



## Subject card

Subject name and code	Virtualization in Telecommunications Networks, PG_00056860						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	February 2024	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group			Optional subject group Subject group related to scientific research in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	1	ECTS credits			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Teleinformation Networks -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Marcin Narloch				
	Teachers		dr inż. Marcin Narloch				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	30		4.0		16.0	50
Subject objectives	Learning the methods and solutions used in Network Function Virtualization in telecommunications. Practical study of problems regarding virtualization in telecommunication networks.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_W03] Knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum.	Student defines basic notions of the virtualization in telecommunications, characterizes elements of Network Function Virtualization architecture and describes exemplary solutions of Network Function Virtualization realizations.			[SW1] Assessment of factual knowledge		
	[K7_U06] can analyse the operation of components, circuits and systems related to the field of study; measure their parameters; examine technical specifications; interpret obtained results and draw conclusions	Student configures parameters of selected virtualization solution for realization of particular network function and modifies their values according to conducted test and measurements.			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools		
	[K7_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions	Student analyses, measures and tests network function virtualization solution including its performance and scalability.			[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject		
	[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	The student assesses the practical usefulness of known solutions for virtualization of particular network functions.			[SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	<p>Notion of virtualization in telecommunications and overview of virtual system solutions used in telecommunications.</p> <p>Introduction to the concept of Network Functions Virtualization (NFV).</p> <p>The reasons and the aim of NFV introduction.</p> <p>NFV standardization.</p> <p>Basic notions of virtualization.</p> <p>NFV architecture elements. Network Functions Virtualization Infrastructure (NFVI).</p> <p>Software and hardware mechanisms used in Network Functions Virtualization Infrastructure realization.</p> <p>Network functions implemented in the virtual form (Virtualized Network Functions, VNF). Examples of VNF realization in the context of NGN data transport layer and control layer.</p> <p>Relation between NFV and Software Defined Networks (SDN).</p> <p>NFV Management and Orchestration Framework (NFV-MANO).</p> <p>Systems, protocols and data structures used in NFV-MANO.</p> <p>Evolution of NFV concept in the context of (Cloud-native Network Functions (CNF).</p> <p>Container technology (operating system level virtualization) and its influence on NFV in the context of CNF.</p> <p>Measurement, testing, performance and scalability of NFV and CNF solutions.</p> <p>Detailed description of selected NFV and CNF realization.</p>											
Prerequisites and co-requisites												
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="453 1397 794 1424">Subject passing criteria</th> <th data-bbox="799 1397 1141 1424">Passing threshold</th> <th data-bbox="1145 1397 1485 1424">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="453 1431 794 1458">Practical exercise</td> <td data-bbox="799 1431 1141 1458">50.0%</td> <td data-bbox="1145 1431 1485 1458">40.0%</td> </tr> <tr> <td data-bbox="453 1464 794 1491">Midterm colloquium</td> <td data-bbox="799 1464 1141 1491">50.0%</td> <td data-bbox="1145 1464 1485 1491">60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Practical exercise	50.0%	40.0%	Midterm colloquium	50.0%	60.0%
Subject passing criteria	Passing threshold	Percentage of the final grade										
Practical exercise	50.0%	40.0%										
Midterm colloquium	50.0%	60.0%										
Recommended reading	Basic literature	<p>Materials prepared by lecturer, made accesible as xerocopy.</p> <p>Manual in the form of xerocopy</p>										
	Supplementary literature	<p>Smith J. E., Nair R. Virtual Machines Versatile Platforms for Systems and Processes, Morgan Kaufman, 2005.</p> <p>Stallings W., Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Prentice Hall, 2015.</p> <p>Chayapathi R., Hassan S. F., Shah P., Network Functions Virtualization with a Touch o SDN, Addison-Wesley Professional, 2016.</p> <p>Zhang Y., Network Function Virtualization. Concepts and Applicability in 5G Networks, Wiley, 2018.</p>										

	eResources addresses	Adresy na platformie eNauczenie: Wirtualizacja w sieciach telekomunikacyjnych - edycja 2024 - Moodle ID: 37800 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37800">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37800</a>
Example issues/ example questions/ tasks being completed	<p>Configuration and optimization of virtualization system (virtual machine) for software executed in virtual environment.</p> <p>Realization of selected network function in full virtualization environment with hardware extension support.</p> <p>Realization of selected network function in selected virtualization environment on operating system level.</p> <p>Realization of selected network function in selected cloud environment.</p> <p>Realization of management and orchestration of network function virtualization.</p> <p>Automation of virtualization solution deployment in telecommunication.</p>	
Work placement	Not applicable	