SEVENTH FRAMEWORK PROGRAMME

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TELECOM-Bretagne / Kevin Heggarty

Abstract:

This deliverable describes organization end execution of the BONE – TIGER II Summer School, September 6-7, 2010 and the BONE Master School, September 8-10, both taking place at the BME (Budapest University of Technology and Economics) Budapest, Hungary. Attendee statistics are also briefly reported.

Keyword list:
Education, Master study, photonics, switching, packet, buffer, Cross-Connect, performance,
Transport, optical core, energy-efficiency, http://www.tmit.bme.hu/bone-summer-program

Clarification:

Nature of the Deliverable

R	Report
P	Prototype
D	Demonstrator
O	Other

Dissemination level of Deliverable:

PU	Public
PP	Restricted to other programme participants (including the Commission Services)
RE	Restricted to a group specified by the consortium (including the Commission Services)
CO	Confidential, only for members of the consortium (including the Commission Services)

Disclaimer

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1. Executive Summary :

Workpackage WP02 of NoE BONE has organised four events in the period of September 6-10, 2010 in Budapest:

- BONE-TIGER2 Summer School 2010, September 6-7 (http://www.tmit.bme.hu/bone-summer-program)
    - BONE-TIGER2 Participant Workshop (Student Presentations in 3 Sections, as a part of the Summer School)
- BONE Master School 2010, September 8-10, (http://www.tmit.bme.hu/bone-master-program)
- WP02 Meeting, September 8, 16:30

All these events took place at the premises of the BME (Partner 24), the Budapest University of Technology and Economics, Magyar tudósok körútja 2, H-1117 Budapest, Hungary.

The total number of participants was 78, where 12 participants attended the Summer School only, while 3 participants attended the Master School only. 27 different institutions were represented from 16 different countries.

The BONE-TIGER2 **Summer School** (September 6-7) was devoted to the theme of Designing a National Backbone Network. This theme is closely linked to practically all WPs of the NoE BONE.

This was a joint event of the NoE BONE and of the CELTIC TIGER II projects. The homepage of the CELTIC TIGER II ("Togehter IP, GMPLS and Ethernet Reconsidered – II") project is available at: http://www.celtic-initiative.org/Projects/Celtic-projects/Call5/TIGER-II/tiger2-default.asp.

There were 5 tutorials, 90 minutes each. Four were from Industrial partners (two major network and service operators, one major vendor and one SME), and one from the academia.

There was also opportunity given to the PhD students and researchers attending the tutorials to present their new results in their own related research areas in oral sessions. There were three such oral sessions with a total of 20 presentations.

The Summer School (September 6-7) was attended by a total of 75 participants (including the speakers).

The BONE **Master School** (September 8-10) was devoted to the curriculum on "Photonics in Switching", where the emphasis was on emerging switching techniques and technologies for optical networks, including both photonic circuit switching and packet switching. The objectives of reducing power requirements of optical networks has also been discussed as well as buffering and scheduling approaches as well as traffic performance evaluations.

The Master school was ended with a 90-minute lab-work.

All presentations have been recorded and are available for streaming, i.e., for offline teaching.

There was a total of 8 courses and one laboratory training, all lasting for 90 minutes. These courses were given by the BONE colleagues that have prepared the teaching material for the "Photonics in Switching" curriculum, except one, that was given by our distinguished guest from NICT, Japan. NICT is associated/external member of NoE BONE.

The Master School (September 8-10) was attended by a total of 66 participants (including the speakers).

2. BONE Schools 2010 Organizing Committees

2.1 *Summer School 2010 Committee*

Since this Summer School was a joint event of NoE BONE and CELTIC TIGER II projects, the composition of the Program Committee reflected this. Five BONE and three TIGER II members were involved. Five from academia, three from industry:

- Branko Mikac, WP02 leader, FER, Croatia (BONE)
- Juan Pedro Fernandez-Palacios Gimez, Telefonica , Spain, (Celtic Tiger2)
- Josep Sole-Pareta, UPC, Spain (BONE)
- Kevin Heggarty, WP02 co-leader, TELECOM-Bretagne, France (BONE)
- Maliosz Markosz, BME, Hungary (Celtic Tiger2)
- Szilárd Zsigmond, BME, Hungary (BONE)
- Tibor Cinkler, BME, Hungary (BONE)
- Varga Pál, AITIA, Hungary, (Celtic Tiger2)

2.2 *Master School 2010 Committee*

Mostly academic people of BONE constituted the Master School Committee:

- Branko Mikac, WP02 leader, FER, Croatia
- Carla Raffaelli, UNIBO Italy
- Kevin Heggarty, WP02 co-leader, TELECOM-Bretagne, France
- Lena Wosinska, KTH, Sweden
- Szilárd Zsigmond, BME, Hungary
- Tibor Cinkler, BME, Hungary

2.3 Local Organizing Committee:

Scientists and administrative staff from BME took care of local organising issues for the Schools:

- Attila Vidács
- Csaba Simon
- Markosz Maliosz
- Robert Szabó
- Anita Szendrei
- Szilárd Zsigmond
- Tibor Cinkler

3. Summer School

3.1 Overview of the Summer School

The BONE-TIGER2 **Summer School** (September 6-7) was devoted to the theme of Designing a National Backbone Network. This theme is closely linked to practically all WPs of the NoE BONE.

This was a joint event of the NoE BONE and of the CELTIC TIGER II projects. The homepage of the CELTIC TIGER II ("Togehter IP, GMPLS and Ethernet Reconsidered – II") project is available at: http://www.celtic-initiative.org/Projects/Celtic-projects/Call5/TIGER-II/tiger2-default.asp.

The main goal of this Summer School was to gain knowledge on this area, to disseminate knowledge of the NoE BONE, to have co-operation with the CELTIC TIGER II project, to give opportunity to PhD students and researchers to present their newest results.

There were 5 tutorials, 90 minutes each. Four were from Industrial partners (two major network and service operators, one major vendor and one SME), and one from the academia.

- **Challenges in developing and planning of a national and international optical core network Emil Babics** - Magyar Telekom, Hungary [Slides]
- **Innovative IP over Optical Architectures for Future Transport Networks Laurent Ciavaglia** - Alcatel-Lucent Bell Labs France [Slides]
- **Traffic Analysis Results in Control Mechanisms of High Speed Networks** - Pál Varga - AITIA, Hungary [Slides]
- **Migration steps towards future end to end transport networks** - Juan Fernández-Palacios - Telefonica, Spain [Slides]
- **Environmental Implications of Energy-Efficient Global Communication Networks** - Slavisa Aleksic - Vienna University of Technology, Austria [Slides]

All the presentation slides are available in pdf format at the BONE homepage http://www.ict-bone.eu/portal/faces/public/BONE/ecatwiki, or directly, just by clicking the links above. The abstracts and CVs of presenters are available in the Proceedings of Summer School 2010.

There was also opportunity given to the PhD students and researchers attending the tutorials to present their new results in their own related research areas in oral sessions. There were three such oral sessions with a total of 20 accepted presentations. All submitted papers were briefly reviewed by Members of Committee.

The Summer School (September 6-7) was attended by a total of 75participants.

The program of the Summer School is available at the server of the School organisers: http://www.tmit.bme.hu/bone-summer-program .

3.2 Schedule of the Summer School

The program along with the schedule of the Summer School is available at the server of the School organisers: http://www.tmit.bme.hu/bone-summer-program .

	6ummer 6chool		Master 6chool		
	06. Monday	07. Tuesday	08. Wednesday	09. Thursday	10. Firday
9:00:00-9:30:00	Welcome	Traffic Analysis Results in Control Mechanisms of High 6peed Networks -Pál Varga-		Power consumption issues in optical networks -6lavisa Aleksic-	Optical Cross-connect (OXC) architectures and related technologies -Guido Maier-
9:30:00-10:00:00	Challenges in developing and planning of a national and international optical core network -Emil Babibcs-				
10:00:00-10:30:00					
10:30:00-11:00:00		Cofee break	Cofee break	Cofee break	Cofee break
11:00:00-11:30:00	Cofee break	Migration steps towards future end to end transport networks Juan Fernández-Palacios-	Welcome	Buffer-less switch architectures -Michele 6avi-	Traffic performance and simulations -Michele 6avi-
11:30:00-12:00:00	Innovative IP over Optical Architectures for Future Transport Networks -Laurent Ciavaglia-		Introduction to Photonics in 6witching Lena Wosinska, KTH		
12:00:00-12:30:00					
12:30:00-13:00:00		Lunch Break		Lunch Break	Lunch Break
13:00:00-13:30:00	Lunch Break		Lunch Break		
13:30:00-14:00:00					
14:00:00-14:30:00		Environmental Implications of Energy-Efficient Global Communication Networks -6lavisa Aleksic-		Optical buffer architectures -Franco Callegati-	Traffic performance and simulations -Michele 6avi-
14:30:00-15:00:00	Presentation of papers by school participants 1		NICT Naoya Wada		
15:00:00-15:30:00					
15:30:00-16:00:00		Cofee break		Cofee break	Colsing Words
16:00:00-16:30:00	Cofee break	Presentation of papers by school participants 3	Cofee break	6cheduling algorithms -Wojciech Kabacinski-	
16:30:00-17:00:00	Presentation of papers by school participants 2		WP meetings		
17:00:00-17:30:00					
17:30:00-18:00:00					
18:00:00-18:30:00					
18:30:00-19:00:00					
19:00:00-19:30:00	6ocial program Zold Pardon	6ightseeing tour		Gala dinner	
19:30:00-20:00:00					
20:00:00-20:30:00			6zéchenyi Thermal Bath		
20:30:00-21:00:00					

As shown, not only the coffee breaks and lunches were spent together, but also there were less formal social events every evening to spend more time all together in order to improve social aspects as well as to facilitate further, less formal technical discussions among participants.

3.3 Lectures of the Summer School

Five tutorials were proposed to the BONE Summer school attendees on subjects related to the theme 'Designing a National Backbone Network'.

The content of each tutorial, as well as the lecturer biography, are detailed below. These can be found in the Proceedings of Summer School 2010, as well as at the School Homepage at http://www.tmit.bme.hu/bone-summer-program. The pdf of all slides of all presentations is available at http://www.ict-bone.eu/portal/faces/public/BONE/ecatwiki.

Summer School: Invited Speakers:

1. Challenges in developing and planning of a national and international optical core network (Emil Babics, Magyar Telekom, Hungary)
2. Innovative IP over Optical Architectures for Future Transport Networks (Laurent Ciavaglia, Alcatel-Lucent Bell Labs, France)
3. Utilizing Traffic Analysis Results in Control Mechanisms of High Speed Networks(Pál Varga, AITIA, Hungary)
4. Migration steps towards future end to end transport networks (Juan Fernández-Palacios, Telefonica, Spain)
5. Environmental Implications of Energy-Efficient Global Communication Networks (Slavisa Aleksic, Vienna University of Technology, Austria)

1. Challenges in developing and planning of a national and international optical core network (Emil Babics – Magyar Telekom, Hungary)

Summary:

Nowadays a real nationwide WDM network must be suit for diverse expectations: large channel capacity and channel speed, flexibility in the nodes, high reliability, increasing co-operation with the upper network layers, more intelligence in the control and routing etc., and one of the most important expectations is the low cost. This "conflict" (best and newest solutions from the technical side and low cost from the financial side) requires special new and unique solutions in the live network.
This presentation summarizes the current status of a service provider's DWDM network, and describes the challenges of daily work and midterm developments via the special solutions (multivendor network, lambda level co-operation etc.).

Emil Babics received the M.Sc. degree in Electrical Engineering from the Budapest University of Technology and Economics (BME), Hungary, in 2004. He works as a development manager at the Department of Transport Network Development of Magyar Telekom, and he is an attendee of the R&D specialist engineer faculty of BME. His speciality is the optical network planning and modelling focusing on WDM technology.

2. Innovative IP over Optical Architectures for Future Transport Networks (Laurent Ciavaglia – Alcatel-Lucent Bell Labs France)

Summary:

Innovative IP over Optical Architectures for Future Transport Networks deals with introduction of new networking solutions in the metropolitan and core networks areas. This presentation will go through the different stages from the requirements analysis, architecture design and principles, to the specifications of the key building blocks, and their evaluation/benchmarking. Two study cases will be investigated, one called DBORN, for Dual Bus Optical Ring Network which focuses on the deployment of a carrier-grade, metro Ethernet network; and one called MTN (Multipoint Transport Network) which is applied to core, meshed IP networks. Both architectures relies on a common principle of distributed aggregation in the form of full-optical or opto-eletronic buses. The presentation will concentrate on the identification of the essential requirements leading to the design of these new architectures. This methodology could then eventually be applied to other study cases, in other areas

Laurent Ciavaglia is currently working at Alcatel-Lucent Bell Labs France, in a team specialized in autonomic systems. He is vice-chair of the ETSI AFI group, working on the definition of standards for self-managing networks. Laurent is also active at the IETF for the MPLS and Pseudowire technologies and is involved in several European research projects dealing with the control and management of carrier-grade networks. He is coordinator of the CELTIC TIGER2 project and have spent many years in the design, specification and evaluation of carrier-grade Ethernet networks, especially in the metropolitan area. Laurent is co-author of more than 30 publications and holds more than 30 patents in the field of telecommunication networks.

3. Utilizing Traffic Analysis Results in Control Mechanisms of High Speed Networks (Pál Varga – AITIA, Hungary)

Summary:

The effectiveness of traffic control mechanisms can be significantly improved by constantly feeding them with up-to-date traffic analysis results. Although real-time traffic analysis is limited by the ever-increasing speed of network connections as well as the depth and complexity of the information to be analyzed, state of the art traffic capture and analysis systems can still provide valuable information to the control plane.
Traffic mix and traffic matrix are two examples of such worthy analysis results. Both need to be calculated on a per-flow basis, requiring the system to compile flow data based on packet information. Traffic mix analysis outputs application distribution results, uncovering the portion of interactive voice, video streaming, peer-to-peer file sharing, gaming, and other interesting applications. Traffic matrix results disclose the directions and volumes of traffic flows inside the network, allowing the fine-tuning of bandwidth allocations for the operator. Measurement-feedback mechanisms based on these information can be a good base for self-reconfiguration systems.
This presentation describes the main principles of high-speed traffic monitoring, and provides

a brief overview of obtaining and utilizing the above mentioned analysis results.

Pál Varga received an M.Sc. degree in Electrical Engineering from the Budapest University of Technology and Economics (BME), Hungary, in 1997. He is the Director of Telecommunications Division at AITIA International Inc., and works as a Research Fellow at the Department of Telecommunications and Media Informatics of BME.
His research interests include network monitoring, traffic analysis, end-to-end quality of service and root cause analysis. He is lecturing in infocommunications, network management and service quality assurance.

4. Migration steps towards future end to end transport networks (Juan Fernández-Palacios – Telefonica, Spain)

Summary: A huge traffic growth is expected in the metro and core network through new fibre and mobile broadband access connections. According to current network models, network costs per bit are also significantly growing. Therefore, new architectural solutions able to face with the huge expected traffic increase in a more cost-effective way will be needed in order to assure a low cost broadband Internet access. This presentation will focus on the rationale behind end-to-end network architecture able to absorb the expected traffic increase while minimizing transport costs.

Juan Pedro Fernández-Palacios Giménez has graduated with a degree of Telecommunications Engineer from Polytechnic University of Valencia where he carried out his final project working on the simulation of wavelength converters. In September of 2000 he joined Telefónica I+D where he has been working on the analysis and evaluation of optical technologies either in access or backbone networks, likewise he has participated in Europeans projects such as Eurescom P1014 TWIN and ISTs projects DAVID, NOBEL and e-Photon/ONe as well as other internal projects related to the development of optical networks in Telefonica Group. Currently he is Project Manager in the Division of Network Planning and Techno-Economic Evaluation of Telefonica I+D.

5. Environmental Implications of Energy-Efficient Global Communication Networks (Slaviša Aleksić – Vienna University of Technology, Austria)

Summary:

Recently, it was shown that the Internet, including corresponding professional office and telecommunications equipment, contributes to the total electricity consumption by about 1-3 %. Additionally, energy consumed by the home networking equipment also contributes significantly to this already high consumption of the professional equipment. Due to the fact that the number of Internet users, and consequently, the number of network terminals at respective access points increases rapidly, the contribution of new communication-oriented devices and appliances in homes and business to the total consumption of electricity will increase too. Therefore, energy efficient networking technologies that are able to provide high

performance by consuming less energy have already gained a large attention of a broad research community.

Not only savings in energy by developing and using novel networking technologies can help to reduce the total electricity consumption. There are also a large number of applications that can be made possible by a ubiquitous broadband network access, which could contribute indirectly even more to further reduce the global system energy demands. The potential contribution of communication networks and advanced applications to future energy savings and reductions in CO2 emissions may be of significant importance in relaxing the issues related to the climate change.

In this lecture, network technologies for implementing energy-efficient global communication networks will be briefly reviewed. Direct energy saving potentials by using new technologies and concepts in global networks as well as methods to reduce the total energy consumption of IT infrastructure will be addressed. Different commercial and non-commercial broadband services and applications with the potential to increase energy productivity in different branches of industry and economy will be described. Several examples of indirect energy savings by using such advanced applications will be shown.

Slaviša Aleksić received his Dipl.-Ing. and Ph.D. degrees in electrical engineering from the Vienna University of Technology, Austria, in 1999 and 2004, respectively. Currently, he is employed as an Assistant Professor at the Institute of Broadband Communications, Vienna University of Technology (TUW), where he is responsible for teaching and research activities in the area of communication networks. His current research interests include communication networks, photonic networks, energy efficiency in communication networks, high-speed optical and electrical signal processing systems, as well as high-speed media access control (MAC) protocol design and implementation. He is author or co-author of more than 50 scientific publications including book chapters, papers in peer-reviewed scientific journals, and contributions to internationally recognized conferences. He has experience in both research and industrial fields through successfully managing and conducting many projects related to communication networks including two projects funded by the Austrian Science Fund (FWF) and a number of projects in collaboration with several Austrian and European academic institutions and companies. He was the Austrian representative within the COST action no. 291 “Towards Digital Optical Internet” and within the EU Network of Excellence “e-Photon/One.” Currently, he is the leader of the Austrian research group within the EU Network of Excellence “BONE” and within the project “HOME-ICT” funded by the Austrian Research Agency (FFG).
Dr. Aleksić is a member of the Institute of Electrical and Electronics Engineers (IEEE-USA), of the Austrian Electrotechnical Association (OVE-Austria), and of the Institute of Electronics, Information and Communication Engineers (IEICE-Japan). He has received several international and national awards, grants, and recognitions.

3.4 PhD and researcher program of the Summer School

BONE PhD students and researchers had the opportunity to present their preliminary or final thesis results or their research results in general to their peers during the Summer school. The aim of this initiative was two-fold: to stimulate interactions between participants (either PhD students or senior researchers) and to train PhD students to English oral scientific communications.

The following 20 presentations were given in three sections:

- Anica Bukva: **Static versus Dynamic Virtual Network Topology Configuration within GMPLS-enabled connection-oriented Ethernet over WSON** [Slides]
- Attila Mitcsenkov: **Computer-aided, automatic design of FTTx access networks** [Slides]
- Raluca-Maria Indre: **Throughput-Delay Trade-Offs in Slotted WDM Rings** [Slides]
- Sebastian Meier: **The Resource Reservation Protocol for New Network Concepts** [Slides]
- Csernatony Zoltan: **Improving routing efficiency with scalability constraints in multi-domain networks** [Slides]
- Jelena Pesic: **Fault Prediction and Proactive Restoration in Optical Network Links Using Events RecognitionDiana Fidalgo: Chromatic Dispersion Packet Monitoring Based on Nonlinear Optical Preprocessing and Filtering** [Slides]
- Diana Fidalgo: **Chromatic Dispersion Packet Monitoring Based on Nonlinear Optical Preprocessing and Filtering** [Slides]
- Tamás Cseh: **Cost effective RoF with VCSELs and Multimode Fibre** [Slides]
- Marek Michalski: The Graphical Analyzer for Switching Fabrics and VHDL Code Generator for FPGA Controller [Slides]
- Xin Yang: **The Influence of Spectral Truncation on the Shape of Short Optical Pulses** [Slides]
- Fernando Guiomar: **Backward Propagation Algorithms for Digital Post-Compensation of Fiber Impairments** [Slides]
- Tamás Lengyel: **Chromatic Dispersion Compensation in WDM Systems Using Multi-channel Fiber Bragg GratingsJan Derkacz: Protection of personal information in telecommunications networks operations, services and research** [Slides]
- Jan Derkacz: **Protection of personal information in telecommunications networks operations, services and research** [Slides]
- Marija Furdek: **MILP Formulations for Wavelength Assignment Considering In-Band Crosstalk Attacks** [Slides]
- Daniel Mazroa: **Optimal regenerator spacing in BPSK/DPSK modulated all-optical networks** [Slides]
- Anna Zakrzewska: **Multistandard Radio Systems: State of the Art and Research Issues** [Slides]
- Abhinav Rohit: **Fast-Programmable Arrayed Waveguide Routers for Next Generation Optical Networking** [Slides]

- Anders Rasmussen: **High-speed Parallel Forward Error Correction for Optical Transport Networks** [Slides]
- Remigiusz Rajewski: **Nonblocking Switching Network Composed of Optical Switching Elements with Different Sizes** [Slides]
- Tito R. Vargas H: **Providing Quality of Experience to multimedia streams in OBS networks** [Slides]

The slides of all presentations are available in pdf format by clicking to the above links marked as **[Slides]**, while the papers are available in **Proceedings of Summer School 2010**.

3.5 Statistics on participants of the Summer School

The Table shows the number of participants from different countries and different institutions.

Country	*Institution*	*Number*
Austria	TUWien	6
Germany	UniStuttgart	1
Danemark	TU Denmark	2
Spain	UPValencia	1
	CTTC (Tiger)	1
	Telefonica	1
France	ALU Bell	1
	Orange	2
	Telecom Bretagne	1
Croatia	FER	9
	U Rijeka (External)	1
Hungary	BME	21
	Magyar Telekom (External)	1
	AITIA (Tiger)	1
Italy	PoliTo	1
	PoliMi	2
	UniBo	2
Japan	NICT	1
Netherlands	EUT	1
Poland	AGH	6
	PUT	6
Portugal	IT	3
Sweden	KTH	2
Uganda	RTC Uganda (External)	1
UK	ORCU, Southampton (External)	1
15	**25**	**75**

The number of registered participants to the Summer school was 75. They came from 15 different countries and from 25 different Institutions, three of these institutions are Tiger partners, and we had also 4 external participants. The largest number of participants is 23 from Hungary, followed by Poland (12) and Croatia (10) that can be explained primarily by their high involvement into WP2 as well as geographical distance.

A certificate of participation was distributed to each participant at the end of the Summer school.

4. Master School

4.1 Goal of first BONE Master school and targeted audience

The general goal of BONE schools is to disseminate the Network of Excellence knowledge. Particularly, BONE Master schools are aimed to propose and test the courses that were developed within teaching working packages in the framework of e-Photon/ONe and e-Photon/ONe+ NoEs (2004-2008) as well as of NoE BONE.

The BONE **Master School** (September 8-10) was devoted to the curriculum on "Photonics in Switching", where the emphasis was on emerging switching techniques and technologies for optical networks, including both photonic circuit switching and packet switching. The objectives of reducing power requirements of optical networks has also been discussed as well as buffering and scheduling approaches as well as traffic performance evaluations.

The Master school was ended with a 90-minute lab-work.

All presentations have been recorded and are available for streaming, i.e., for offline teaching.

There was a total of 8 courses and one laboratory training, all lasting for 90 minutes. These courses were given by the BONE colleagues that have prepared the teaching material for the "Photonics in Switching" curriculum, except one, that was given by our distinguished guest from NICT, Japan. NICT is associated/external member of NoE BONE.

The Master School (September 8-10) was attended by a total of 66 participants (including the speakers).

The targeted audience was mainly two-folds, although the event was also open to non-BONE members:

1. Master school students of BONE Universities;
2. PhD students willing to improve their knowledge in the Master school theme and/or to collect ECTS in the frame of their doctoral training.

4.2 Schedule of the Master School

The program along with the schedule of the Master School is available at the server of the School organisers: http://www.tmit.bme.hu/bone-master-program. The three-day Master School has followed the two-day Summer School. There was a less formal Social Event on Wednesday and a Gala Dinner on Thursday evening. There was a total of nine ninety-minute lectures, where the last one was a laboratory work.

4.3 Lectures of the Master School

Master school teachers are all members of the BONE community; however, we had a distinguished guest from NICT, Japan as well. NICT is an associated member of BONE. All names, biographies, presentation titles and summaries are listed below.

Master School : Invited Speakers:

1. Introduction to Photonics in Switching (Lena Wosinska - KTH Sweden)
2. New generation network vision and recent progress of optical packet switching technology (Hideaki Furukawa and Naoya Wada, NICT, Japan)
3. Power consumption issues in optical networks (Slavisa Aleksic - Vienna University of Technology, Austria)
4. Buffer-less switch architectures (Michele Savi - UNIBO, Italy)
5. Optical buffer architectures (Franco Callegati – UNIBO, Italy)
6. Scheduling algorithms (Wojciech Kabacinski – PUT, Poland)
7. Optical Cross-connect (OXC) architectures and related technologies (Guido Maier – PoliMi, Italy)
8. Traffic performance and simulations lecture and lab-work (Michele Savi - UNIBO, Italy)

1. Introduction to Photonics in Switching (Lena Wosinska - KTH Sweden)

Aim of the lecture
• To show principles for optical circuit switching, packet switching and burst switching
• To highlight the main technological challenges
• To give an overview of the optical switching node architectures

Summary: The concept of optical transparency refers to the property of an optical network to show independence with respect to a number of characteristics, such as bit rate, protocol, modulation format. Optical transparent networks, based on WDM technology, seem to be the most promising candidates for future high capacity backbone networks. In such networks, switching functions will be carried out directly in the optical domain so that high speed optical signals can travel through the network without any optical-to-electrical conversion. Different switching paradigms can be applied to exploit the optical technology in terms of different switching granularities. These are: optical circuit switching OCS (referred to as wavelength routed optical networks), optical burst switching OBS and optical packet switching OPS.
The optical circuit switching (OCS) paradigm (mostly at wavelength level) is a technique to offer huge bandwidth in the backbone network. This approach provides access to bandwidth with a coarse granularity. It provides end-to-end optical channels (lightpaths) between source and destination nodes. Lightpath can be set up and torn down on request. One of the most important challenges in OCS networks is solving routing and wavelength assignment (RWA) problem, which consists of finding a suitable physical route for each lightpath request, and assigning an available wavelength to that route. Demands to set up lightpaths may be known

in advance and set up semi-permanently (static or off-line), or can arrive in a random manner with random holding times (dynamic or on-line). In the static case, the common objective of RWA is to minimize the resources (such as number of wavelengths or number of fibers) that will be needed to support all the lightpaths in the network, while in the dynamic scenario lightpath blocking probability is a major performance characteristic. A suitable OCS node architecture (referred to as optical cross connect OXC) can significantly improve the blocking performance.

In contrast to OCS, optical burst switching (OBS) is based on statistical multiplexing, which can increase the efficiency of network resource utilization. OBS networks mainly consist of two types of switching nodes, namely edge and core nodes. The edge node can aggregate client data (e.g., IP packets) into bursts. Each burst has an associated control header. Usually, a burst is separated from the control header by the interval of offset time. This characteristic is helpful to overcome the infancy of optical hardware logic. The main functions of the edge nodes are optical burst assembly/disassembly, offset time and burst size decision. The OBS core nodes perform control header lookup, optical crossconnecting and data burst monitoring. Compared with the edge nodes, the core nodes can have relatively simple structure.

In optical packet switching (OPS), packets are buffered and routed in the optical domain. In contrast to OCS and OBS, OPS networks have the switching granularity on the packets level. The functionality of OPS node should include: decoding packet header, (can be electronic if the packet header is encoded at lower bit rates), configuring a switch fabric (the reconfiguration needs to be performed very fast in nanosecond range), synchronization (for synchronous OPS nodes), multiplexing, and contention resolution. The lack of flexible optical buffers makes the contention resolution in optical domain very difficult.

Lena Wosinska received her M. Sc. degree in Electrical Engineering from the Warsaw Institute of Technology, Poland, Ph.D. degree in Photonics and Docent degree in Optical Networking from the Royal Institute of Technology (KTH) in Stockholm, Sweden. She joined the Royal Institute of Technology in 1986 where she is currently an Associate Professor in the School of Communication and Information Technology (ICT) heading a research group working on optical networking and teaching courses on optical networking and queuing theory. She is currently coordinating projects on All-optical Overlay Network and Next-generation Fiber Access Networks and also participating in FP7 project Optical Access Seamless Evolution (OASE) leading a work package on network architectures. She is an Associate Editor of IEEE/OSA Journal of Optical Communications and Networking JOCN. Her research interests include optical network management, reliability and survivability of optical networks, photonics in switching and fiber access networks.

2. New generation network vision and recent progress of optical packet switching technology (Hideaki Furukawa and Naoya Wada, NICT, Japan)

Summary: Limitations are found in the recent Internet such as switching capacity, power consumption, QoS, security, and mobility. It is important for future-networks to meet diversity of emerging requirements such as solving social issues and supporting sustainable progress of planet-wide civilization. We are building visions, designs, and technologies for a new generation network (NWGN) which will be a network meeting the future social requirements. One of key technologies is optical packet switch (OPS), which can implement high-throughput forwarding of optical packets without optical-to-electrical-to-optical (O/E/O) converters in data-plane. OPS can realize energy-efficient processing and transparency for

various bit-rate and formats. Here, we introduce our NWGN vision, and show recent advances on over-1-Tbit/s/port OPS system and related technologies.

Hideaki Furukawa received the B.E., M.E. and Dr. Eng. degrees in Material and Life Science from Osaka University, Osaka Japan, in 2000, 2002 and 2005, respectively. Since 2005, he has been with National Institute of Information and Communications Technology (NICT), Tokyo Japan. His research interests include photonic information technology and photonic networks.

3. Power consumption issues in optical networks (Slavisa Aleksic - Vienna University of Technology, Austria)

Summary: Since demand on high transmission capacity is expected to considerably increase in the near future due to the introduction of new high-speed access systems and bandwidth-hungry services and applications, the requirements on network elements will increase too. Next generation switching and routing elements have to be able to keep track with those developments and should provide a high throughput in a more dynamic and efficient manner. Switching packets directly in the optical domain is an attractive solution because it can provide high speed operation, optical transparency and simplified switch/router architecture. Moreover, optical transmission and switching technologies are potentially highly energy efficient. However, complex optical signal processing is difficult to realize and optical random access memories are not feasible yet. A crucial precondition for implementing complex optical switching and signal processing systems is high-density photonic integration, which is still in an early development stage when compared to electronic integration. Even if it would be possible to realize high-performance all-optical routers having the same complexity and providing equal performance as the current electronic IP routers, it is not clear if they would be much more power efficient than the electronic ones. The energy efficiency of high-performance network nodes can certainly be improved by using optical technologies, but a significant and effective improvement can only be achieved when considering, additionally to new technologies and power-optimized structures, also new network concepts that are able to naturally support high capacities, high quality of service (QoS) standards and low-power operation.

Within core networks, all transmission links base on optical transmission because it allows very high data rates and enormous capacities over long distances. Moreover, next generation optical networks employing multiplexing, switching, data processing and routing in the optical domain could be a viable service infrastructure for applications that require both high bandwidth and high quality of service. Therefore, an optimal power-aware design of optical links for networked systems, which scales both link bit rate and supply voltage to optimize power consumption with respect to network utilization, is necessary. On the one hand, different technologies, devices, and protocols for power-efficient optical transmission are needed to reduce the amount of energy required to transmit each individual bit of data in long- and medium-haul transmission. On the other hand, power consumption of future ultra high capacity switching and routing elements has to be reduced.

Within the access area, there is a variety of technologies and protocols currently in use or proposed for use to relax the bottleneck of the first mile. The heterogeneity of protocols and a large number of users lead to a complex structure and a high total power consumption of access networks. There are a number of methods proposed for reduction of power consumption in access networks. Especially for mobile devices, a very low consumption is of great importance because the batteries have limited capacity, size and weight. Because wireless technologies use shared transmission medium, there is strong interference at the receivers that needs to be mitigated by using advanced modulation formats and coding schemes as well as intelligent control of the transmitter power by combining efficient channel selection algorithms together with power-aware transmission and routing protocols. Thus, mobile devices are already optimized for energy efficiency, but there is still room for additional improvement of radio base stations. Although radio and wireless access solutions have made a lot of progress towards energy efficiency and there are many new highly efficient components and systems for power supply and transmission in copper-based technologies, the most promising technology concerning both high performance and low power consumption for the access area seems to be a solution based on optical fibers. Since the contribution of the first mile equipment to the total power consumption of global networks is large, the deployment of energy-efficient components and systems for access area will have a large impact on the overall power consumption. Energy-efficient access networks can be realized by using low-power-consuming technologies together with a dynamic resource control and power management that is able to adapt the operating mode of network elements to actual needs and according to day/night utilization curves.

This lecture will briefly review technologies and approaches for implementing energy-efficient network elements. Potentials for improvement of energy efficiency in communication networks will be shown and discussed. Various technologies, concepts and architectures will be evaluated by means of power consumption. Transmission and switching systems for core, metro and access areas will be considered and assessed on the basis of their energy saving potentials.

Slaviša Aleksić received his Dipl.-Ing. and Ph.D. degrees in electrical engineering from the Vienna University of Technology, Austria, in 1999 and 2004, respectively. Currently, he is employed as an Assistant Professor at the Institute of Broadband Communications, Vienna University of Technology (TUW), where he is responsible for teaching and research activities in the area of communication networks. His current research interests include communication networks, photonic networks, energy efficiency in communication networks, high-speed optical and electrical signal processing systems, as well as high-speed media access control (MAC) protocol design and implementation. He is author or co-author of more than 50 scientific publications including book chapters, papers in peer-reviewed scientific journals, and contributions to internationally recognized conferences. He has experience in both research and industrial fields through successfully managing and conducting many projects related to communication networks including two projects funded by the Austrian Science Fund (FWF) and a number of projects in collaboration with several Austrian and European academic institutions and companies. He was the Austrian representative within the COST action no. 291 “Towards Digital Optical Internet” and within the EU Network of Excellence “e-Photon/One.” Currently, he is the leader of the Austrian research group within the EU Network of Excellence “BONE” and within the project “HOME-ICT” funded by the Austrian Research Agency (FFG).
Dr. Aleksić is a member of the Institute of Electrical and Electronics Engineers (IEEE-USA), of the Austrian Electrotechnical Association (OVE-Austria), and of the Institute of

Electronics, Information and Communication Engineers (IEICE-Japan). He has received several international and national awards, grants, and recognitions.

4. Buffer-less switch architectures (Michele Savi -- UNIBO, Italy)

Summary: One of the key problems in application of packet switching in optical domain is the handling of packet contentions that take place when two or more incoming packets are directed to the same output line. Various techniques have been examined in literature: buffering, deflection routing and wavelength conversion. The application of buffering technique would make the structure of a optical packet switch strictly close to that of a traditional electronic packet switch, therefore it has been extensively studied. Unfortunately, at least with current technology, optical buffer can be only implemented through a bundle of Fiber Delay Lines (FDLs) ant this significantly reduces the buffer capacity of an optical packet switch. Thus the number of FDLs is a critical system design parameter because it has an impact on the optical hardware volume, on the switch size and on the noise level due to the transit of optical signal in FDLs. A recent surge of new research results in the area of slow light has opened up the possibility of improved optical buffer performance. The high attenuation of buffer realized in slow light technology needs to be compensated by optical amplifiers that, in turn, contribute to the increase in total power consumption. The deflection routing is simply a multiple path routing technique that allows the contention problems to be solved and the buffer depth and the number of optical gates to be reduced with a sensitive saving in hardware volume and cost. The effectiveness of this technique critically depends on the network topology; as a matter of example, meshed topologies with a high number of interconnections benefit of the largest gain from deflection routing whereas minor advantages arises from more simple topologies.
The use of the wavelength conversion for the packet contention resolution in Bufferless Optical Packet Switch can considerably reduce the required buffer capacity and the complexity of the switching matrix. Optical buffers are eliminated and the traffic is split on the wavelength channels by using Wavelength Converters (WC). During the lecture the following topics will be investigated:
- Definition and Performance Evaluation of BOPS: The use of the wavelength conversion to solve the output packet contentions needs the use of many WCs; we propose and analytically evaluate slotted and unslotted switching architectures in which the use of WCs is optimized by introducing WC sharing techniques. BOPS with Limited Range Limited will be also proposed and investigated.
- Implementation of BOPS in Semiconductor Optical Amplifiers (SOA) Technology: Examples of implementation of BOPS in SOA technology will be given. We illustrate how both switching matrix and Wavelength Converters can be realized by means of SOA. The main techniques of realization of WC that employs non linear effects in SOA (Cross Gain Modulation, Cross Phase Modulation, Four Wave Mixing,...) will be shown. The main limitations will be investigated.
- QoS Techniques in BOPS: QoS differentiation scheme for BOPS are introduced and investigated. To differentiate the offered QoS, the packets are given different priorities in accessing the output wavelengths and the WC. The effectiveness of the introduced schemes to differentiate the QoS is investigated.
- Evaluation of Power Consumption in BOPS: when using optical buffers, due to attenuation problems, optical nodes consumes more power than electronic nodes. We will discuss issues concerning power consumption of switching fabrics in BOPS realized in SOA technology.

SOA's power consumption models will be introduced and the BOPS power consumption will be analytically evaluated as a function of the offered traffic, switch parameters and device characteristics. The power consumption of switching fabric in BOPS will be compared to the ones in market routers.

Michele Savi received the Master degree in Telecommunication Engineering from the University of Bologna, Italy, in 2004 and the PhD degree in Electrical, Computer and Telecommunication Engineering from the same University in 2008. He is currently working at the Department of Electronics, Computer Science and Systems of the University of Bologna, Italy, in the field of traffic performance and node architectures for optical packet/burst switching networks, and related control algorithms. He is currently involved in the EU-funded IST e-Photon/ONe and BONE Network of Excellence projects

5. Optical buffer architectures (Franco Callegati – UNIBO, Italy)

Summary: The lecture will address the logical issues related to optical delay based buffers. First of all the working principle of a delay based buffer will be explained, with reference to the various formats of optical packets. Then the most common architectures of delay based optical buffers will be reviewed, and their functional behavior explained. In the second part the talk the performance issue related to the various architectures will be addressed, with a focus on understanding the congestion phenomena that mostly influence the buffer performance. Finally the importance of the buffer scheduling policy will be explained, several possible algorithms compared and a possible general purpose implementation of the scheduler will be described.

Professor Franco Callegati is Assoc. Prof. of Telecommunication Networks at the University of Bologna, Italy. His research interests are in the field of teletraffic modelling and performance evaluation of telecommunication networks. In the last ten years he has been actively contributing to research in the area of optical networking, with emphasis on optical burst and packet switching. He has been active in several UE funded research projects on the subject, coordinating reasearch activities and workpackages. He published more than 100 papers on international journals and conferences, plus several book chapters. Recently he has been working on service aware optical networks in support to the future Internet. For furher details please refer to: http://www.unibo.it/docenti/franco.callegati

6. Scheduling algorithms (Wojciech Kabacinski – PUT, Poland)

Summary: Packet contention resolution is one of important problems in pocket switching technology. In optical pocket switching this problem can be resolve by optical buffers, wavelength conversion, or deflection routing. In case of optical buffering, different strategies for locating buffers in an optical pocket switch can be use: input buffering, output buffering are examples. Optical buffering is currently realized by a bundle of Fiber Delay Lines (FDLs). This reduces the buffer capacity and requires special scheduling algorithms. The role of a scheduling algorithm is to match inputs and outputs so that contention at outputs is resolve. The aim of the lecture is to provide basic knowledge about scheduling algorithms in optical packet switching. Algorithms in switches, input and output queuing will be presented.

Switches with wavelength converters will also be considered.

Wojciech Kabaciński (PUT, Poland) has received M.Sc. (83) and PhD (88) degrees from the Poznan University of Technology, Poland, where he is currently the full professor at the Chair of Communication and Computer Networks. His research interests focus on switching fabric architectures, control algorithm, broadband and photonic switching, and also signaling in telecommunication networks. He co-authored several books (some in Polish) on switching, signaling and telecommunication networks and over 150 papers on switching and control algorithms. In 2005-2009 he was the chair of Communications Switching and Routing Technical Committee of IEEE Communication Society. He is also the TPC member of many international conferences and the editorial board member of IEEE Communications Magazine and IEEE Communications Surveys and Tutorials.

7. Optical Cross-connect (OXC) architectures and related technologies (Guido Maier – PoliMi, Italy)

Summary: This lesson provides the basic knowledge for understanding and analyzing the Optical Cross-Connects (OXCs). After introducing to the main functions and requirements of an OXC, a first part overviews the photonic technologies and devices most suited to implement and interconnect the switching elements for cross-connecting applications. Particular attention will be attributed to integrated-optics devices such as micro-ring resonators and arrayed-waveguide gratings, illustrating merits and limits of this technology. A second part provides a classification of OXC architectures, from the simplest add-drop multiplexers (ROADMs) to the full-functionality non-blocking multi-layer cross-connects. The last part is dedicated to current hot-topics in the area of optical-circuit switching which promise to be the ground for future developments of research in the field: namely, optical interconnection "inside-the-box" and optical-transparent switching.

Guido Maier received his Ph.D. degree in Telecommunication Engineering at Politecnico di Milano (Italy) in 2000. Until February 2006 he has been researcher at CoreCom (research consortium supported by Pirelli in Milan, Italy), where he achieved the position of Head of the Optical Networking Laboratory. On March 2006 he joined the Politecnico di Milano as Assistant Professor. His main areas of interest are: optical network modeling, design and optimization; ASON/GMPLS control-plane architectures; WDM and optical switching systems. He is co-author of more than 60 papers in the area of Optical Networks published in international journals and conference proceedings and co-inventor of 6 patents with extensions in various Countries (including Europe and the U.S.). He is currently involved in industrial and European research projects.

8. and 9. Traffic performance and simulations lecture and lab-work (Michele Savi - UNIBO, Italy)

Summary: In this lecture optical and electro-optical switching architectures will be presented, suitable for both long-haul and short-range scenarios.
The architectures are based on advanced optical technology to implement the switching fabric, as Semiconductor Optical Amplifiers, Wavelength Converters, MUX/DEMUX,

splitters/couplers etc.
They exploit wavelength and (possibly) time domain for contention resolution, in order to achieve significant throughput for future high performance applications.
Since Wavelength Converters are complex and expensive components (perhaps not mature yet), different wavelength converters sharing strategies inside the switching node will be considered to reduce cost obtaining at the same time good performance.
These architectures are suitable for different contexts, ranging from Optical Circuit Switching (OCS) to Optical Burst/Packet Switching (OBS/OPS).
In this lecture the focus will be put on OPS.
Different input traffic patterns can be considered, also considering different QoS needs, which lead to different performance.
To manage packet forwarding in such architectures providing QoS differentiation, proper scheduling algorithms have been designed according to the synchronous/asynchronous network context.
Optimal and heuristic scheduling algorithms have been defined taking the adopted sharing scheme into account.
The resulting computational complexities have been also considered.
Some examples of such scheduling algorithms will be presented during the lecture.
In the laboratory, the students will be guided to the use of ad-hoc simulators (written in C language) able to capture the functionalities of the proposed architectures according to the scheduling algorithms defined to manage them in both synchronous and asynchronous scenarios.
The simulators return the packet loss probability (and other parameters) of the proposed architectures, useful to understand, evaluate and compare the performance of the different architectures.
The target of the laboratory lecture will be the production of a graph showing the trend of the packet loss according to the number of wavelength converters available in the switching matrix.

The lecture will be organized according to the following topics:
- Schemes to share wavelength converters in bufferless architectures: Shared per Node, Shared per Input Wavelength, Shared per Output Wavelength. In the first part different ideal schemes to share wavelength converters in a node will be presented, including some considerations about advantages/drawbacks of each scheme.

- Modular implementation of one of these architectures. The Shared per Input Wavelength scheme well fits a possible modular implementation, which allows reducing the complexity and increasing the flexibility of the architecture.

- Electro/optical architecture with electronic buffers for contention resolution. Electronic buffers can be added to the proposed architecture to improve the performance, with limited additional complexity.

- Traffic patterns including QoS differentiation. Different traffic patterns can be considered on input of the proposed architectures, including two-classes traffic scenario requiring different QoS.

- Scheduling algorithms to manage packet forwarding. The input traffic should be scheduled according to the QoS requirements, thus providing differentiation among classes. The computational complexity of the scheduling algorithm must be kept as low as possible to ensure the execution of the scheduling algorithm in time slot duration.

- Laboratory: use of the simulators to obtain packet loss of the proposed architectures. The simulators return the packet loss and other parameters (as an example, delay for buffered architectures) according to the number of input/output fibers, number of wavelengths per fiber, load per wavelengths, QoS requirements. The values returned will be used to compare different architectures and to understand the behavior of the proposed architectures in different contexts.

Michele Savi received the Master degree in Telecommunication Engineering from the University of Bologna, Italy, in 2004 and the PhD degree in Electrical, Computer and Telecommunication Engineering from the same University in 2008. He is currently working at the Department of Electronics, Computer Science and Systems of the University of Bologna, Italy, in the field of traffic performance and node architectures for optical packet/burst switching networks, and related control algorithms. He is currently involved in the EU-funded IST e-Photon/ONe and BONE Network of Excellence projects.

4.3.1 Video courses streaming and storage

During each course, the synchronization between the respective audio track and the presentation slides has been realized by BME colleagues. Mp4 files were produced that can be used for on-line streaming or off-line use of the teaching materials.

Here we would like to express our gratitude to AGH colleagues, particularly to Krzysztof Wajda, for all their help in realisation. BME has used the same processing tools and methods as AGH for the last BONE Schools in Krakkow in 2009, and AGH colleagues have helped much.

All these recordings as well as the pdf format of all the presentation slides are stored in the private part of the general BONE website www.ict-bone.eu as detailed in ANNEX II.

4.3.2 Storage of presentation files

All courses, invited and student presentations of both, Summer and Master Schools are stored in the private part of the general BONE website www.ict-bone.eu in pdf format as detailed in ANNEX II.

4.4 Master school official documents

For both, the Summer School and the Master School certificates of attending the School were given. Depending on local ECTS (European Credit Transfer and Accumulation System) evaluation rules, this is sometime sufficient to allow participants to collect ECTS for their doctoral training.

4.5 Statistics on Participants of the Master School

The Table shows the number of Master School participants per country and per institution.

Country	***Institution***	***Number***
Austria	TUWien	4
Belgium	UdMons	1
Spain	UPValencia (External)	1
	CTTC (Tiger)	1
	Telefonica (Tiger)	1
France	ALU Bell	1
	Orange	1
	Telecom Bretagne	1
Croatia	FER	9
	U Rijeka (External)	1
Hungary	BME	18
	Magyar Telekom (External)	1
	AITIA (Tiger)	1
Italy	PoliTo	1
	PoliMi	3
	UniBo	2
Japan	NICT (assoc BONE partner)	1
Netherlands	EUT	1
Poland	AGH	4
	PUT	6
Portugal	IT	2
Sweden	KTH	2
Uganda	RTC Uganda (External)	1
UK	ORCU, Southampton (External)	1
15	***24***	***65***

The distribution of attendees is similar to that for the Summer School. The total number of registered participants of the Master School was 65, i.e., 10 attendees less for the Master than for the Summer School. 24 institutions of 15 countries were represented.

5. Co-located event: WP02 meeting

As a collocated event the BONE WP02 workpackage meeting took place in Budapest on September 8, 2010, afternoon, at 16:30. It was attended by 9 WP02 members. Five topics were discussed as follows:

1. The next (the last) WP02 meeting will take place in Bologna in February 2011 collocated to Final Plenary and ONDM.

2. Final version of curricula and revised teaching materials of BONE virtual Master study should be uploaded to the BONE / WP02 web site. Within the course curricula there are links to teaching materials files. For each course module authors have to decide if weather:

a) The module is ready for open access according to Creative Commons Public License, or

b) The module is for private use only.

3. As a follow up of teaching activities Branko proposed that all contributors to teaching materials in BONE project continue basic collaboration after the end of BONE by forming Teaching Pool BONE for exchange of teaching materials.

Veronique proposed that WP02 starts writing a joint paper for IEEE Trans on Education about our teaching achievements within e-Photon/ONe and BONE. Veronique is in charge to propose the way if realization.

4. WP02 scoring points for 2009 are discussed. Branko will send the table to Peter.

5. Branko has thanked to Tibor and Szilárd and their team in BME for a big effort in organizing BONE Master/Summer School 2010.

List of participants:

1. Lena Wosinska KTH
2. Tito R. Vargas UPVLC
3. Tibor Cinkler BME
4. Veronique Moeyaert UMONS/FPMs
5. Guido Maier PoliMI
6. Wojciech Kabacinski PUT
7. Marija Furdek FER
8. Krzysztof Wajda AGH-UST
9. Branko Mikac FER

6. Conclusions

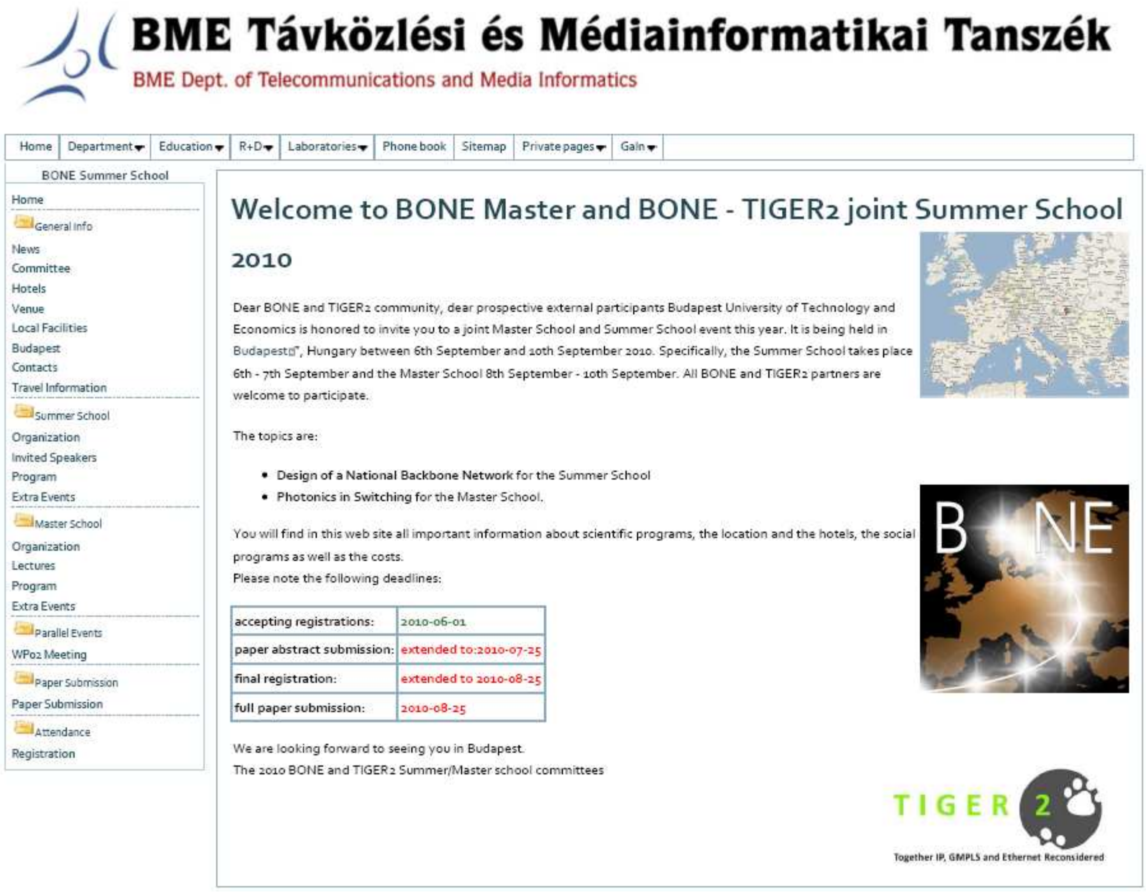
WP02 has fully completed its task foreseen for the Deliverable D02.4 and it has reported in this Deliverable the successfully accomplished 5-day event held at the BME premises.

Following achievements should be emphasised:

1. 5 SummerSchool lectures by distinguished experts, mostly from Industry
2. 8 Master School lectures by experts from NoE BONE, including a special guest from NICT, Japan (associated BONE partner)
3. Video streaming and video courses storage
4. Practical exercise on traffic performance and simulation devoted to network planning;
5. A co-located event of the BONE Summer School, devoted to PhD student training and interactions with 20 student and young researcher presentations.
6. WP02 meeting

Annex 1: Summer School and Master School dedicated web page

BME-TMIT : bone-school http://www.tmit.bme.hu/bone-school



BME Távközlési és Médiainformatikai Tanszék
BME Dept. of Telecommunications and Media Informatics

Home | Department | Education | R+D | Laboratories | Phone book | Sitemap | Private pages | Gain

BONE Summer School
Home
General info
News
Committee
Hotels
Venue
Local Facilities
Budapest
Contacts
Travel Information
Summer School
Organization
Invited Speakers
Program
Extra Events
Master School
Organization
Lectures
Program
Extra Events
Parallel Events
WPo2 Meeting
Paper Submission
Paper Submission
Attendance
Registration

Welcome to BONE Master and BONE - TIGER2 joint Summer School 2010

Dear BONE and TIGER2 community, dear prospective external participants Budapest University of Technology and Economics is honored to invite you to a joint Master School and Summer School event this year. It is being held in Budapest, Hungary between 6th September and 10th September 2010. Specifically, the Summer School takes place 6th - 7th September and the Master School 8th September - 10th September. All BONE and TIGER2 partners are welcome to participate.

The topics are:

- Design of a National Backbone Network for the Summer School
- Photonics in Switching for the Master School.

You will find in this web site all important information about scientific programs, the location and the hotels, the social programs as well as the costs.
Please note the following deadlines:

accepting registrations:	2010-06-01
paper abstract submission:	extended to:2010-07-25
final registration:	extended to 2010-08-25
full paper submission:	2010-08-25

We are looking forward to seeing you in Budapest.
The 2010 BONE and TIGER2 Summer/Master school committees

TIGER 2
Together IP, GMPLS and Ethernet Reconsidered

Annex 2: Where are the "BONE Schools 2010" documents stored?

This Document is available among BONE Deliverables.

http://www.ict-bone.eu/portal/faces/public/BONE/ecatrepository?portal:componentId=repository&portal:type=render&portal:isSecure=false&repoId=13d3a9561ae8958c011b1172b9700b82&pmRender=ERepositoryMain&folderId=13d3a9561b7dc7ba011b98c655a8031c&repoId=13d3a9561ae8958c011b1172b9700b82&view=info

All the tutorials and presentation slides, the recorded talks and the proceedings were uploaded to http://www.ict-bone.eu .

Master School pdf of slides and recorded mp4 tutorials for on-line streaming and downloading:

http://www.ict-bone.eu/portal/faces/public/BONE/ecatwiki?portal:componentId=ewiki&portal:type=render&portal:isSecure=false&groupid=13d3a9561ae8958c011b113d71d20b7d&pmRender=EWikiViewDocument&wikiId=13d3a9561ed46713011ed56d815f006b&document=Master_School_2010

Summer School pdf of slides of tutorials (lectures) as well as of Student Presentations for on-line viewing and downloading:

http://www.ict-bone.eu/portal/faces/public/BONE/ecatwiki?portal:componentId=ewiki&portal:type=render&portal:isSecure=false&groupid=13d3a9561ae8958c011b113d71d20b7d&pmRender=EWikiViewDocument&wikiId=13d3a9561ed46713011ed56d815f006b&document=Summer_School_2010

Proceedings of the Summer and Master Schools:

http://www.ict-bone.eu/portal/uploadedfile?instanceId=13d302052d9842c5012e47e4b9521b6c

The eight Master School videos are TEMPORARILY available here as well for on-line streaming (These same videos are available permanently for download at the above mentioned http://www.ict-bone.eu link):

http://opti.tmit.bme.hu/~cinkler/BudapestSchools/FrancoCallegati11/
http://opti.tmit.bme.hu/~cinkler/BudapestSchools/GuidoMaier34/
http://opti.tmit.bme.hu/~cinkler/BudapestSchools/HideakiFurukawa57/
http://opti.tmit.bme.hu/~cinkler/BudapestSchools/LenaWosinska92/
http://opti.tmit.bme.hu/~cinkler/BudapestSchools/MicheleSaviFriday73/
http://opti.tmit.bme.hu/~cinkler/BudapestSchools/MicheleSaviThursday48/
http://opti.tmit.bme.hu/~cinkler/BudapestSchools/SlavisaAleksic28/
http://opti.tmit.bme.hu/~cinkler/BudapestSchools/WojciechKabacinski56/