WAVES

The Bharti School Newsletter

"To Develop Telecom Leaders Through Excellence In Education and Research"

Issue : 08 **May, 2019**

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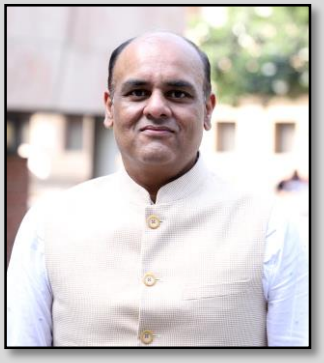
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Greetings!

The last year at Bharti School has been very productive. Some of the initiatives of the previous year started bearing fruit, the funding to the school jumped from about 5cr in the last 15 years to more than 40cr last year. The number of research labs increased to 7 from 2, a more than 3-fold increase in the last 2 years. Now is the time for further changes; the school needs to adapt to the times and that transition is the journey we embarked on this year. One change, the process of which has been initiated, is human resource restructuring. The technical, managerial and administrative staff organization has been restructured. New hires and replacements have been done to support the fast paced change the school is experiencing. The associated faculty have been requested to re-look at their association with the school vis-a-vis their alignment with the next generation telecommunications. A bold new initiative is involving 8 new adjunct faculty members, from other IITs, to bolster the research output.

There was a gap between the opportunity and our ability to respond and deliver. This gap is being bridged and the process has been initiated by strategic partnerships with 3 IITs, while others are being negotiated in this current year.

The school will also work on restructuring the curriculum now. The PG academic program will address the new requirements that the fast paced telecom industry evolution has mandated. We will work towards including Machine Learning on the one hand and policy regulation, standardization & ethical, environmental aspects on the other. This will be done over the next 2 years and should give another upward thrust to the school contributions. At another level, research will be given equal focus in the curriculum which will reflect in the increased number of PhD students.

Finally, we stay committed to continued growth and service to the nation at large. As a specific contribution we will endeavour to support Bharti University so that it can set an example for other private universities to follow.

Best wishes,
Prof. Brejesh Lall, Head



ACTIVITIES:

❖ *Inauguration of India's First 5G Massive MIMO Lab*

India's first 5G Massive MIMO lab "Next Generation Wireless Communication Laboratory" was inaugurated on 13th April, 2018 by Prof. M. Balakrishnan (DDSP), IIT Delhi and Mr. Jayaram Pillai, MD (IndRA), National Instruments . The ceremony was attended by faculty members of IIT Delhi and Industry partners.

The Next Generation Wireless Communication Laboratory (Next Gen Lab) is engaged in research on future wireless communication technologies and their applications. The vision of this lab is to, i) discover/invent new communication technologies which enhance the capabilities of current communication technology, ii) to train skilled personnel in the area of design and development of 5G/6G communication systems and their implementation, iii) to file patents for inventions and publish research findings in high impact factor journals, transactions and conferences, and iv) to provide solution to industrial problems through sponsored industry projects and consultancy.

The Next Gen Lab is among the first few labs in India which houses a 5G massive mimo base station. It also houses equipments necessary for design and implementation of 5G/6G communication systems. Projects currently being executed in Next Gen Lab are as follows:

i) Indigenous 5G Test bed (Funded by DoT, Govt. of India).

ii) Random Access and Re-Transmission protocols for massive mimo systems (Funded by SERB, DST Govt. of India).







❖ *5G Awareness Workshop:*

A 5G workshop was organized by Prof. Brejesh Lall, Head, Bharti School of Telecommunication Technology & Management, IIT Delhi entitled “5G Awareness Workshop”, on 14th June, 2018. Motive of this workshop was to spread awareness among IITD community, so that they can participate and contribute to the ongoing activities. This workshop talked about 5G , its applications and its impact across various disciplines.

The Workshop was inaugurated in the presence of Prof. Huzur Saran, Prof. S.D. Joshi and Prof. S. Arun Kumar. Mr. Deepak Soni, Head 5G & Strategic Network Evolution, Ericsson gave the introductory talk to IITD community. Students also actively participated in this workshop and presented their research work and demos. Technical talk was presented by Prof. Huzur Saran, Dr. Sunil Jha, Dr. Madhusudan Singh and Dr. Manav Bhatnagar. A panel discussion was held by Dr. Monika Aggarwal, Mr. Umang Jindal and Mr. Guninder Preet Singh.







❖ *Inauguration of Ericsson-IITD 5G CoE*

In a bid to stimulate the 5G ecosystem in India, Swedish telecommunications company Ericsson formally launched the country's first "Centre of Excellence (CoE) and Innovation Lab" for 5G at the Indian Institute of Technology (IIT) Delhi on 3rd July, 2018. This will be a first-of-its-kind 5G innovation lab set up by Ericsson for Indian industry and academia. This is also the first time a 5G testbed is being created in an academic institute. Why is this important? According to an Ericsson report, 5G enabled digitization revenue potential in India will be $27.3 billion by 2026. Some of the unique features of 5G technology include industrial control and automation, autonomous driving, hospital and medical applications and data management amongst others.

The 5G innovation lab is an open platform and aims to help the industry and the academia to leverage the 5G technology to develop new 5G-based apps and business models.

On Tuesday, (3rd July 2018), this CoE was dedicated to the nation by Manoj Sinha, the Central Minister of State for Communication (I/C) and Minister of Railways, together with Börje Ekholm, President and CEO, Ericsson at IIT Delhi. Speaking at the launch the minister said: "I would like to congratulate Ericsson for taking the lead in terms of setting up the first 5G Centre (CoE)…this supports the government's plans to foster a robust and vibrant 5G ecosystem in India." Mr. RS Sharma, Chairman of the Telecom Regulatory Authority of India (TRAI) was also present for the inauguration.

At the Centre, a host of applications for 5G data were displayed. For example, 5G data can be used to monitor civilian safety, control traffic, help doctors operate on patients from remote places amongst others. It can also be used to monitor plant growth with the help of sensors and much more.





❖5G Workshop – India Perspective

A workshop was organized by Prof. Brejesh Lall, Head, Bharti School of Telecommunication Technology & Management, IIT Delhi entitled "5G Workshop- India Perspective", on 21st September, 2018. This workshop presented a glimpse of all the activities being undertaken in India to ensure a smooth and fruitful transition to 5th Generation Mobile Communication Technologies. Many novel applications are on the horizon due to the capabilities inherent in 5G Technologies. Some of them were be demonstrated at the workshop. The research & academia, industry, telecom regulator and government perspective were invited to attend the workshop. The workshop was inaugurated by Sh. N Sivasailam, Special Secretary, DoT, along with Prof. M. Balakrishnan, Deputy Director, IITD, Ms. Pamela, Director General, TSDSI , Prof. Ranjan Bose, Director, IIIT Delhi, Mr. Anil Dwivedi, Hub CTO, Vodafone Idea Ltd. and Mr. Sandeep Aswal, CTO, Vodafone Idea Ltd. Prominent speakers included Prof. Kuchi Kiran Kumar, Dept of Electrical Engg, IIT Hyderabad, Prof. Bhaskar Ramamurthi, Director, IIT Madras, Mr. Madhusudana Raghupatruni, Platform Architect, Intel Corporation, Mr. Thiaw Seng, Head of NS Network Evolution, Ericsson.









❖*Driverless Car Demo at Indian Mobile Congress 2018*

Ericsson and Reliance Jio showcased their jointly developed 5G use cases demo at IMC 2018. The demonstration include 5G connected car and VR-enabled driving using 5G. It demonstrates remote operation and control of a car that is connected over a live 5G network on 3.5 GHz band it IIT Delhi. The use case was made accessible at the IMC for remote driving and showcasing assistance through 5G edge computing.

The 5G connected car was developed in collaboration with Ericsson-IIT Delhi 5G Centre of Excellence. The car showcased "5G's reliability, high data rate capability and low latency-key elements for remote operations of machines.



❖ *Marconi Society sponsored Celestini Project India 2018 Competition Awards Ceremony*

The Marconi Society Young Scholars (http://marconiyoungscholars.org/) are working to inspire undergraduate students in developing countries to help solve important social problems through the Celestini Program (http://marconiyoungscholars.org/project/celestini/). The Program expanded to India in 2017 and is led by IIT Delhi alumnus Dr. Aakanksha Chowdhery (Marconi Young Scholar, Princeton University) in partnership with IIT Delhi. IIT Delhi partners include Prof. Brejesh Lall (Professor, IIT Delhi and Head, BSTTM IIT Delhi) and Dr. Prerana Mukherjee and Aditi Bhateja (PhD Research Scholar IIT Delhi). Student teams are selected through a technical screening exam, as well as an interview in spring. The selected student teams work over the summer at IIT Delhi to identify an important problem in their community that they would like to solve and then to prototype their projects. In 2018, more than one hundred students expressed interest in working on the program during the summer and three student teams, comprising of eight students, were selected and they worked on the problem of air pollution and road safety analytics. The winning entry developed an Android application, called Air Cognizer, to perform real-time air quality analytics. To detect the Air Quality Index (AQI), the user has to upload an image taken outside with half of it covering sky region. Using image processing and machine learning tools the app estimates the AQI in the area. The app returns the AQI in real-time using Tensorflow Lite and ML Kit. The second team prototyped a website that prototyped a low-latency platform to transmit vehicle-to-vehicle alerts about potential road safety hazards/ collisions using Xbee radios. **The award ceremony was held on Nov 1, 2018 at Amar Nath & Shashi Khosla School of IT, IIT Delhi** where Prof. Andrea Goldsmith, Director Marconi Society and Professor of Electrical Engineering, Stanford University gave the inaugural address on "Can machine learning beat the theory in communication system design?" The ceremony was attended by IIT Delhi's Dean Alumni Affairs & International Programmes, Prof. Sanjeev Sanghi, and several faculty members from Electrical Engineering and Computer Science Departments, as well as Industry Partners. **The winning team was awarded a certificate with a cash prize of $1500**.







❖ *Publications since 22nd SAB:*

- Manoj BR, Ranjan K. Mallik, Manav R. Bhatnagar, and Shubhankar Gautam presented paper, " Virtual Full-Duplex Relaying in Multi-Hop DF Cooperative Networks Using Half-Duplex Relays With Buffers" in IET Communications, December 2018.
- Manoj BR, Ranjan K. Mallik, and Manav R. Bhatnagar, "Performance Analysis of Buffer-Aided Priority-Based Max-Link Relay Selection in DF Cooperative Networks" in IEEE Transactions on Communications, July 2018.
- BR Manoj, RK Mallik, MR Bhatnagar, "Priority-based max-link relay selection scheme for buffer-aided DF cooperative networks" 2018 IEEE Wireless Communications and Networking Conference (WCNC), April 2018 pages 1-6.
- S.V. Pechetti, A. Jindal, R. Bose, "Exploiting Mapping Diversity for Enhancing Security at Physical Layer in the Internet of Things", IEEE Internet of Things Journal, May 2018.
- S Garg, A Dixit, "Models for Evaluating Power Saving Techniques in Flexible Optical Access Networks", 2018 20th International Conference on Transparent Optical Networks (ICTON).
- S Mukherjee, AK Sinha, SK Mohammed, "Timing Advance Estimation and Beamforming of Random Access Response in Crowded TDD Massive MIMO Systems", IEEE Transactions on Communications, Feb 2019.
- A Agarwal, SK Mohammed, "Rate Region of the ZF Precoder in a 2× 2 Multiuser Optical IM/DD Channel", IEEE Transactions on Communications, Feb 2019.
- BC Pandey, SK Mohammed, "A Low Latency Transmission Method for Massive MIMO Systems with Low Control Signaling Overhead", IEEE Transactions on Communications, Jan 2019.
- N Pandey, RK Mallik, B Lall, "Molecular Communication: The First Arrival Position Channel", IEEE Wireless Communications Letters, October 2018.
- A Grover, B Lall, "A Novel Solution to Prevent Diesel Pilferage at Telecom Tower Site", IEEE Transactions on Instrumentation and Measurement, March 2019.
- F Fauziya, M Agrawal, B Lall, "Quaternion based representation of Vector Sensor Receiver", OCEANS 2018 MTS/IEEE Charleston, 1-5.
- F Fauziya, B Lall, M Agrawal, "Impact of vector sensor on underwater acoustic communications system", IET Radar, Sonar & Navigation 12 (12), 1500-1508.
- F Fauziya, V Dodeja, B Arora, B Lall, M Agrawal, "Feasibility Study of Vector Sensor Based Hybrid MIMO Underwater Communication Systems", 2018 OCEANS-MTS/IEEE Kobe Techno-Oceans (OTO), 1-5.
- F Fauziya, B Lall, M Agrawal, "Application of Vector Sensor for Underwater Acoustic Communications", April, 2018.
- NK Dev, R Shankar, R Gupta, J Dong, "Multi-criteria evaluation of real-time key performance indicators of supply chain with consideration of big data architecture", Computers & Industrial Engineering 128, 1076-1087.
- R Shankar, R Gupta, DK Pathak, "Modeling critical success factors of traceability for food logistics system", Transportation Research Part E: Logistics and Transportation Review 119, 205-222.
- Vrat, P., Gupta, R., Bhatnagar, A., Pathak, D.K., & Fulzele, V. (2018) Literature Review Analytics (LRA) on Sustainable Cold-chain for Perishable Food Products: Research Trends and Future Directions. OPSEARCH: Journal of the Operational Research Society of India, Vol. 55, pp. 601-627 ('C' rank in ABDC).
- Prasad, S., Shankar, R., & Gupta, R., Roy, S. (2018). A TISM modeling of critical success factors of blockchain based cloud services. Journal of Advances in Management Research, Vol. 15(4), pp. 434-456.
- Rajesh K. Singh, Ananjan Basu, Shiban Koul, "Reconfigurable Microstrip Patch Antenna with Switchable Polarization" , IETE Journal of Research, Aug 2018.
- Rajesh kumar Singh, Ananjan Basu, Shiban Kishen Koul, "A Novel Reconfigurable Microstrip Patch Antenna With Polarization Agility in Two Switchable Frequency Bands", IEEE Transactions on Antennas and Propagation, Jul 2018.
- P Chakraborty, S Prakriya, "Optimizing Performance of Co-Existing Underlay Secondary Networks", IEEE Transactions on Wireless Communications 17 (6), 4134-4149.
- B Kumar, S Prakriya, "Performance of adaptive link selection with buffer-aided relays in underlay cognitive networks", IEEE Transactions on Vehicular Technology 67 (2), 1492-1509.
- B Kumar, S Prakriya, "Framework for Discrete Rate Transmission in Buffer-Aided Underlay CRN With Direct Path", April 2018.

❖ *Airtel Lectures :*

5th September, 2018

"Right of Way Policy"

By

Rajan S. Mathews,

Director general, COAI





❖ *Talk :*

16th March, 2018

"Stress Management, Rejuvenation, How to complete sleep in 1.5 hours"

By

Mr. M.K. Seth,

CGM, BSNL





❖ *New Adjunct Faculty*

Seven new adjunct faculties have become a part of Bharti School:



Dr. Vimal Bhatia, IIT Indore

Specialities:

- Audio signal processing, Video Signal processing, Communication channel estimation



Dr. Arzad Alam Kherani, IIT Bhilai

Specialities:

- Computer networks, Queueing systems, Wireless communications.



Dr. Dhiman Saha, IIT Bhilai

Specialities:

- Cryptography, Theoretical Cryptanalysis, Hash functions, Authenticated / Block Ciphers, Fault Analysis Attacks, Higher Order Boolean Derivatives, Memory Hard Functions, Proof-of-Work.



Dr. S K Subidh Ali, IIT Bhilai

Specialities:

- Cyber Security, Hardware Security and Trust, Adversarial Machine Learning, IoT and Smart Infrastructure Design and Security



Dr. Ashish Mathur, IIT Jodhpur

Specialities:

- Power Line Communications, Free Space Optical Communications, Visible Light Communications



Dr. Arun Kumar Singh, IIT Jodhpur

Specialities:

- Communication Theory, Wireless and Mobile Communications, Satellite based Navigation Systems, Spread Spectrum Systems



Dr. Soumava Mukherjee, IIT Jodhpur

Specialities:

- SIW, Broadband planar antenna, multiband planar antenna



Dr. Anand Srivastava, IIIT Delhi

Specialities:

- Optical core and access network, Fiber-Wireless (FiWi) architectures, Optical Signal Processing, Free space optical communications, energy aware optical networks

❖ *Projects:*

1) "Building end-to end 5G Test Bed" - DoT.
2) "802-11n WLAN Phase-1" -- HSC.
3) (i) IoT CSR initiative (ii) 5G Broadcast study and (iii) VR Gaming -- Samsung
4) "Focus Group on Machine Learning " – ITU-T.

❖ *Collaborations :*

1) "Collaboration in the field of Telecommunications Standards, IPR generation and 5G technologies" - TSDSI
2) MoU with MoMagic and MediaTek.
3) MoU with HSC.
4) IITD-TCS workshop on 5G.

HONOURS AND AWARDS

BHARTI MERIT AWARD AND BEST WOMEN GRADUATE AWARD (2016-17)















BHARTI MERIT AWARD AND BEST WOMEN GRADUATE AWARD (2017-18)

















STUDENT ACTIVITY

❖ Placements:

M.Tech and MBA Graduates had an excellent placement.

Year 2017-19

Companies who recruited M.Tech Students:

Havells Innovation Center, Infineon Technologies India, Intel, Delta Electronics, Enphase Energy, MediaTek , Intel

***Average Salary Package*: Rs. 11 Lac P.A.**

***Highest salary Offered*: Rs. 25 Lac P.A.**

Companies who recruited MBA Students:

Brillio, Amazon, EY, Accenture Strategy, CapGemini, Wipro, Cognizant, Texas Instruments, Deloitte, Maruti Suzuki, Aspiring Minds, Shell, Axtria, ICICI Bank, HDFC Bank, Mitsul & Co. Azure Power.

***Average Salary Package*: Rs. 13Lac P.A.**

***Highest Salary Offered:* Rs. 21.7 Lac P.A.**

❖ Bharti Students Views:



My overall experience with bharti is excellent .I have learnt a lot in these two years .The best part about bharti school is 24*7 availability of labs and a highly competitive and motivated environment. Two years in the college brought immense change in my life in terms of confidence and skills. Highly qualified and experienced faulty make this department one of the best department in IIT Delhi .I am really lucky of being a part of Bharti family as it brought immense change in my life.

Bhawna Kamra
2017JTM2187

❖ Coverage on Alumni:



Being part of Bharti School at IIT Delhi was an enriching experience for me both academically and personally. Bharti School has a unique course structure that it offers through an interdisciplinary M.Tech program in Telecom Technology and Management. The program offered me a large pool of courses to choose from and the flexibility in curriculum empowers the student to broaden their skill set based on their individual interest. On a personal front I learnt a lot about team work and the challenging assignments that always came a "short" deadline that helped me in honing time management skills and efficient working- a life-long lesson I'll always cherish. Altogether it was an extraordinary experience to be a student here at BSTTM.

Vipul Saxena
2015JTM2190

❖Students who attended International Conferences and Presented Papers :



1)"Farheen Fauziya" attended conference "OCEANS 2018 MTS/ IEEE", held at "Charleston, USA" from "22-25 Oct, 2018".
She got her paper published "Quaternion based representation of vector sensor receiver", pages 1-5.

2) "Farheen Fauziya" attended conference "OCEANS 2018 MTS/ IEEE Kobe Techno Oceans(OTO)", held at "Kobe, Japan" from "28-31 May, 201".
She got her paper published "Performance Analysis of Vector Sensor based MIMO Underwater Communication Systems", pages 1-5.



"Manoj BR" attended conference "IEEE Wireless Communications and Networking Conference (WCNC)", held at "Barcelona, Spain" from "15-18 Apr, 2018".
He got his paper published "Priority-based max-link relay selection scheme for buffer-aided DF cooperative networks".



"Sukriti Garg" attended conference "20th International Conference on Transparent Optical Networks (ICTON), IEEE", held at "Romania" from "1-4 July, 2018".
She got her paper published "Models for Evaluating Energy Saving Techniques in Flexible Optical Access Networks".



"Kirti Kant" attended conference "2018 International Conference on Signal Processing and Communications (SPCOM)", held at "Romania" from "1-4 July, 2018".
He got his paper published "Jammer Assisted SEE Maximization in Decode-and-Forward Relay Network".

❖Students who attended National Conferences/ Workshops and Presented Papers:



"Sukriti Garg" attended conference "12th IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS)", held at "IIT Indore" from "1 - 6 December, 2018".
She got her paper published "Power, Cost and Reach Based Evaluation of Next Generation Passive Optical Networks Architectures".



1) "Ramakrishnan S" attended conference " 24th National Conference on Communications (NCC2018)", held at "IIT Hyderabad" in "Feb 2018".
He got his paper published "Analysis of Computational Complexity and Power Consumption in Cloud Based Heterogeneous RAN".

2) "Ramakrishnan S" attended conference " 25th National Conference on Communications (NCC2019)", held at "IISc Banglore" in "Feb 2019".
He got his paper published "Analysis of Mid-Haul Characteristics for LTE-NR Multi-Connectivity in Heterogeneous Cloud RAN".



"Kirti Kant" attended conference "2018 International Conference on Signal Processing and Communications (SPCOM)", held at "Romania" from "1-4 July, 2018".
He got his paper published "Jammer Assisted SEE Maximization in Decode-and-Forward Relay Network".



"Rahul Gogia" attended conference "IEEE International Conference on Advanced Networks and Telecommunications Systems", held at "Indore" from "16-19 December, 2018".
He got his paper published "Fast algorithm for Blind Deinterleaving of a Block Interleaver using binary and non-binary Block codes in a telecommunication system".



"Rachita Gupta" attended conference "International Conference on Role of Industrial Engineering in Industry 4.0 Paradigm (ICIEIND) ", held at "Bhubaneswar, Orissa" from "27 – 30th September, 2018".
She got her paper published "Role of Blockchain in Smart Manufacturing".

Bharti Foundation

Bharti Foundation, the philanthropic arm of Bharti Enterprises was set up in 2000. It implements and supports programs mainly on school education as well as on higher education and sanitation. Flagship 'Satya Bharti School Program' (started 2006), provides free quality education for holistic development of underprivileged children, with a special focus on girls, making them self-reliant and responsible citizens. The Program outreaches over 46,000 students (50% Girls) through 254 schools in six states. Satya Bharti Learning Centre Program (2013-18), identified and mainstreamed 33,816 Out-of-School-Children through 1,522 centres in three states. Scope for remediation now rests with Satya Bharti Quality Support Program (started 2013), which works in partnership with state governments for enhancing overall schooling experience for over 2,25,000 students (50% Girls) in 771 government schools in 14 states. The sanitation initiative, Satya Bharti Abhiyan (started 2014) enabled rural Ludhiana and urban Ludhiana (Punjab) attain self-declared Open Defecation Free (ODF) in Nov'16 and Oct'18 provisioning over 18,000 toilets. In rural Amritsar (started Sep'17 in collaboration with Govt. of Punjab and is currently ongoing) the Abhiyan has already provisioned 5000+ toilets. In addition, 14 girls toilets in Government schools (Ludhiana) and 37 ladies toilets at Ludhiana Police Commissionerate for women officers and visitors have been provisioned. (Abhiyan beneficiaries: over 1,75,000 people). ***(data as of March 31st 2019)***

Instilling entrepreneurial skills to help students become self-reliant- a case story

Students, Satya Bharti Adarsh Senior Secondary School, Rauni (Ludiana, Punjab) won *'**School Enterprise Challenge Award'** for two consecutive years. They developed business plan, bought raw materials and made products, and sold these at a profit during PTMs and stalls in local markets.









Project I: *Winner of the Bronze Asia Pacific 2017: 'Cash Crop Farming' business promoted cost-efficient and sustainable farming. Students grew crops on a small piece of land in school premises, taught farmers water conserving and eco-friendly techniques to improve the quality and yield of crops.*

Project II: *Winner of India Country Prize 2018:'Satya Pickles' and 'Satya Agarbattis' businesses involved low cost investment and simple production techniques. 'Rags to Rugs' involved making products like bags, mats, and table cloths by reusing waste materials like paper, old clothes, plastic bottles, etc.*

* *School Enterprise Challenge is an international business program for schools run by the educational charity Teach A Man To Fish, UK. It guides and supports teachers and students to plan and set up real, sustainable school businesses.*

For partnerships, please contact partnership@bhartifoundation.org

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