DBBT
Digital Broadcasting &
Broadband Technologies

THE REPORT ON THE COMPARATIVE ANALYSIS OF MASTER STUDY PROGRAMMES IN THE FIELDS OF DBBT FROM EU AND ICT FROM WB

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INTRODUCTION

This document includes a report on the work and results of the WP1 "Analysis consulting and training" activity No3. In the scope of this activity a comparative analysis of postgraduate study programmes in the fields of DBBT from EU and ICT based study programmes from WB countries have been made. This report includes an overview of WB and EU study programmes with a list of recommended topics and directions for implementation of new DBBT postgraduate curricula in WB countries.

ICT related study programmes of WB partners – an overview

This chapter includes a short overview of the ICT related study programmes in the WB partner countries: Serbia, Kosovo and Bosnia and Hercegovina. The main curricula topics are discussed as well as their appropriateness for post graduate studies in the DBBT domain. A more detailed analysis of six ICT related study programmes from WB partner countries was made in the "D1.2 THE REPORT ON ANALYSIS OF WB MASTER STUDY PROGRAMMES IN THE FIELD OF ICT". The main outcomes of this analysis are presented in this section.

A general observation of these study programmes is that most of them are to a significant extent based on the field of electrical engineering. This in itself presents a solid basis for the DBBT study programmes as electrical engineering is a basic domain, on which many of DBBT topics are based on. Consequently, most of the WB study programmes include mathematical topics, physics, basics of electrical engineering, digital signal processing, etc. Furthermore, many of the study programmes include advanced topics like digital signal processing, telecommunications including networks, digital communications, information theory and coding, to name just a few. Some of the study programmes include more multimedia related topics such as multimedia systems, audio-visual systems and in some cases also digital TV topics. All of these are highly relevant for the DBBT domain.

As in many of the domains, the DBBT domain also experienced an evolution in terms of software and application supported terminal equipment, better known in technological terminology like "smartTV", "AndroidTV", "IPTV", to name just a few. This evolution allows for development of interactive applications in the DBBT domain, therefore knowledge of application/software development is needed and appreciated by the employers of DBBT experts. Many of the analysed WB study programmes already include a significant part of these topics, while others address them to a lesser extent.

Other topics related to the DBBT domain are addressed as well such as social sciences, management, etc., which are not necessarily essential for the DBBT domain, but can add value to the students' knowledge.

DBBT related study programmes of EU partners – an overview

The study programmes of EU partners are a complementary combination of different aspects from the DBBT domain. A typical representative of such study programmes are the ones provided by the University of Ljubljana, where the graduate and postgraduate study programme Multimedia are taking place. The DBBT domain is strongly represented through topics such as Radio and TV systems, multimedia systems, Studio and broadcasting, etc. These study programmes include a noticeable amount of software development oriented topics as well as other application and interaction related topics. The laboratory work provides students with hands on experience in broadcasting as well as the content (audio-video) production domain to some extent.

A similar study programme is offered by the Universidad Politecnica de Madrid from Spain, where a Multimedia systems and services study programme is taking place. In this study programme the students learn about broadband as well as broadcast fundamentals of content delivery to the end users. Additional topics cover the basics of content production, human computer interaction in case of interactive applications and content properties from the compression/processing point of view.

Technical school of Ostrava, which is a typical electrical engineering and telecommunications based study programme, offers a significant amount of theoretical basics as well as higher level topics related to multimedia and DBBT. Theoretical topics cover well both the broadcasting aspects as well as content processing aspects, while the higher level courses introduce the students to more practical aspects of multimedia services.

Somewhat different is the study programme from the University of Tartu, which includes basic DBBT domain topics such as mathematical basics, digital signal processing, and image processing topics as well as a significant amount of software development etc. This study programme represents a basis for other domains such as robotics.

All mentioned EU institutions have a lot of industry projects, which probably shapes to some extent the topics they offer and proves that the knowledge obtained is useful and needed in practise.

Recommendations for the WB DBBT postgraduate study programmes by the industry partners

The industry partners have made some suggestions regarding the teaching topics as well as to the procurement of the equipment. The suggestions are related as the teaching topics should also be focused on practical work, which obviously requires corresponding equipment purchase.
The main recommendations are related to the domain of multimedia content processing and display, which should include all of the current and upcoming video formats such as 4K and 8K. This requires some updates in the Audio-Video technologies and production topics as well as updates in the content processing courses.

Furthermore the industry partners made some suggestions regarding the measuring equipment and instruments, which should cover the entire spectrum of technologies.

Recommendations for the WB DBBT postgraduate study programmes

Based on the analysis of individual study programmes and comments from the industrial partners the general recommendations are made in this section for implementation of DBBT related study programmes in individual institutions. It should be noted that there is no such thing as "the ideal study programme in the DBBT domain", because this domain has a number of "flavours" such as more broadcasting and core engineering oriented vs. content production oriented or even application development oriented. Additionally it should be noted that the suggested topics can be covered in different combinations of courses, therefore it makes no sense to exactly determine the contents of courses in this document, but rather define general guidelines, which should be followed in a general sense and implemented according to each institutions capabilities, local needs and resources available.

University of Priština (UPKM)

Based on the analysis in D1.2 the University of Priština the existing ICT study programmes cover two main fields: The electrotechnics and telecommunication on one hand and Computing and information on the other. These topics do represent a sound basis for a postgraduate study programme in DBBT as many of the existing topics are more or less related to it.

Based on the analysis, the following topics/courses are recommended for inclusion in the DBBT postgraduate study programme:

- Audio-Video technologies and production

- Digital TV broadcasting basics including cable and satellite technologies

- IP, networking related topics

- Sound and acoustics

- Software/application development topics

- Some basic topics related to information/data/content processing

Optionally some additional topics are recommended from the domain of human-computer interaction, Intellectual property rights (IPR) and regulation, design basics, graphics and animation, research methods, etc.

It is advisable to have a larger number of elective courses, so the students can choose from them and adapt their knowledge to the desired skills.

University of Banja Luka (UNIBL)

The University of Banja Luka offers two DBBT related study programmes: "The electronics and telecommunications" as well as "Computing and informatics". These study programmes cover a number of fields related to DBBT, as described in D1.2.

Based on the analysis, the following topics/courses are recommended for inclusion in the DBBT postgraduate study programme:

- Audio-Video technologies and production

- Digital TV broadcasting basics including cable and satellite technologies

- Digital TV engineering

- Multimedia systems

- Software/application development topics

- Some basic topics related to information/data/content processing

Optionally some additional topics are recommended from the domains of human-computer interaction, Intellectual property rights (IPR) and regulation, design basics, graphics and animation, sound and acoustics, research methods, etc.

It is advisable to have a larger number of elective courses, so the students can choose from them and adapt their knowledge to the desired skills.
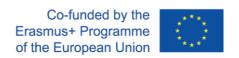

Singidunum University (SINGI)

The study programmes at the Singidunum University have two basic fields related to the DBBT domain. These are the software engineering and development as well as electrotechnical engineering. Thus, SINGI offers more software/programming oriented topics than any other of the WB project partners. Their study programmes as such are a good basis for DBBT postgraduate study programmes as both domains fit well into it.

Based on the analysis, the following topics/courses are recommended for inclusion in the DBBT postgraduate study programme:

- Audio-Video technologies and production

- Digital TV broadcasting basics including cable and satellite technologies

- Digital TV engineering

- Multimedia systems

Optionally some additional topics are recommended from the domain of human-computer interaction, Intellectual property rights (IPR) and regulation, design basics, graphics and animation, sound and acoustics, research methods, etc.

The school of Electrical and computer engineering of applied studies (VISER)

The school of Electrical and computer engineering of applied studies (VISER) offers two highly correlated study programmes in terms of their compatibility with the DBBT domain. As such, they offer a sound basis for the DBBT post-graduate studies: The Electronics and Telecommunications and Audio and video technologies. The former is related to DBBT from the engineering perspective while the latter is oriented towards the production of the digital TV related content (audio and video content).

Based on the analysis, the following topics/courses are recommended for inclusion in the DBBT postgraduate study programme:

- Advanced topics on audio-video technologies and production

- Digital TV broadcasting basics including cable and satellite technologies

- IP, networking and (multimedia) content transmition related topics

- Software/application development topics

- Some basic topics related to information/data/content processing

Optionally some additional topics are recommended from the domain of human-computer interaction, Intellectual property rights (IPR) and regulation, research methods, etc.

University of Bihać (UNBI)

The analysis of the UNBI study programme has shown two domains, related to the DBBT. Namely electrotechnical engineering as a basis, with a significant inclusion of software engineering topics. In this way, the UNBI study programmes are most similar to the SINGI study programmes, with less telecommunications/networking topics and consequently the recommendations will be very similar. The following DBBT related topics/courses are recommended for UNBI postgraduate study programme:

- Audio-Video technologies and production

- Digital TV broadcasting basics including cable and satellite technologies

- Digital TV engineering

- IP, networking and (multimedia) content transmition related topics

- Multimedia systems

Optionally some additional topics are recommended from the domain of human-computer interaction, Intellectual property rights (IPR) and regulation, design basics, graphics and animation, sound and acoustics, research methods, etc.

Higher technical professional school in Zvečan (HTPSZ)

The ICT study from the Higher technical professional school in Zvečan differs from the other study programmes in the sense that it is not that ICT/telecommunications engineering oriented. In order to provide basis for a DBBT based post-graduate study programme, more of the telecommunications and multimedia related topics are needed, which can be covered through a number of mandatory and elective courses covering the above mentioned domain on graduate and post-graduate level.

Based on the analysis and discussion, the following topics/courses are recommended for inclusion in the DBBT postgraduate study programme:

- Selected mathematical topics

- Basics of signal transmition/telecommunications

- DVB-X systems as   technology overview

- Multimedia systems

- Radio and TV engineering

- AV production

- Software/application development basics

Optionally some additional topics are recommended from the domain of IP and networking, human-computer interaction, graphics and animation, etc.

REFERENCES

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2) University of Banja Luka study programmes[+]
3) Singidunum University programmes[+]
4) VISER study programmes[+]
5) University of Bihać study programmes[+]
6) Higher technical professional school in Zvečan study programmes[+]
7) Website of the study programme: http://www.multimedija.info/eng/
8) Website of the Faculty – Education (in English): http://www.fe.uni-lj.si/en/
9) Virtual learning environments , e.FE at UL FEE: https://e.fe.uni-lj.si/login/
10) Virtual learning environments , eClassrom at UL FRI: https://ucilnica.fri.uni-lj.si
11) Massive Online Open Course: http://www.ut.ee/en/current-students/moocs
12) Website of Intelligent Computer Vision Research group: http://icv.tuit.ut.ee
13) Web site of Robotics and Computer Engineering programme: http://rce.tuit.ut.ee

[+]*The documents presenting the individual study programmes were sent to EU partners over email*

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APPENDIX

The below list includes some examples of courses or topics with additional subtopics, relevant to the DBBT domain and suggested for postgraduate study programmes in WB countries. These topics can be covered in a different combination of courses and with different levels of intensity, so this list should serve only as a general topics guideline for the implementation of the study programmes'.

AV Production

- Production aspects and challenges
- Planning AV project (from idea to realisation)
- AV project planning
- Preparing documentation
    - Synopsis
    - Screenplay
    - Storyboard
    - recording plans
    - budget planning,
    - costumography
    - scenery
    - location planning
- AV project management
- Finalizing project

RTV engineering

- Radio and television systems (understanding basics concepts and designs)
- Understanding differences between low-cost and high-reliability systems
- Design of simple and advanced radio station
    - Studio acoustics
    - Studio equipment (microphones, audio mixing consoles)
    - Transmission systems and technologies
    - Additional services
- TV studio designs
    - Space requirements
    - Purposes
    - Control rooms
    - Studio equipment (cameras, optics, lighting, scenery, sound, acoustics)
    - Connections, standards, interoperability
- Outside Broadcasting
    - Requirements
    - Purposes
    - Equipment design and space issues
    - Mobility and interoperability
- Planning, specifying and argumentation

Digital Video Broadcating

- Digital transmission systems
- Multiplexing, transport stream, content and tables
- Statistical multiplexing (reasons and results, means)
- Modulation details
- OFDM basics and reasons
- Primary and secondary distribution systems
- Understanding broadcast distribution chain
- DVB-x basics and common design
- Designing DVB-C/C2 systems (differences, special requirements, environment issues, combining with different additional services)
- Designing DVB-T/T2 systems (differences, special requirements, environment issues and impact of relief, gap fillers, size of cells)
- Designing DVB-S/S2 systems (differences, special requirements, atmosphere impact, DVB-RCS)
- FEC algorithms and implementations
- RF systems, Rx and Tx antennas, propagation details
- Measuring and understanding Modulation Error rate, Bit error rate before and after FEC

Basics of software development

- Basic data types
- Statements
- Methods
- Classes and Objects
- Tables, Arrays
- Inheritance
- Graphics
- Event driven programming
- Exceptions

Web development

- Basic web standards: HTML (DHTML. ..), CSS, design principles
- Review of the basic server technologies
- The concepts of web programming.
- Web applications in technology ASP.NET / JSP / PSP / PHP
- Features, installation and configuration of the most important web servers (IIS, Apache)
- Advanced server programming, events, ISAPI, ISAPI filters ...
- Client programming:
- Interactivity and AJAX
- XML and JSON
- Web services.
- Service-oriented architecture. Writing distributed applications.
- Safety on the Internet. Identity management. User profiling.
- Web 2.0. Semantic Web. RDF metadata and metadata standards. Ontology, OWL. Knowledge representation.

Mobile development

• Android or iOS

Project management, team work and innovation

• Basics of project management, objective, stages, main and specific objectives of the project, duration, timing of the project, resources needed for the project, , planning, tracking, prediction, decision making and evaluation of research and development projects, use of the program Super Project and / or Microsoft Project.
• Types of teams, teamwork characteristics, the roles of team members, techniques and tools for establishment of the teamwork.
• Identifying and defining problems, searching for possible solutions, choosing the best solution to the problem and the implementation of solutions. The cycle of problem solving - simplex. Techniques of problem solving: problem analysis (SWOT analysis, fishbone diagram, etc.), techniques for creating ideas for solutions (brainstorming, recording ideas, etc.), idea selection techniques (decision tree, the comparison in pairs, etc.).
• Systematic approaches for managing innovative organizations (situation analysis, setting targets of innovation, building an organizational culture of innovation, systems of promotion and reward, management of innovation and research work).
• OPTIONAL: Intellectual property (intellectual property - patents, models and copyright, the processes for registration and grant of rights). The Web and European support environment for innovations, research and development.

ICT and society

•The role of ICT in society:
    - technological determinism;
    - transnational informational capitalism;
    - inclusion and exclusion in the information society;
    - the importance of media and technological literacy for active use of modern media and
•Information services and the development of democratic potential of ICT;
    - ICT technologies for people with special needs
    - privacy and security on the Internet.
•Individuals and groups in cyberspace:
    - personality and interpersonal relationships in the cyberspace as a new social environment;
    - motivation, opinion leaders, conformism;
    - prejudice, discrimination, hate speech, violence;
    - cyber-trading and gifting.
•Web (sub)cultures and phenomena:
    - online social networks and communities of interest;
    - subcultures of hackers, crackers, gamers, pirates;
    - The social aspects of open source systems for content management;
    - online encyclopedias (e.g. Wikipedia)
    - categorization of digital documents (folksonomies, blogosphere);

Design basics

- History and development of design: an overview of styles and genres
- Basic art elements, color theory, composition - tutorial: visual studies, color studies
- Fundamentals of typography and the laws of the use of typefaces and families
- Format break and structuring with artistic and typographic elements
- Visual Communication Design
- Principals of screenshots: resolution and flexibility of design solutions to different screen resolutions, color values, contours and anti-aliasing
- The concept of interactivity in new media
- Website Design

Legal issues and IPR

- Basic legislation related to public telecommunications sector (broadcasting, Internet, telephony...)
- IPR issues
- Privacy, anonymity and citizen rights
- Influence of telecommunications and multimedia technology on legal issues

User eXperience and interaction design, HCI

- User experience and interaction design
- Service design. Requirements field research and use case scenarios.
- User centred design
- Usability.
- Specifics of human perception and accessibility design.
- User groups specifics, user modelling and personas design
- Interaction modalities.
- Virtual/Augmented reality interaction and content.
- Visual design fundamentals
- Properties and limitations of terminals in terms of Ux interaction.
- Design of user interfaces and rapid prototyping (wire framing).
- Evaluation and testing methodologies for user interfaces, interactions and prototypes. Meta-methodologies.
- Cognitive flow and gamification principles. Social interactions.
- User interface presentational formats and design, prototyping and evaluation tools.
- Best practice examples and applications in industry. Standardisation.

Multimedia Systems

- History of multimedia systems (development of radio, TV and internet services)
- Analogue and digital concepts, principles of digitalization of content and services
- Multimedia systems overview
  - IPTV systems

-         -   OTT and Internet services
-         -   Cable systems
-         -   DTT systems
- Devices and user interfaces
- Multimedia delivery chain, specifics of content types and delivery paths
- Content protection
- Legal aspects and intellectual property
- Multimedia services and convergent environments

Research methods

- Define research; explain and apply research terms; describe the research process and the principle activities, skills and ethics associated with the research process.
- Identify the components of a literature review process. Critically analyse published research
- Explain the relationship between theory and research.
- Describe and compare the major quantitative and qualitative research methods
- Propose a research study and justify the theory as well as the methodological decisions, including sampling and measurement.
- Understand the importance of research ethics and integrate research ethics into the research process.
- Be able to construct an effective questionnaire that employs several types of survey questions.
- Experiment preparation and execution
- Scientific publishing and article writing
- Research results utilization and project proposal writing

Communications security and content protection
- Data integrity and basic aspects of security: confidentiality, authenticity, authenticity and availability.
- Types of coding procedures and classification of cryptographic algorithms: stream, block, symmetric, asymmetric.
- Basic symmetric encryption algorithms (e.g. AES), examples of practical applications.
- Review of asymmetric cryptographic algorithms (e.g. RSA, ElGamal, DH) on a practical application.
- Digital signature of information content and the basics of hash algorithms.
- The management of encryption keys, digital certificates and public key infrastructure. Security of network, transport and application layers, including internet of things and clouds (example protocols are IPsec, TLS, S/MIME, SET, XMLSec, SAML, XACML, WS-*).
- Security of physical and data layers (e.g. WEP, WPA1 and WPA2).
- Basic principles of security devices: routers, firewalls and security of content.
- Secure electronic commerce. Secure radio communication systems with practical examples
- Security policy and security management in multimedia systems.
- Mechanisms of copyright protection and copyright management systems, multimedia content (DRM, CA, TP, Watermarking).
- Privacy management and privacy by design (sensor networks, RFID systems) with trust management and reputation management basics in services oriented architectures.

- Fundamentals of security engineering.
- Risk management in IS, organizational views and human factor views (security policies, human factor modelling and simulations).
- Accreditation and auditing of IS related to security (ISO 2700X, CISSP), and standards for technical implementations of hardware and software components (Common Criteria).
- Basic legislation in the area of IS security and privacy (EU directives, national implementations).

Graphics and virtual reality sets

- Understanding graphics layers, keys and mixing effects (usage of different layers, limits, differences between live and offline)
- TV workflow operations (visual mixer, CG, ME, virtual sets,…)
- Titling (character generators, creating templates, positioning, animation)
- Image editing and keying (Image processing and design)
- Video editing and keying (chroma key, luma key, masking,..)
- Weather graphic systems and animation
- Creating virtual sets and studios
- 3D virtual sets (creating backgrounds, animating, positioning
- Matching sources (brightness, contrast, lighting – positioning and softening, color balance, sharpness, perspectives, camera angles and background positioning)
- Motion tracking
- Rendering

Animation

- Creating virtual objects subjects
- Digital sculpting (creating skeletons, models, textures, painting, shaping)
- Animating skeletons
- Matchmoving and compositing
- Creating 2D and 3D models
- 2D models animation
- 3D models animation
- Cartoons