Nurzaman Ahmed

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Research Summary

Area of Interest	IoT, SDN, WiFi-based long distance network
Research Experiences	6.5 Years
Number of Citations (Google Scholar)	464
H-Index (Google Scholar)	8
Number of Publications	40
Number of SCI Indexed Journals	15
Number of Patents	2
Invited as Resource Person	13
Recent Publication Venues	IEEE/ACM/Elsevier Journals, IEEE Comm. letters, INFOCOM Worksp, GLOBECOM, ICC, HPSR,...
Laboratories	SWAN Lab. (IIT Kharagpur, India), IoT Lab (NEHU, Shillong, India), Rural WiFi Lab. (NEHU, Shillong, India)
Training and Guidance	**Deployment of WiFi-based Long Distance (WiLD) Network** in Border Out Posts for Border Security Force (BSF), India, 2 March-4 April, 2018
Tutorial	"Programmability for Context-Aware Smart IoT Applications", **WCNC'21**, 2021 "Programmable IoT" Invited speaker: **ACM India Summer School**, 8 July, 2021.
Hardware & Software Platforms	SensorTag (CC2650), OpenMote (CC2538), TelosB (CC2420), RaspberryPi (Gateway), Arduino, and ContikiOS, NS-2, NS-3, Mininet, Ryu,...

Employment History

1 **Research Associate (PostDoc.):** Department of Computer Science & Engineering, Indian Institute of Technology, Kharagpur, India (21 Aug 2019 –20 Aug 2021).
SERB/IMPRINT-2 (Govt. of India) sponsored Project titled: **Unified Software-Defined Architecture for Industrial Internet of Things**.
Responsibilities- (i) Overall monitoring and coordination of the different components/manpower of the project, and (ii) Designing programmable network architecture for IoT.

2 **Visiting Faculty:** Department of Computer Science & Engineering, MIT University, Shillong, India. (23 Jan 2019 –31 May 2019).
Responsibilities- Taught subjects: (i) Computer Network (ii) System Administrations, and (iii) Algorithms.

3 **Project Scientist:** Department of Information Technology, School of Technology, North-Eastern Hill University, Shillong, India. (6 Nov 2015–30 Sep 2018.)
MeitY (Govt. of India) sponsored Project titled: **QoS Provisioning in Internet of Things (IoT)**
Responsibilities:(i) Overall monitoring and coordination of the different components/manpower of the project, and (ii) Designing MAC protocol for large-scale IoT.

Employment History (continued)

4 **Junior Research Fellow**- Information Technology Department, School of Technology, North-Eastern Hill University, Shillong, India. (Aug 2013–Jan 2015.)
DeitY (Govt. of India) sponsored Project titled: **QoS Provisioning in WiFi-based Long Distance Wireless Networks for Hilly Terrain Areas.**
Responsibilities: (i) Designing MAC and routing protocol for WiFi-based long distance network, (ii) Implementation and evaluation of proposed schemes over real Atheros driver for OpenWrt router.

Education

2016 – 2020 **Ph.D., North-Eastern Hill University, India** in Information Technology (22 Aug 2016-17 Nov 2020).
Thesis title: *Designing IEEE 802.11ah-based scalable network architecture for Internet of Things.*

2014 – 2016 **M.Tech., North-Eastern Hill University, India** in Information Technology.
Thesis: *Designing a MAC protocol for Internet of Things (IoT).*
First Class, ***79%*** (14 Aug 2014- 8 Aug 2016)

2008 – 2013 **B.Tech., North-Eastern Hill University, India** in Information Technology.
Project: *Extension of NS-2 for Long Distance Wi-Fi support.*
First Class, ***70%*** (21 July 2009- 8 Aug 2013)

2006 – 2008 **Higher Secondary, Assam Higher Secondary Education Council, India** in Science.
First Class, ***71%***, Dakshin Kamrup College (21 July 2006- 3 July 2008)

2003 – 2006 **High School Living Certificate, Board of Secondary Education, Assam, India**
First Class, ***78%***, Padupara Ancholic High School (3 June 2003- 14 May 2006)

Research Publications

Journal Articles

1. **Ahmed, N.**, De, D., Barbhuiya, F. A., Hussain, M. I. (2021). "MAC protocol for IEEE 802.11ah-based Internet of Things: A Survey". *IEEE Internet of Things Journal* (***SCI, IF: 9.9***). Available at: 10.1109/JIOT.2021.3104388.

2. **Ahmed, N.**, Hussain, M. I. (2021). "Scalable Internet of Things Network Design Using Multi-hop IEEE 802.11ah". *Accepted for publication in Telecommunication Systems (TELS), Springer* (***SCI, IF: 2.3***).

3. **Ahmed, N.**, Misra, S. (2021a). "Collaborative Flow-Identification Mechanism for Software-Defined Internet of Things". *IEEE Internet of Things Journal* (***SCI, IF: 9.9***). Available at: https://doi.org/10.1109/JIOT.2021.3099822.

4. Firoj, G., **Ahmed, N.**, Misra, S. (2021). "Reinforcement Learning-Based MAC Protocol for Underwater Multimedia Sensor Network". *Accepted for publication in ACM Transactions on Sensor Networks* (***SCI, IF: 4.2***). Available at: https://doi.org/10.1145/3484201.

5. Hussain, M. I., **Ahmed, N.**, Ahmed, Z. I., Sarma, N., Hussain, M. I. (2021). "QoS Provisioning in Wireless Mesh Networks: A Survey". *Accepted for publication in Wireless Personal Communications* (***SCI, IF: 1.67***). Available at: https://doi.org/10.1007/s11277-021-08893-3.

6. Medhi, K., **Ahmed, N.**, Hussain, M. I. (2021). "Dew-based Offline Computing Architecture for Healthcare IoT". *Accepted for publication in ICT Express* (***SCI, IF: 3.4***). Available at: https://doi.org/10.1016/j.icte.2021.09.005.

7. Sharmistha, N., **Ahmed, N.**, Misra, S. (2021). "Deep-Learning-Based Reliable Routing Attack Detection Mechanism for the Industrial Internet of Things". *Accepted for publication in Adhoc Networks* (***SCI, IF: 4.1***). Available at: https://doi.org/10.1016/j.adhoc.2021.102661.

8. **Ahmed, N.**, Hussain, M. I. (2020a). "Periodic Traffic Scheduling for IEEE 802.11 ah Networks". *IEEE Communications Letters, (**SCI, IF: 3.4**)* **24**.7, pp. 1510–1513.

9. Das, R. K., Ahmed, N., Pohrmen, F. H., Maji, A. K., Saha, G. (2020). "6LE-SDN: An Edge-Based Software-Defined Network for Internet of Things". *IEEE Internet of Things Journal, (**SCI, IF: 9.9**)* **7**.8, pp. 7725–7733.

10. Thungun, L., **Ahmed, N.**, Sahana, S., Hussain, M. I. (2020). "A Lightweight Authentication and Key-Exchange Mechanism for 6LoWPAN-based Internet of Things". *Transactions on Emerging Telecommunications Technologies, (**SCI, IF: 1.49**)*. DOI: 10.1002/ett.4033.

11. **Ahmed, N.**, Das, S. K., Hussain, M. (2019). "Dynamic Bandwidth Allocation Schemes for Multi-hop Wireless Mesh Networks". *International Journal of Next-Generation Computing, (**ESCI**)* **10**.2, pp. 81–90.

12. **Ahmed, N.**, De, D., Hussain, I. (2018). "Internet of Things (IoT) for Smart Precision Agriculture and Farming in Rural Areas". *IEEE Internet of Things Journal, (**SCI, IF: 9.9**)* **5**.6, pp. 4890–4899. DOI: 10.1109/JIOT.2018.2879579.

13. **Ahmed, N.**, Rahman, H., Hussain, M. I. (2018). "An IEEE 802.11 ah-based scalable network architecture for Internet of Things". *Annals of Telecommunications, (**SCI, IF: 1.55**)* **73**.7-8, pp. 499–509.

14. Rahman, H., **Ahmed, N.**, Hussain, M. I. (2018). "A QoS-aware hybrid data aggregation scheme for Internet of Things". *Annals of Telecommunications (**SCI, IF: 1.55**)* **73**.7-8, pp. 475–486.

15. **Ahmed, N.**, Rahman, H., Hussain, M. I. (2016). "A comparison of 802.11 ah and 802.15. 4 for IoT". *ICT Express, (**SCI, IF:4.3**)* **2**.3, pp. 100–102.

Communicated Journal Articles

1. **Ahmed, N.**, Saha, R., Roy, A., Misra, S., (#TNSESI-2021-05-0432) "Federated Learning-based Collaborative Traffic Classification Scheme for Software-Defined IoT", *IEEE Transactions on Green Communications and Networking*.
2. **Ahmed, N.**, Roy, A., Misra, S. (#TGCN-SI-IIoT&SG-21-0018) "Traffic-aware Wake-up Scheduling Scheme for IEEE 802.11ah-based Industrial Internet of Things', *IEEE Transactions on Green Communications and Networking*.
3. Pal, S. **Ahmed, N.**, Mukherjee, A., Misra, S. (#IoT-15011-2020) "Analytics-on-the-Fly: SDN-Controlled Resource-Tailored Analytics for Healthcare IoT", *IEEE Internet of Things Journal*.
4. **Ahmed, N.**, Roy, A. Misra, S. (ID: Paper-TW-Jul-21-0967) "Programming Edge-based 6TiSCH Networks for Control-Loop Communication", *IEEE Transactions on Wireless Communications*.
5. Thungun, L.C, **Ahmed, N.**, Hussain, M.I. (ID: COM-2021-6138.R1) "A Survey on 6LoWPAN Security: State-of-the-art and Challenges", submitted after 1st round of revision to IET Communications.
6. **Ahmed, N.**, Hussain, M.I. (ID: TW-Mar-21-1128) "QoS.11ah: A QoS-aware Scheduling-cum-grouping scheme for IEEE 802.11ah", *IEEE Transactions on Wireless Communications*.
7. Shukla, A., **Ahmed, N.**, Roy, A., Misra, S.C. (ID: COMCOM-D-21-00905) "Softwarized Management of 6G Network for Green Internet of Things", *Elsevier Computer Communications*.
8. Shukla, A., **Ahmed, N.**, Misra, S.C. (ID: TGCN-SI-MI4SC-21-0015) "Machine Learning-Based Network Slicing for Enabling Green Communication in Smart Cities", *IEEE Transactions on Green Communications and Networking*.

Conference Proceedings

1. **Ahmed, N.**, Arijit, R., Ayan, M., Sudip, M. (2021). "SDN-Based Link Recovery Scheme for Large-Scale Internet of Things". *IEEE 22nd International Conference on High-Performance Switching and Routing (HPSR)*. IEEE. Virtual (Invited Paper), pp. 1–6.

2 **Ahmed, N.**, Misra, S. (2021b). "Programmable IEEE 802.11ah Network for Internet of Things". *IEEE International Conference on Communications (ICC)*. IEEE, pp. 1–6.

3 Mehbub, A., **Ahmed, N.**, Rakesh, M., Ferdous Ahmed, B. (2021). "ioFog: Prediction-based Fog Computing Architecture for Offline IoT". *IEEE IWCMC'21*. IEEE. Virtual, pp. 1–6.

4 Ruelia, S., **Ahmed, N.**, Sudip, M. (2021). "SD-Health: SDN-Controller Triggered Dynamic Decision Control Mechanism for Healthcare". *Accepted for publication in IEEE GLOBECOM*. IEEE, pp. 1–6.

5 **Ahmed, N.**, Misra, S. (2020). "Channel Access Mechanism for IEEE 802.11 ah-Based Relay Networks". *IEEE International Conference on Communications (ICC)*. IEEE. Dublin, Ireland, pp. 1–6.

6 Gaji, F., Misra, S., **Ahmed, N.**, Mukherjee, A., Kumar, N. (2020). "UnRest: Underwater Reliable Acoustic Communication for Multimedia Streaming". *Proceedings of IEEE Global Communications Conference (GLOBECOM)*. Taipei, Taiwan (Accepted), pp. 1–6.

7 Misra, S., Saha, R., **Ahmed, N.** (2020). "Health-Flow: Criticality-Aware Flow Control for SDN-Based Healthcare IoT". *Proceedings of IEEE Global Communications Conference (GLOBECOM)*. Taipei, Taiwan (Accepted), pp. 1–6.

8 Misra, S., Sarkar, K., **Ahmed, N.** (2020). "Blockchain-Based Controller Recovery in SDN". *Proceedings of IEEE International Conference on Computer Communications Workshops (INFOCOM Workshops)*. IEEE. Toronto, Cananda, pp. 1–6.

9 Nayak, S., Misra, S., **Ahmed, N.** (2020). "Blockchain-Based Programmable Fog Architecture for Future Internet of Things Applications". *Proceedings of IEEE Global Communications Conference (GLOBECOM)*. Taipei, Taiwan (Accepted), pp. 1–6.

10 Thungon C., L., **Ahmed, N.**, Hussain, M. I. (2019). "Comparison of AES and PRESENT Block Cipher for 6LoWPAN Based Internet-of-Things". *International Journal of Computational Intelligence & IoT*. Vol. 1. 2. URL: https://ssrn.com/abstract=3354723.

11 **Ahmed, N.**, De, D., Hussain, M. I. (2018). "A QoS-aware MAC protocol for IEEE 802.11 ah-based Internet of Things". *2018 Fifteenth International Conference on Wireless and Optical Communications Networks (WOCN)*. IEEE, pp. 1–5. DOI: 10.1109/WOCN.2018.8556133.

12 Thungun, L. C., **Ahmed, N.**, Hussain, M. (2018). "Comparison of AES and PRESENT Block Cipher for 6LoWPAN based Internet-of-Things". *International Conference on Computational Intelligence & IoT (ICCIIoT)*. NIT, Tripura, India, pp. 1–6.

13 **Ahmed, N.**, Rahman, H., Hussain, M. I. (2017a). "Scalability Analysis of Medium Access Control Protocols for Internet of Things". *Proceedings of International Conference on Communication and Networks*. Springer, pp. 601–611.

14 Kalita, A., **Ahmed., N.**, Rahman, H., Hussain, M. I. (2017). "A QoS-aware MAC protocol for large-scale networks in Internet of Things". *IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS)*. IEEE, pp. 1–6. DOI: 10.1109/ANTS.2017.8384132.

15 **Ahmed N.**, Hussain, M. I. (2016). "A distributed channel access mechanism for IEEE 802.11 ah". *IEEE 3rd World Forum on Internet of Things (WF-IoT)*. IEEE, pp. 1–6.

16 **Ahmed, N.**, Hussain, M. I. (2016). "Relay-based IEEE 802.11 ah network: A Smart City solution". *2016 Cloudification of the Internet of Things (CIoT)*. IEEE, pp. 1–6. DOI: 10.1109/CIOT.2016.7872922.

17 Rahman, H., Ahmed, N., Hussain, M. I. (2016). "A hybrid data aggregation scheme for Internet of Things (IoT)". *2016 IEEE Annual India Conference (INDICON)*. IEEE, pp. 1–6.

18 Rahman, H., **N. Ahmed**, Hussain, I. (2016). "Comparison of data aggregation techniques in Internet of Things (IoT)". *International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)*, pp. 1296–1300. DOI: 10.1109/WiSPNET.2016.7566346.

19. Ahmed, S., Hussain, I., **Ahmed, N.** (2015). "Driver level implementation of TDMA MAC in long distance WiFi". *International Conference on Computational Intelligence and Networks*. IEEE, pp. 80–85. DOI: 10.1109/CINE.2015.25.

20. **N. Ahmed**, Ahmed, Z. I., Saikia, S. I., Hussain, I. (2015). "Augmentation of Directional and Sector Antenna Support in NS2". *2015 International Conference on Computational Intelligence and Networks*, pp. 68–73. DOI: 10.1109/CINE.2015.23.

21. Rahman, H., **Ahmed, N.**, Hussain, I. (2015). "Internet of Things (IoT): Advances and Research Challenges". *International conference on Computing and Communication Systems (I3CS)*. April. NEHU, Shillong, India, pp. 89–96.

22. Hussain, I., **Ahmed, N.**, Saikia, D., Sarma, N. (2014). "A QoS-aware multipath routing protocol for WiFi-based long distance mesh networks". *2nd International Conference on Emerging Technology Trends in Electronics, Communication and Networking*. IEEE, pp. 1–8. DOI: 10.1109/ET2ECN.2014.7044990.

23. Hussain, M., Dutta, S. K., **Ahmed, N.**, Hussain, I. (2014). "A Multi-gateway based Reliable Low Cost Network Architecture for Rural Region". *National Conference on Emerging Global Trends in Engineering & Technology (EGTET)*. Don Bosco University, Assam, India, pp. 1–7.

Communicated Conference Proceedings

1. **Ahmed, N.**, Misra, S. (#705) "RecoNet: Abstracting the Data-plane of Heterogeneous Networks", *INFOCOM'22*.
2. Sarkar, K., **Ahmed, N.**, Misra, S. (#454) "FluidSDT: Realizing Fluid Control Across Software Defined IoT Domains", *INFOCOM'22*.
3. Saha, R., **Ahmed, N.**, Misra, S. (#416) "VSpace: Virtualizing Data Plane Space with IoT Network Slices", *INFOCOM'22*.
4. **Ahmed, N.**, Saha, R., Misra, S. (#153) "6G-Fi: Fast and Intelligent Flow-control Scheme for 6G Network", *MobiCom'22*.

Patents

1. Das, R., **Ahmed, N.**, Saha, G., Maji, A. (2021). *Multi-Purpose Switch Adaptable for a Specific SDN Based IoT Architecture*. Indian patent filed on:04/12/2019, published on: 02/04/2021, number of pages: 37, number of claims: 7 (Ref: 201931049931).
2. Saha, G., Das, R., **Ahmed, N.**, Maji, A. (2021). *An improved SDN based IoT system*. Indian patent filed on:16/04/2021 (Ref: 202131017791).

Books and Chapters

1. **Ahmed, N.**, Rahman, H., Hussain, M. I. (2017b). "Scalability Analysis of Medium Access Control Protocols for Internet of Things". *Advances in Intelligent Systems and Computing*. Vol. 508. Springer Singapore, pp. 601–611. DOI: 10.1007/978-981-10-2750-5_62. URL: https://doi.org/10.1007/978-981-10-2750-5_62.

Skills

Languages	Strong reading, writing and speaking competencies for English, Hindi, and Assamese.
Coding	C,C++,Java, PHP, JSP, Python, SQL, LaTeX, ASP.NET,TCLscript.
IoT	Sensor/Actuator, Contiki, COAP, MQTT, TelosB, CC2650, ESP8266, Arduino, RaspberryPi, iFogSim, Thingspeak.
IoT Apps	Healthcare IoT, Smart Agriculture, Smart City, Smart Home, and Smart Lighting.

Skills (continued)

Networking — Mikrotik Board, Winbox, OpenWrt, Atheros Driver, Driver Programming, 6Lbr, SDN Switch (DELL EMC), Openflow, P4, Mininet, NS-3, and NS-2

Web Dev — Angular 2.0 (above), Html, css, JavaScript, Liferay, Django, Apache Web Server, Tomcat Web Server.

Misc. — Academic research, teaching, training, consultation, LaTeX typesetting and publishing.

Invited as Resource Person

1. **Protocols and Platformns for Next Generation IoT**, Five Days AICTE ATAL Faculty Development Programme (FDP) on Internet of Things (IoT), conducted by conducted by Department of Computer Science & Information Technology, University of Jammu, Jammu, 1-4 June 2021.
2. **Introduction to Contiki-Cooja Simulator: A Demonstration**, Five Days AICTE ATAL Faculty Development Programme (FDP) on Internet of Things (IoT), conducted by Department of Computer Science & Information Technology, University of Jammu, Jammu, 1-4 June 2021
3. **Sensors & Actuators with Communication Protocols for Next-Generation IoT**, Five Days AICTE ATAL Online Faculty Development Programme (FDP) *Internet of Things (IoT)*, conducted by department of Information Technology, Mizoram University, Aizwal, 1-4 Feb 2021.
4. **Hands on Contiki-OS and Cooja Simulator**, Five Days AICTE ATAL Online Faculty Development Programme (FDP) *Internet of Things (IoT)*, conducted by department of Information Technology, Mizoram University, Aizwal, 1-4 Feb 2021
5. **Wireless Sensor & Actuator Network Using Contiki-Cooja Simulator**, Five Days AICTE ATAL Online Faculty Development Programme (FDP) *Internet of Things (IoT)*, conducted by department of Information Technology, Mizoram University, Aizwal, 1-4 Feb 2021
6. **Software & Hardware platforms for NextGen IoT Implementation**, in AICTE sponsored workshop on *IoT and its Applications*, conducted by department of IT, NEHU, Shillong and CKolon, 5-9 Oct 2020.
7. **Implementation of IoT**, in a Two-weeks National workshop-cum-Summer Internship on *IoT and Android Applications Development*, conducted by department of CSE & IT, Assam Don Bosco University, India, 11-23 Jun 2019.
8. **Implementation of IoT using 6LoWPAN-based Network**, 2-day MeitY sponsored National workshop on *Internet of Things: It's Inside out*, in the department of IT, NEHU, Shillong, India, 12-13 May 2017
9. **Technologies and Protocols for Internet of Things (IoT)**, 2-day MeitY sponsored National workshop on *Internet of Things: It's Inside out*, in the department of IT, NEHU, Shillong, India, 11-23 Jun 2019
10. **Protocol Implementation in open source Wireless Local Area (WLAN) driver**, 2-day National workshop on *Trends in Wireless Networks - Protocols and Practice* in the department of IT, NEHU, Shillong, India, 29-30 Jan 2015
11. **Protocol Implementation and Simulation using Network Simulator 2 (NS2)**, 2-day National workshop on *Trends in Wireless Networks - Protocols and Practice* in the department of IT, NEHU, Shillong, India, 29-30 Jan 2015.

Tutorials

13. Misra, S. **Ahmed, N.**, Roy, A. "Programmability for Context-Aware Smart IoT Applications", Half-day tutorial for *WCNC'21*, 29 March - 1 April 2021, Nanjing, China
14. **Ahmed, N.**, Sarkar, K. "Programmable IoT" Invited speaker: ACM India Summer School, 8 July, 2021.

Paper Presented

1. **Programmable IEEE 802.11ah Network for Internet of Things**, in IEEE International Conference on Communications (ICC), Virtual, 2021.
2. **SDN-Based Link Recovery Scheme for Large-ScaleInternet of Things**in IEEE HPSR'21. IEEE. Virtual, 2021
3. **Channel Access Mechanism for IEEE 802.11 ah-Based Relay Networks**, in IEEE International Conference on Communications (ICC), Dublin, Ireland.
4. **A QoS-aware MAC protocol for large-scale networks in Internet of Things**, in 11th IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS), Bhubaneswar, Odisha, India, June 2020.
5. **Augmentation of Directional and Sector Antenna support in NS-2**, in IEEE sponsored International Conference on Computational Intelligence and Networks (CINE) held on January 2015 in KIIT University, Bhubaneswar, Orisha.
6. **Driver Level Implementation of TDMA MAC in Long Distance WiFi**," in IEEE sponsored International Conference on Computational Intelligence and Networks (CINE) held on January 2015 in KIIT University, Bhubaneswar, Orisha.
7. **A QoS-aware Multipath Routing Protocol for WiFi-based Long Distance Mesh Networks**in 2nd IEEE conference on Emerging Technology Trends in Electronics, Communication and Networking (ET2ECN) held on December 2014 in NIT Surat, Gujrat.

Description of PhD work

Title — **Designing IEEE 802.11ah-based scalable network for Internet of Things**

About — IEEE 802.11ah has introduced several new concept for PHY and MAC layer to achieve communication over longer distances among a large number of low-power devices. However, it does not consider many interesting issues for supporting communication in IoT which provide motivation and necessity for designing a smart scalable IEE 802.11ah-based IoT network focusing on the MAC layer aspects. For scalability in the 802.11ah-based network, the following issues are considered.

Objectives

1. Estimation of optimal RAW size for large, dynamic, and heterogeneous IoT environment
2. Managing event-driven traffic in RAW-based channel access mechanism employed large scale IoT
3. Generation of dynamic Tx/Rx schedule for a relay node in supporting scalability over multi-hop networks
4. Issues of congestion in periodic RAW-based MAC schemes for a large network

Objectives 1 — We propose a method to estimate the RAW size based on traffic loads and provide relay node support for stations to use different MCSs. The proposed scheme significantly improves the performances of RAW-based 802.11ah MAC protocol. In a heterogeneous and saturation environment, the proposed protocol shows a performance close to a network with homogeneous nodes.

Objectives 2 — We propose a QoS-aware MAC layer solution to increase network reliability and reduce critical traffic latency by an adaptive grouping and a priority scheduling scheme respectively in IEEE 802.11ah-based network. The proposed grouping scheme calculates the current traffic load and distributes them among different RAW groups if needed considering different requirements of stations.

Description of PhD work (continued)

Objectives 3
- A dynamic relay and channel allocation scheme for 802.11ah is proposed by considering the angular separation of nodes and multiple available channels in the sub-1GHz band. We propose a distributed 802.11ah-based MAC protocol for supporting a massive number of devices. Utilizing the available channels the proposed protocol facilitates multi-hop communication efficiently.

Objectives 4
- We propose a new RAW scheme for IEEE 802.11ah to reduce access delay in a large-scale periodic monitoring application network. It predicts the service interval and schedules the next frame without allowing for further contention. In saturation condition, the proposed protocol improves throughput up to 25% as compared to the traditional schemes.

Professional Services

Workshop Committee

May 2017
- **Organizing Member**, National workshop on *Internet of Things: It's Inside out*, 12-13 May, 2017, conducted by Department of IT, NEHU, Shillong, India.

Technical Program Committee

IEEE ICC'21 Workshop
- COVI-COM: Communication, IoT, and AI Technologies to Counter COVID-19.

IEEE HPSR 2021 Workshop
- VNI: Virtualization for Enabling Next-Generation IoT Networks.

Journal Referee

1. **IEEE Internet of Things Journal**
2. **IEEE Access**
3. **IEEE Transaction on Mobile Computing**
4. **IEEE Transaction on Vehicular Technology**
5. **Iranian Journal of Science and Technology**
6. **IEEE Transactions on Green Communications and Networking**
7. **IEEE International Conference on Communication**

Miscellaneous

Guidance

Jul 2018
- **Guided Border Security Force (BSF) Technical Team**, *Deployment of WiFi-based Long Distance (WiLD) Network in Border Out Posts (BOPs)*, Ftr, HQ, BSF Frontier Shillong from 2 March to 4 April 2018.

Workshops and Training

Jul 2012
- Undergone an internship programme on **IP addressing** for 7-days at Indian Oil Corporation Limited, Noonmati, Guwahati, Assam.

Mar 2011
- Participated in the **Bhuwan** workshop organized by North Eastern Space Applications Center, Umiam, Shillong

Sep 2009
- Attended workshop on **C programming** organized by CIPHER (a forum under Department of IT, NEHU)

References

Prof. Sudip Misra
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Declaration

I hereby declare that the information furnished above is correct to the best of my knowledge and I bear the responsibility for the correctness.

NURZAMAN AHMED