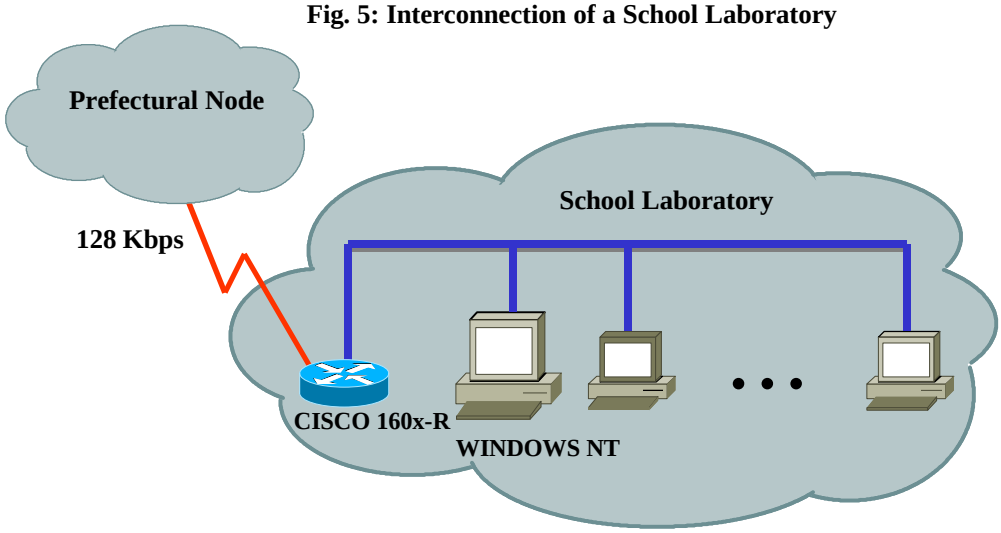
Two particular features of the Access Network, that give special significance to the Greek School Network related to other networks of commercial ISPs, are the following:

- In every educational or administrative unit corresponds a dedicated telecommunication circuit and port in the active network equipment, in order to ensure the availability of the network services.
- Even for the cases of non-permanent interconnections the initiation of the communication can be performed either from the side of the units or from the side of the node. By this way the network does not terminate in the points of presence but reaches inside the units.

2.5 Local Network

In school laboratories, computing devices and networking equipment (Fig. 5) are installed.

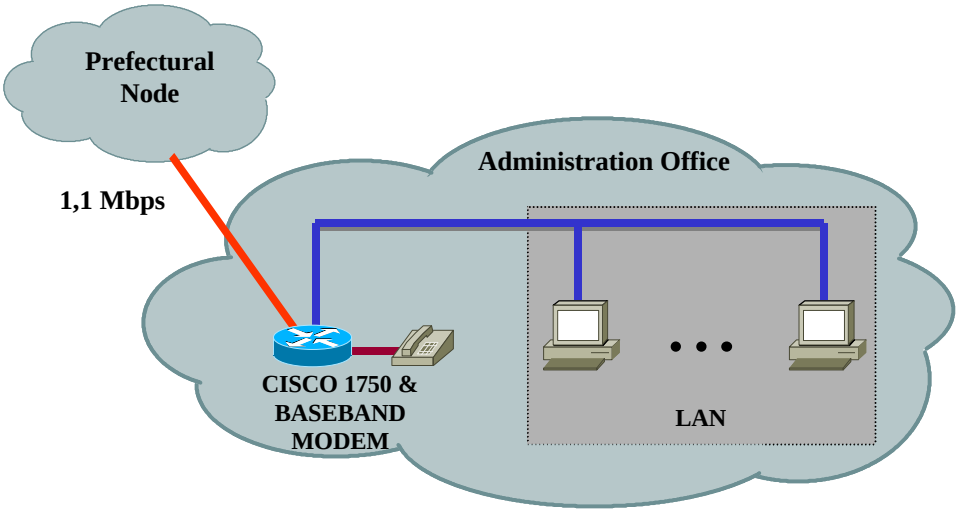
Fig. 5: Interconnection of a School Laboratory



This modern equipment (installed by project "*Mnistires*") consists of a powerful server (with operating system Windows NT Server), approximately 10 multimedia stations (with operating system Windows 98), a color printer, a UPS unit and a backup unit (DAT). The local network of the school laboratory is realized by an Ethernet Hub (10BaseT). The networking equipment consists of one router (CISCO 160x-R) and in some schools (according to the telecommunication circuit) one Baseband modem.

The Secondary Education Administration Offices use more powerful networking equipment and interconnect through a high-speed line of 1,152 Kbps (Fig. 6). This equipment provides besides the basic network services, the possibility of voice transmission through the school network.

Fig. 6: Interconnection of an Administration Office



2.6 Schools interconnection with dialup lines

In the area of each point of presence of the network (29 prefectures) the schools of an area may be connected to the school network via a dialup line. Each school may have access to the network services like e-mail (one or more accounts), access to the Internet, web hosting etc. The minimum required equipment is a PC, a modem and a PSTN or ISDN line. In this case the school is responsible for the telecommunication charges.

3. Network Services

3.1 Bearer services

Bearer services are defined (Bouras [13], 1997) as the set of minimum services among the different operational levels of the network and constitute the basic frame of the network. These services include:

- Addressing scheme and routing plan
- Directory Name Service scheme

3.2 Basic services

The basic services offered by the network to the Greek schools (Bouras [14], 1998) are the following:

- *E-mail*: Transmission and reception of electronic messages with attached file of every type. The network provides the possibility of unlimited number of accounts in each school laboratory.
- *World Wide Web (www)*: The users can explore the Internet resources through web browsers. Also the network supports web hosting for its users in the prefectural nodes.
- *Telnet*: Access to a remote host.
- *File Transfer Protocol - FTP*: Transfer of files from an FTP server to the users' PC.

- *Electronic Discussion Forums*: Communication (live conversation or message exchange) among members of an educational group.
- *Directory Services*: Access to indexes related with personal information, e-mail addresses, file information, etc.
- *Web filtering*: Exclusion of access to particular sites (like sites with indecent material).
- *Caching Proxy Service*: Information exchange between school network servers and GRNET servers in order to improve the network's operation.

3.3 Advanced Services

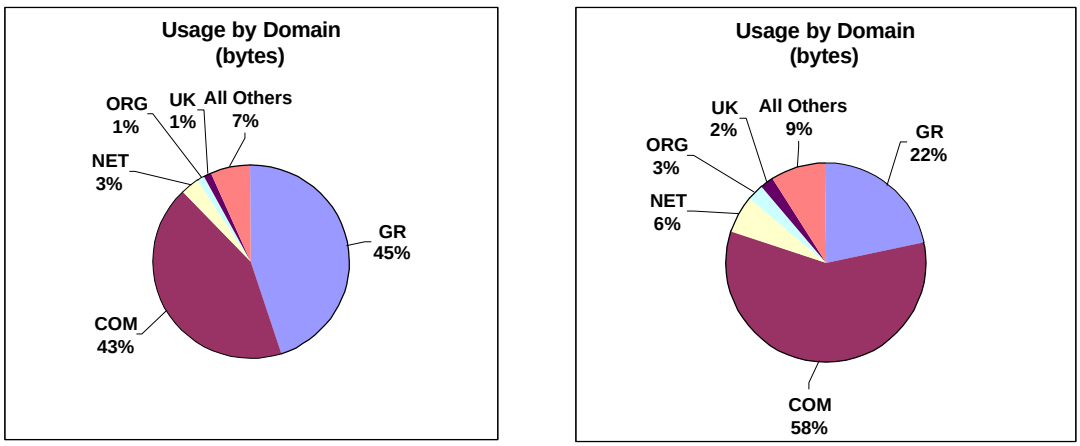
The advanced services (Furht [18], 1996), (Furht [19], 1996), (Bouras [20], 1997) that will be offered to the school network users very soon, are the following:

- Teleconference
- Asynchronous Open Distance Learning
- Synchronous Open Distance Learning
- Video on Demand - VoD
- Voice over IP

4. Statistical data

In this section we present some statistical data concerning the network's operation and the users' behavior during the last four months. A special qualitative characteristic of network traffic is the distribution of the incoming traffic to the units of the network. As is shown in Fig. 7, the traffic coming from Greek domains is 45% of the total incoming traffic, while according to GRNET statistical data, the corresponding percentage concerning the Higher Level Education is calculated to 22%.

Fig. 7: Users' behavior in the secondary and higher level education

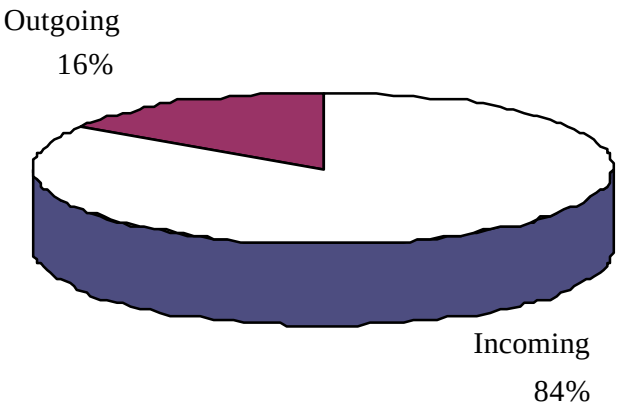


Secondary Level Education

Higher Level Education

In Fig. 8 the proportion between the incoming and outgoing network traffic is presented. It is observed that the incoming traffic is the 84% of the total traffic, while the outgoing one occupies only the 16%. That means that the educational and administrative units of the Greek School network still act more as consumers than as creators in the information society.

Fig. 8: Proportion of incoming and outgoing network traffic



In Table 1, the 20 most popular Internet sites accessed by network's users are presented with descending order, according to the requested numbers of visits. One or more visits of a person to a web page with difference time lower than 30 minutes are considered as one visit. These data were collected from all the network nodes and were processed by the data given by the Web/Proxy Service.

Table 1: The most popular Internet Sites according to the number of visits

Web Site	**Number of Visits**	**Data (Bytes)**	**Percentage**
www.microsoft.com	351.662	674.953.52	6,3%
www.in.gr	294.733	1.498.621.1	5,3%
Odysseia.cti.gr	266.869	280.188.72	4,8%
ad.doubleclick.net	90.981	75.295.679	1,6%
www.megatv.gr	81.483	127.495.95	1,5%
www.megatv.com	80.606	124.361.39	1,4%
www.sport.gr	78.424	157.872.82	1,4%
find.in.gr	70.403	125.761.06	1,3%
www.jokes.gr	58.585	209.650.52	1,1%
www.culture.gr	57.707	249.415.55	1,0%
www.mtnsms.com	49.776	92.222.699	0,9%
arktos.cti.gr	43.274	572.879.98	0,8%
www.olympiakos.gr	41.722	219.341.56	0,7%
www.ypepth.gr	41.673	136.536.71	0,7%
stocks.naftemporiki.gr	40.623	281.529.47	0,7%
www.geocities.com	36.166	290.499.47	0,6%
m.doubleclick.net	31.844	160.801.81	0,6%
www.antenna.gr	31.059	100.468.30	0,6%
www.ferrari.com	30.748	130.084.84	0,6%
www.playstation-europe.com	29.967	145.008.81	0,5%

5. Voice Over IP - VoIP

In this section the design of the Voice Over IP (VoIP) service provided to the Greek School Network is presented. This service provides telephone services to a closed user group (30 administration offices) and is a part of the biggest VoIP networks in Greece and virtually the first attempt for the provision of differentiated services over the GRNET to an IP level.

The implementation of the voice network is based on VoIP Gateways installed to each prefecture and each administration office. The network is managed centrally by the use of a Gatekeeper, which has been installed in one node of the network. According to the proposed by the H.323 standard topology, zones are created and served by the corresponding Gateways. Every prefecture corresponds in one zone and the corresponding gateway serves all the calls from and towards this zone. All the Gateways refer to the Gatekeeper, which maintains the routing table of all calls within the network.
The adoption of the H.323 standard allows the realization of calls from and towards the workstations within the network. The workstations perform calls to telephone devices in the Gateways. The H.323 network constitutes a domain, which has followed the same naming scheme (sch.gr) with the existing DNS for compatibility reasons.

6. Conclusions

The project "Winds of Aiolos" establishes a network environment which:

- Supports, develops and renews the learning process in secondary education.
- Offers teaching and learning through communication and collaboration.
- Allows flexible information search related to the educational procedure.
- Gives the possibility among people geographically distributed to exchange information and aspects.

For publicity and information reasons a web page (http://ww.sch.gr) has been created. This web page is acquainted very often, contains technologically innovative material, accepts a great number of visitors every day and aspires to become the most popular Greek educational portal.

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About the Authors

N. Adamopoulos, Computer Technology Institute, adamopou@cti.gr
P. Ganos, Computer Technology Institute, ganos@cti.gr
D. Karaiskakis, Computer Technology Institute, karaisk@cti.gr
M. Paraskevas, Computer Technology Institute, mparask@cti.gr

Dr. Christos Bouras, Assistant Professor
Department of Computer Engineering and Informatics, University of Patras
and Computer Technology Institute
GR-26500 Rio, PATRA, GREECE
Tel: +30-61-960375, +30-61-996314
Fax: +30-61-996314
E-mail: bouras@cti.gr
http://ru6.cti.gr