



## On

# Non-orthogonal Multiple Access Technology for 5GB

(14/06/2021 to 25/06/2021)

<b>Sponsored by:</b> <b>Scheme for Promotion of Academic and Research Collaboration (SPARC)</b>	<b>Organized by:</b> <b>Department of Electronics and Communication Engineering, NIT Tiruchirappalli, India</b>	<b>Collaboration with:</b> <b>National Research Tomsk Polytechnic University, Russia</b>
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### About SPARC:

Scheme for Promotion of Academic and Research Collaboration (SPARC) is a Ministry of Human Resource Development (MHRD), GOI initiative to improve research ecosystem in India. It supports national premier educational institutions by facilitating academic and research collaborations between Indian institutions and the best and selected institutions across the world's 28 nations. It encourages international faculty, Indian institution visits and long-term stays to teach courses and conduct workshops for the benefit of Indian researchers and students in the selected research area.

### About TPU- Russia:

The Tomsk Polytechnic University (TPU), Russia is ranked at 387 in QS world rank and is ranked as 10th in Russia. It has 277th place in the world in the direction of "Engineering and Technology" as of QS ranking and 201-250 place in the world in the discipline "Engineering: mechanics, aviation, production" and Chemistry. TPU is the first engineering school in Russia's Far East to open doors in 1896. Today TPU is one of Russia's leading public research universities with focus on applied science and technology. TPU is a research university with a strong tradition of excellence in the areas of physics, applied engineering, and electronics engineering. Recently, we added nanotechnologies and alternative energy to our research portfolio. Tomsk Polytechnic's annual research budget of \$30 million ranks second among technical and engineering schools in the country. Roughly 10% of funding comes from outside Russia; we rank second to none in this category.

### Key Resource Person:

#### **Prof. DUSHANTHA NALIN K JAYAKODY,**



Senior Member IEEE, Fellow, IET, received the Ph. D. degree in Electronics and Communications Engineering, from the University College Dublin, Ireland. He received his MSc degree in Electronics and Communications Engineering from the Department of Electrical and Electronics

Engineering, Eastern Mediterranean University, Turkey (under the University full graduate scholarship). From 2014 - 2016, he was a Postdoc Research Fellow at University of Tartu, Estonia and University of Bergen, Norway. From 2016, he is a Professor at the School of Computer Science & Robotics, National Research Tomsk Polytechnic University (TPU), Russia. Prof. Jayakody also serves as the Head of Research and Educational center on Automation and

Information Technologies and Founder of Tomsk infocomm Lab at TPU, Russia. In addition, since 2019, he also serves as the Head/ School of Postgraduate & Research, Sri Lanka Technological Campus (SLTC), Padukka Sri Lanka and Founding director of Centre of Telecommunication Research, SLTC, Sri Lanka.

He held visiting and/or sabbatical positions at the Centre for Telecommunications Research, University of Sydney, Australia in 2015 and Texas A&M University in 2018. Prof. Jayakody has received the best paper award from the IEEE International Conference on Communication, Management and Information Technology (ICCMIT) in 2017. In July 2019, Prof. Jayakody received the Education Leadership Award from the World Academic Congress in 2019. In 2017 and 2018, he received the outstanding faculty award by National Research Tomsk Polytechnic University, Russia. He also received Distinguished Researcher in Wireless Communications in Chennai, India 2019. Prof. Jayakody has published nearly 200 international peer reviewed journal and conference papers and books. His research interests include PHY and NET layer prospective of 5G communications technologies such as NOMA for 5G etc, Cooperative wireless communications, device to device communications, LDPC codes, Unmanned Ariel Vehicle etc. In his career, so far, he has attracted nearly 6M \$ research funding. Prof. has organized or co-organized more than 25 workshops, special sessions and IEEE conferences. He currently serves as an Area Editor the Elsevier Physical Communications Journal, MDPI Information journal, MDPI Sensors and Wiley Internet of Technology Letters. Also, he serves on the Advisory Board of MDPI Multidisciplinary Journal Sci. In addition, he serves as a reviewer for various IEEE Transactions and other journals.

### Eligibility:

The programme is open to UG, PG and Ph.D. Scholars of Electronics and Communication Engineering and allied disciplines of Institutes throughout India and Foreign Countries.

### Course Coordinators:

- ❖ Dr. P. Muthuchidambaramanathan, Professor, ECE Dept.
- ❖ Dr. G. Lakshmi Narayanan, Professor, ECE Dept.
- ❖ Dr. G. Thavasi Raja, Assistant Professor, ECE Dept.

### Registration:

No Registration fee, Last date of Registration 13.06.2021  
**(Maximum 100 Participants)**

**To Register click on the below link :**

**<https://forms.gle/D6CyP1jVPPF3UJ6pB7>**

**For any clarification, please contact:**

Mr. Anandpushparaj. J, Mobile: 9092085186

Mail id: sparc5gnitt@gmail.com

## Course Outline

<b>Name of course:</b>	<b>Non-orthogonal Multiple Access Technology for 5GB (12 Lectures)</b>
<b>Course level:</b>	<b>UG, PG (any year)</b>
<b>Course Instructor:</b>	<b>Prof. Dushantha Nalin K. Jayakody</b>
<b>Course Coordinator:</b>	<b>Dr. P. Muthuchidambaranathan</b>
<b>Teaching Assistants:</b>	<b>Dr. Rajkumar Samikkannu (TPU) &amp; Anandpushparaj P. (NIT- T)</b>
<b>Discipline:</b>	<b>Electronics &amp; Electrical Engineering/ Telecommunications Engineering</b>
<b>Lecture hours:</b>	<b>12 hrs</b>
<b>Pre-requisites:</b>	<b>Module on Digital Communications</b>

### Course Description:

Non orthogonal multiple access (NOMA) scheme is identified as one of the most prominent technology in 5G and beyond wireless network. Main features of NOMA includes its capability to support large number of new mobile connections and high spectral efficiency. In particular, the power domain NOMA serves for several users with same time and frequency resources provided with different power levels according to the channel conditions. Hence, the proper power allocation among the mobile users is another major problem in NOMA based wireless network. Basic operation of the power domain NOMA includes the superposition coding (SC) technique to combine the transmit signals and the successive interference cancellation (SIC) technique to separate the signals at the receiver.

In this module, we discuss NOMA and the various issues in NOMA networks, including integration to 5G and other design issues. This module starts from the basics and key techniques of NOMA. Then, we identify a few critical issues in NOMA networks, including integration with other core technologies, energy efficiency, NOMA based energy harvesting, and security. Finally, new expansions on artificial intelligence (AI)-enabled NOMA networks will be discussed. Also, the research challenges on NOMA to support colossal number of users and other possible research trends will be discussed.

### Intended Learning Outcome

ILO 1: Explain the basic introduction Non orthogonal multiple access (NOMA) for 5GB.

ILO 2: Critically analyses the Compatibility of NOMA with Het Nets, Space time block coding and Cognitive Radio. This is pivotal in understanding and quantifying the performance of NOMA in physical (PHY) layer.

ILO3: Evaluate NOMA as a competitive scheme in relation to sustainability, security.

ILO4: Explain recent developments on artificial intelligence (AI)-enabled NOMA networks are discussed, and the research challenges on NOMA to support massive number of devices are identified

Lecturer Hrs – 12 (14/06/2021 to 25/06/2021)

### Course Contents (# of lecture hours)

Topic	Contents	# of hours
1	What is Non-Orthogonal Multiple Access (NOMA)?	1
2	Compatibility in NOMA	1
2	Integration of OFDM with NOMA: A Bridge	1
3	NOMA Architecture Based on Distributed Space Time Block Coding	1
4	Sustainability of NOMA	2
5	Security in NOMA-assisted Networks	1
6	NOMA aided Network Coding	2
7	Artificial Intelligence (AI) Enabled NOMA	1
8	Standardization of NOMA and Future Research Directions	1
9	What is Non-Orthogonal Multiple Access (NOMA)?	1

**Practical:** Practical Sessions on NOMA and a physical Demo of NOMA will be conducted.

### Assessment

**- By attendance 75%**

**- Quizzes 25%**

### Reference:

1. Mojtaba Vaezi, Zhiguo Ding, H. Vincent Poor, "Multiple Access Techniques for 5G Wireless Networks and Beyond", 2019, ISBN: 978-3-319-92089-4.
2. M. N. Jamal, S. A. Hassan, Dushantha Nalin K. Jayakody and Joel J. P. C. Rodrigues, "An Efficient Cooperative NOMA Architecture Based on Distributed Space Time Block Coding," IEEE Vehicular Technology Magazine, to appear, Dec 2018
3. V. Basnayaka, Dushantha Nalin K. Jayakody, V. Sharma, N. Sharma, P. Muthuchithamparanathan, H. Mabel, "A New Green Prospective of Non-orthogonal Multiple Access (NOMA) for 5G", MDPI Information, 11
4. L. Dai, B. Wang, Z. Ding, Z. Wang, S. Chen and L. Hanzo, "A Survey of Non-Orthogonal Multiple Access for 5G," in IEEE Communications Surveys & Tutorials, vol. 20, no. 3, pp. 2294-2323, thirdquarter 2018, doi: 10.1109/COMST.2018.2835558.
5. O. Maraqa, A. S. Rajasekaran, S. Al-Ahmadi, H. Yanikomeroglu and S. M. Sait, "A Survey of Rate-Optimal Power Domain NOMA With Enabling Technologies of Future Wireless Networks," in IEEE Communications Surveys & Tutorials, vol. 22, no. 4, pp. 2192-2235, Fourthquarter 2020, doi: 10.1109/COMST.2020.3013514.
6. S. M. R. Islam, N. Avazov, O. A. Dobre and K. Kwak, "Power-Domain Non-Orthogonal Multiple Access (NOMA) in 5G Systems: Potentials and Challenges," in IEEE Communications Surveys & Tutorials, vol. 19, no. 2, pp. 721-742, Secondquarter 2017, doi: 10.1109/COMST.2016.2621116.