INNOVATIVE METHODS FOR QUALIFICATION IMPROVEMENT OF STUDENTS AND YOUNG SCIENTISTS BY CREATING A MOBILE COMMUNICATIONS TRAINING CENTER

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Abstract. Innovative teaching and learning methodologies such as lectures, simulations, role-playing, portfolio development and problem-based learning are very useful in addressing the rapid technological advances. It is important to interrogate a number of strategies and methods that become critical when there's need to motivate and increase enthusiasm in students. The aim of this article is to show how the established new training center and laboratory at Nikola Vaptzarov Naval Academy could improve their qualification. Innovative methods to train students and young specialists in the field of mobile communications and IT have been suggested. In this paper only the mobile communications aspect will be considered.

Two year work resulted in a laboratory that has been completed after gaining an approval for additional financing supported by the Bulgarian Ministry of Education and Scientific Researches Fund as well as Telenor Bulgaria. A dedicated area was built with working places equipped with PC workstations and connected in a local area network. Experimental settings were created with modern microwave radio relay stations and multiplexers to provide intranet enhancement and to establish connections to remote locations of the Bulgarian Navy. Innovative methods were inrroduced- such as the so called learning by doing science.

Stimulation of creative and intellectual abilities of students through modern technologies is important in order to enjoy their learning experience far more than the traditional approaches. Incidential methods, problem based learning and computational thinking have to be considered while students work with real equipment. Innovative teaching methodologies using self configured experimental staging would enhance student participation and promote interaction. A questionaire will be introduced to assess the skills of students due to the new methods mentioned above and compared with those tradionally taught.

Keywords. Mobile communications, laboratory, microwave radio, IT platform, base transceiver stations, traffic measurement, field sensors, incidential learning, problem based learning

1. Introduction

It is uncertain nowadays if traditional methods and conventional assessment are as effective as they are believed to be. This article is about new pedagogical aspects implemented in the education by creating this mobile communications training centre. Innovative teaching and learning methodologies such as lectures, simulations, role-playing, portfolio development and problem-based learning are very useful in addressing the rapid technological advances. It is important to interrogate a number of strategies and methods that become critical when there's need to motivate and increase enthusiasm in students. What is taught should also be intelligible as the students become familiar with the expected standards. New methods should provide a free-flowing learning process [1]. Traditional didactic lectures limit the opportunities for student interaction, but recent attempts to provide greater student interactions in lectures have resulted in much higher satisfaction, higher thinking skills and enhanced motivation. The modern lecturing is definitely undergoing significant changes and with the net generation as the main audience, it will be vital for lecturing to move with the time and to adopt more innovative techniques to keep students engaged [2].

In the digital world where students have an extensive amount of visual information, in-depth knowledge of a topic and higher thinking skills could be at risk. So, implementation of innovative methods though with benefits, should be carried out with caution. For some students who are overwhelmed by media multitasking, it may seem that the traditional lecturing model of keeping it simple, could be a relief from the digital environment [3]. Active learning and collaboration are critical components of successful teaching. But one should always remember that the traditional method of lecturing will offer students the opportunity to have quality information from an expert with personal overviews that may not be available on-line [4].

2. Materials and methods. The project was undertaken in the period 2014-2016 in the region of Varna. Twenty-two people have been involved including the director, one coordinator, two consultants, team members and external members. It has been supported by Ministry of Education state funding and a partnership with Telenor Bulgaria.

The aim of this article is to show how the established new training center and laboratory at Nikola Vaptzarov Naval Academy where implementation of innovative methods

to train students and young specialists in the field of mobile communications and IT could improve their qualification.

Secondary objectives are:

- To improve the qualification level of the engineers who intend to join the bulgarian mobile communications operators and include the corresponding training courses in their program for professional growth.
- To promote the positive development of training in information and communication technologies in the region of neighboring Balkan countries,
- To develop virtual LAN over various communication channels.
- To create a a chain of serious partnerships with commincation companies – such as Telenor Bulgaria and Vivacom.

3. Suggested innovative methods

First method proposed is so called **learning by doing science** [5]. Engaging with authentic tools and practices such as controlling laboratory experiments can build science skills, improve conceptual understanding and increase motivation. Access to specialized equipment is now expanding to trainee teachers and university students. With appropriate support, access to lab will deepen understanding by offering hands-on investigations and opportunities for direct observation [6]. Context enables students to learn from experience. By interpreting new information in the context of where and when it occurs and relating it to what they already know, they come to understand its relevance and meaning. Beyond the classroom, learning can come from an enriched context such as this laboratory. There are opportunities to create context, by interacting with the equipment. This is a **context based learning** [8]. Working in a laboratory can be considered as learning in informal settings. This is known as **crossover learning** [9] This appears to be an effective method first to propose and discuss a question during lecture. Then learners are expected to explore that question in the laboratory, collect problems and notes, then share their findings to produce individual or group answers. Such learning experiences exploit the strengths of both environments and provide learners with authentic and engaging opportunities for learning. Students can advance their understanding of science by arguing in ways similar to professionals. This is also a method called **learning through argumentation** [10]. Argumentation helps students attend to contrasting ideas, which can deepen their learning. It makes technical reasoning public, for all to learn. It also allows students to refine ideas with others, so they learn how scientists

work together. When students argue in scientific way, they learn how to take turns, listen actively, and respond constructively to others [7].

4. Proposed realization essentials and learning methods

The laboratory consists of eight working places equipped with PC workstations and connected in a local area network. (See Fig.1.) There's one instructor place operating a server running dual OS – Microsoft Windows Server 2016 and Ubuntu Linux Server 16.04.2.LTS. The practice classes included in the educational program concern three subjects – Mobile communications (including also topics on Traffic Microwave Transmission), Information Management and Communication Exchange technologies.

The place contains the following equipment –

- Power supply rack SUNLIGHT model SPSD -3000 with incorporated battery department including 4pcs of MonoLite 100Ah 12V
- Rectifiers/ chargers SUNLIGHT model SMR-D 48VDC
- Two base transceiver stations manufactured by Ericsson - Model RBS2206 GSM/ EDGE second generation. Used for educational purposes and not connected to the transmission of traffic.
- Two STM-16 Multiplexer equipment manufactured by Nokia Siemens Networks Model SUPRASS hiT 7035
- Three hybrid microwave stations manufactured by HUAWEI model OptiX RTN 950 and RTN 980 running three radio network baseband units ensuring duplication of the digital channel communication
- Two analog microwave stations by Allgon Microwave Radio (AMR) Model R1A ensuring 4xE1 capacity transfer operating in the 18GHz band
- Antenna complex with outdoor units and feeders operating on 28MHz band utilizing dedicated channels

Traffic generator (VIAVI model MTS-5800) is utilized for input data to the multiplexers manufactured by Nokia Siemens Networks, having optical fibre connection between each other. The Ethernet ports and the E1 ports are configurable and a task for the students is to route the traffic from a certain port to another one on the distant side. This is a problem based learning method [7].

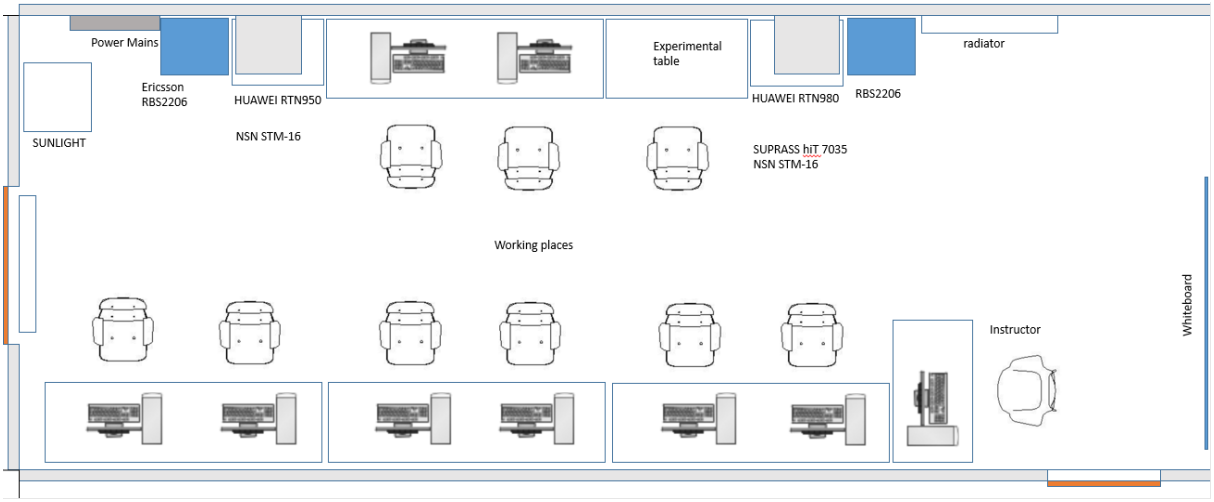


Fig.1. Allocation of the working places and the equipment from above

Second part of the task is to configure an optical fibre connection between the multiplexer and microwave station (Optix RTN 980) having such feature. Fig.2. shows side view of the equipment allocation. The traffic generated is passed from the multiplexer via the microwave equipment over radio protocol to the corresponding Huawei OptiX RTN 950 on the closer side. There is another RTN 950 microwave station receving the traffic via Ethernet in order to supply the next destination in the neighboring campus of the Naval Academy. The software utilized is U2000WebLCT ver200R015 of HUAWEI. Using the software for configuration, it is possible to configure VLAN addressing three optional places - two in the laboratory campus and one in the neighboring campus. The configuring connection is web based over a separated port. It is a context based task. Internet access will be granted for the distant place where operates another microwave equipment (OptiX RTN 950) with autonomous and separate power supply. The power supply utilized is PowerOne model Aspiro XS19.48. The internet connectivity will be gained by the institutional LAN router with the corresponding privileges and intranet options. The outdoor units (ODU) that are utilized are HUAWEI RTN600 model 18G-HP configured to ensure 1+1 reservation and 1+0 radio connection. Measurement are usually conducted with 28MHz channel bandwidth. The center frequencies utilized are as follows:

- 28.1505GHz/ 29.1585GHz for the 1+0 configuration
- 28.2625GHz/ 29.2705GHz for the 1+1 configuration

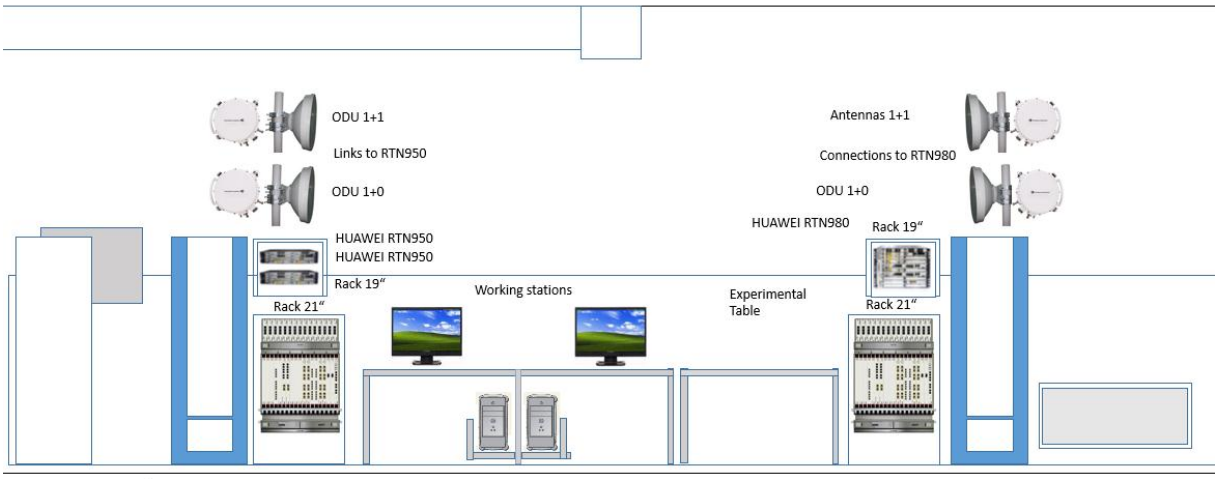


Fig.2. Allocation of the working places and the equipment front side

The mentioned two microwave stations AMR R1A as descibed above deliver 4xE1 traffic only to each other operating on the following frequencies – 19.196GHz and 18.186GHz. The equipment is third generation indoor unit (IDU).

Fig.3. Event list of AMR R1A connected with the opposite hop partner

Using web interface configuration, the students are able to track the alarm lists, event list, event interfaces, event logs. It is also possible to conduct loop tests, radio frequency channel test, traffic channel test etc. The Fig.3. illustrates the web interface of the AMR unit, where the alarms are ordered by severity with comments and options for further action.

Fig.4 Slot layout of the microwave equipment Optix RTN980

Figure 4 illustrates the main graphical interface of the manufacturer's software where all modules are visualized with their status and corresponding alarms. Tributary/ Line loopback is also visualized and offered user friendly handling for the engineer.

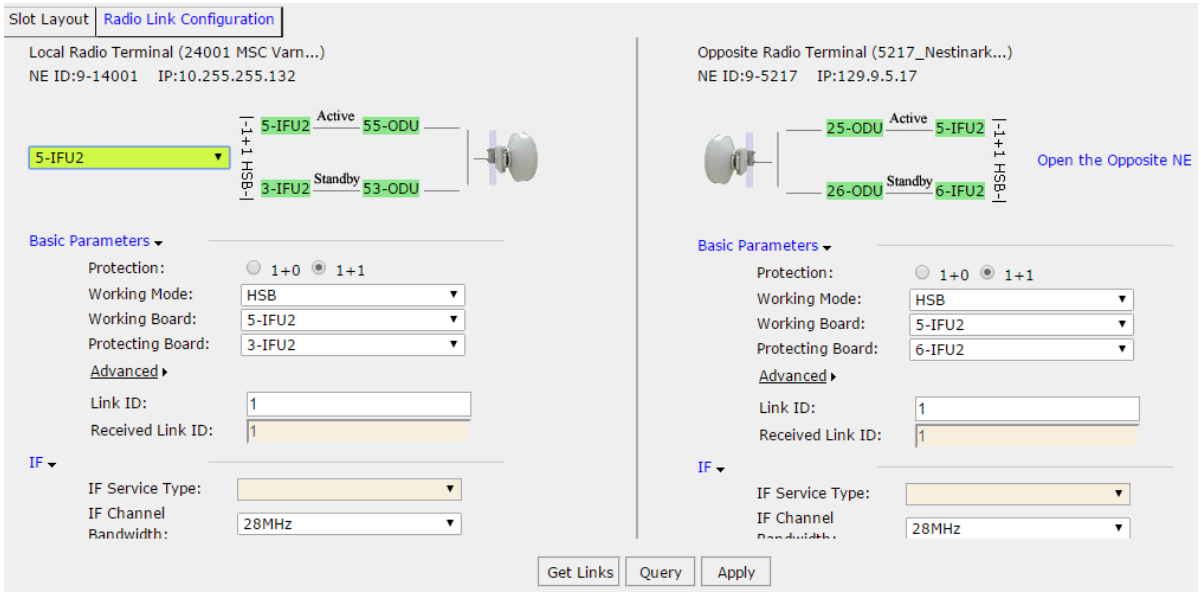


Fig.5 Radio Link Configuration showing the corresponding ODU terminals

Figure 5 shows the two microwave stations link with the corresponding IFU boards and their settings.

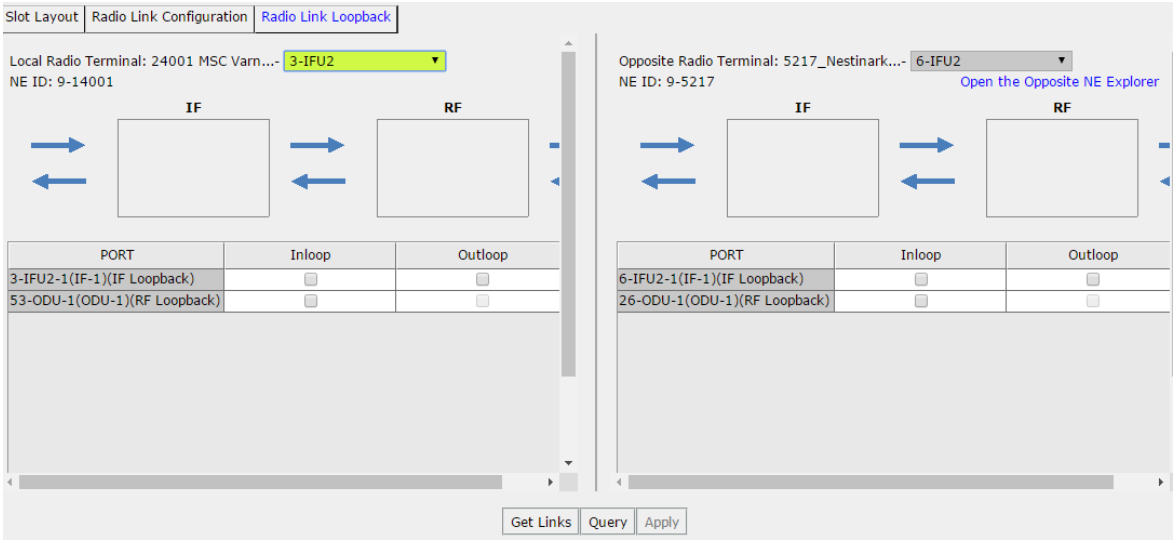
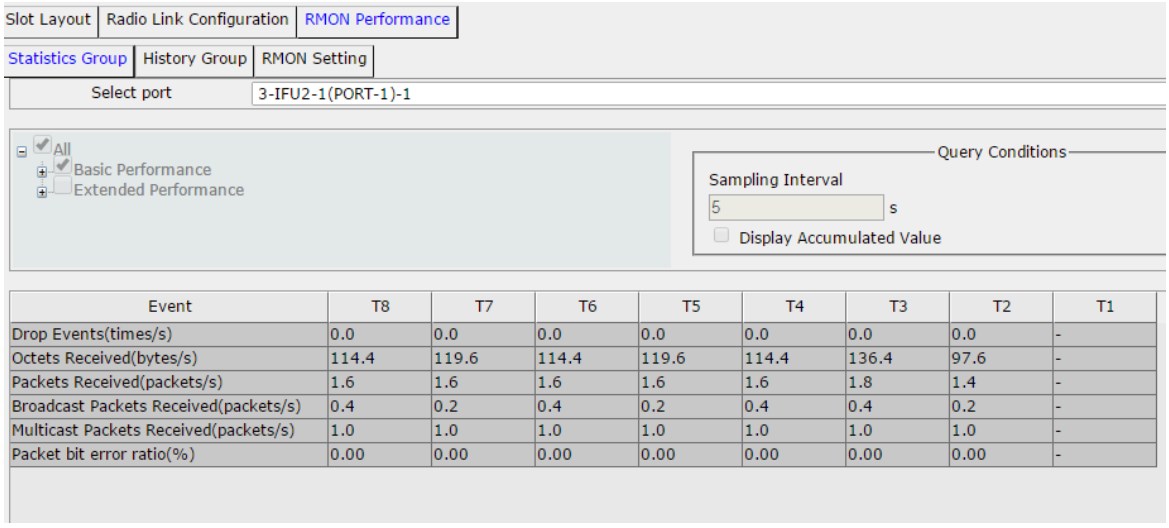


Fig.6. Configuration page used for setting radio link between microwave equipment

The IP networks, masks are entirely separate and independent. The figure 6 shows the connections between the intermediate frequency boards and the outdoor unit transceivers. It is possible to simulate loopback in order to test the sections with or without traffic



Event	T8	T7	T6	T5	T4	T3	T2	T1
Drop Events(times/s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Octets Received(bytes/s)	114.4	119.6	114.4	119.6	114.4	136.4	97.6	-
Packets Received(packets/s)	1.6	1.6	1.6	1.6	1.6	1.8	1.4	-
Broadcast Packets Received(packets/s)	0.4	0.2	0.4	0.2	0.4	0.4	0.2	-
Multicast Packets Received(packets/s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-
Packet bit error ratio(%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-

Fig7. Performance data using sampling interval of 5 sec.

On Fig.7 are shown performance data concerning packets received, packet bit error ratio, broadcast and multicast packets for different smapling intervals. Students are expected to trace the parameter changes and draw conclusion how to improve performance and change the configuration if possible.

5. Conclusions

This paper concerns stimulation of creative and intellectual abilities of students in order to enjoy their learning experience far more than in traditional approaches. Effects of innovative methods implementation will be assessed on a later stage by developing an

interactive application to measure both system performance and qualification improvement. Such innovative methodology would enhance student participation and promote interaction. Incidential methods, problem based learning and computational thinking have been considered while students work with real equipment. Automatic data collection going on in background when students work, could be applied to receive discrete assessment of the learning process. Teaching depends upon successful mode of communication and innovation. Problem based learning is a model that focuses on problem solving through self-directed strategy. The results expected are students' ability to think independently and become self-motivated. In this paper four innovative methods for qualification improvement and learning are suggested – learning by doing science, context based learning, crossover learning and learning through argumentation. Professional development can help teachers to learn strategies for learing by argumentation and overcome challenges, such as how to share the intellectual expertise with students appropriately. Since learning occurs over a lifetime, drawing on experiences across multiple settings, the wider opportunity is to support learners in recording, linking, recalling and sharing their diverse learning events. Adaptive teaching could be recommended as it uses data about a learner's previous and current learning to create a personalized path through educational content. Adaptive teaching can either be applied to classroom activities or in online environments where learners control their own pace of study.

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