International Journal of Advance in Computer Science & its application – IJCSIA 2018
Copyright © Institute of Research Engineers and Doctors , SEEK Digital Library
Volume 7 : Issue 2 [ISSN : 2250-3765] - Publication Date: 25 June , 2018

Trend Analyses of Critical Values Obtained for Minimum CBR Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies.

M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY

Abstract – **Pervasive computing constitute of many sub fields including location-tracking, ubicomp functionalities and MANET transmission strategies, which are stressed to serious research [1-59]. Albeit these efforts, their merging still has a long way to go before fruitfully materialising. More precisely here, the enforcement of location-aware transmission strategies is prospected to enhance energy management in ubicomp. Such enhancements expected [1] englobes improvements in location accuracy and refresh rates, the application of land-based GPS systems, development of better protocols optimised for transmission according to distance criteria and refining the precision of the distance criteria to apply the protocol. The learning of distance coverages by transmitted packets in ubicomp environments and corresponding variations over different node densities, is unquestionably advantageous for polishing transmission protocols in MANETs. One clear cut empirical study was conducted formerly [28] in which the metric Minimum CBR Distance, Min_CBR_Dist, was elaborated. This was strengthened by a study [44] where trends of parameters of equations for metric Min_CBR_Dist were analysed.**

In this paper, the next level of probing is put as: "What are the observable critical values in Min_CBR_Dist trends? What are the trends of variation observable within each critical value for metric Min_CBR_Dist over varying node densities?" Designers will utilise these output towards producing augmented "realistic" ubicomp scenarios for future ubicomp tools.

This study remains a follow-up of previous studies [1-58].

Key terms: Ubicomp- Ubiquitous Computing, MAUC-Mobile and Ubiquitous Computing, Min_CBR_Dist-Minimum CBR Distance, CBR- Constant Bit Rate, MANET-Mobile Adhoc Network, CV- Critical Value.

M. Kaleem GALAMALI,
University of Technology Mauritius (student)
Mauritius
mkaleemg@gmail.com

Assoc. Prof Nawaz Mohamudally
University of Technology Mauritius,
Mauritius
alimohamudally@umail.utm.ac.mu

1. Introduction

It is supposed that for a considerable era in the future, many ubicomp environments may be having scanty network resources as one of the many heterogeneities they may suffer. Other determining differences include accuracy level of distance measurement, location refresh rates and performance characteristics of existing protocols. For environments with poor networking supports, MANETs will be the most welcome solution. Moreover, the performance features of MANETs, more particularly energy consumption features, may be ameliorated with location-aware transmission. The angle of metrics analysis in ubicomp remains a primordial method of studying distance coverage attributes. One corresponding metric was developed in a prior paper [28] in which metric Min_CBR_Dist was put forward as following the exponential distribution:

$$F(x) = a * \exp(b * (x - c)) + d$$

The related follow-up study [44] was conducted to mathematically model the four parameters of equation observed above. Results will be subservient towards more proper understanding of the evolution and predictability of ubicomp environments. There are slowly ensuing progresses in this direction which will seemingly allow designers to produce more realistic scenarios for simulations, based on which more beneficial test cases can be conducted over experimental components for middleware and communication protocols.

The analysis hence wished for metric Min_CBR_Dist is the identification of observable critical values obtained during experiments execution and formulation of relative theoretical trend of such CVs over varying node densities. Two such CVs were observed.

The key contribution of this paper is the derivation of the trends of variations for each of the two CVs observed for metric Min_CBR_Dist elaborated formerly [28, 44] over node numbers ranging from 7 until 56. Such classification of information must obligatorily be made available in a conducive format to more successfully assist designers in understanding the evolution and predictability of ubicomp behaviour and be conveniently equipped to carry out reliable simulation scenarios testing of novel communication components. The rest of this paper is organised as follows: section 2- Min_CBR_Dist Critical Values, section 3- Critical Values Trend Analyses- Metric Min_CBR_Dist, section 4- Conclusion and References.

International Journal of Advance in Computer Science & its application – IJCSIA 2018
Copyright © Institute of Research Engineers and Doctors , SEEK Digital Library
Volume 7 : Issue 2 [ISSN : 2250-3765] - Publication Date: 25 June , 2018

2. Min_CBR_Dist Critical Values.

2.0 Critical Values Identified.

Two CVs were identified as follows: Column headings are: C1→Min_CBR_Dist CV, C2→Meaning of Min_CBR_Dist CV, C3→Corresponding figure number for Min_CBR_Dist CV.

C1	C2	C3
1	% CBR at smallest distance	1
2	Largest distance noted	2

Table 1: Min_CBR_Dist Critical Values

2.1 Experimental Critical Values Obtained.

The values obtained during experiments have been summarised below. Values have been rounded to a maximum of 9 decimal places. Column heading NN → Node Number.

NN	CV1	CV2
7	92.222222222	111
8	95.813435212	111
9	96.158730159	111
10	95.984126984	60
11	95.984126984	60
12	96.136724960	60
13	97.158730159	60
14	97.317460317	60
15	97.238095238	60
16	97.238095238	60
17	96.666666667	38
18	96.666666667	38
19	96.746031746	38
20	96.666666667	38
21	97.444444444	44
22	97.523809524	44
23	97.603174603	44
24	97.539682540	44
25	97.539682540	44
26	97.190476190	35
27	97.269841270	35
28	97.269841270	35
29	96.952380952	35
30	97.031746032	35
31	96.873015873	32
32	96.952380952	32
33	97.047619048	32
34	97.047619048	32
35	97.047619048	32
36	96.968253968	32
37	97.777424988	28
38	97.777777778	28
39	97.857142857	28
40	97.857142857	28
41	97.936507937	28
42	97.857142857	28
43	98.253968254	28
44	98.252858958	28
45	98.333333333	28
46	98.333333333	28
47	98.333333333	28
48	98.333333333	28
49	98.412698413	28
50	98.968253968	22
51	98.968253968	22
52	99.047619048	22
53	98.968253968	22
54	99.047619048	22
55	99.047619048	22
56	99.047619048	22

Table 2: Experimental Critical Values Obtained

3. Critical Values Trend Analyses- Metric Min_CBR_Dist.

3.0 General Procedure Adopted.

The procedure adopted here consist of four steps:

i. The tabulated data for each Min_CBR_Dist CV is plotted onto gnuplot.
ii. Graphical analyses are performed and general observations are noted.
iii. Different equations of fit are tried. Criteria of value of least reduced chi-square and most appreciable extendability produced at node numbers 80, 100 and 120 for both CVs.
iv. The parameter values for each Min_CBR_Dist CV equation are noted.

3.1 Trend Analysis – Min_CBR_Dist CV1.

The plots depict a small oscillation with decreasing amplitude perceived along an axis with increasing tendency. The applicable equation is

$$F(x) = a * x^{-1.5} * \sin((b*x)+c) + d*x+f$$

Ch_sq = 0.261 418 F(80) = 100.398 264
F(100) = 101.543…….. F(120) = 102.758 573

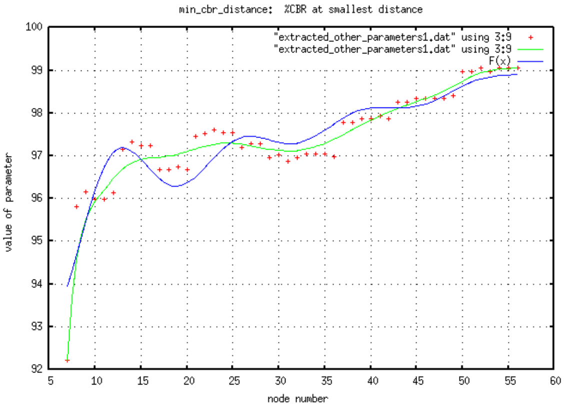

Figure 1: Min_CBR_Dist Critical Value 1

The projected values beyond node number 56 tend to be greater than 100%, which is nonsensical. It is safe to say that beyond node number 56, the CVs lie between 99 and 100, possibly asymptotically increasing.

Other equations attempted gave ch_sq values greater than 0.45 and hence were rejected. The parameters obtained for best fit are:

a = 38.621 2 , b = -0.483 786 , c = 1.675 58 , d = 0.059 723 4 , f = 95.586 8

International Journal of Advance in Computer Science & its application – IJCSIA 2018
Copyright © Institute of Research Engineers and Doctors , SEEK Digital Library
Volume 7 : Issue 2 [ISSN : 2250-3765] - Publication Date: 25 June , 2018

3.2 Trend Analysis – Min_CBR_Dist CV2.

Here, a curve with decreasing tendency at a decreasing rate is observed.

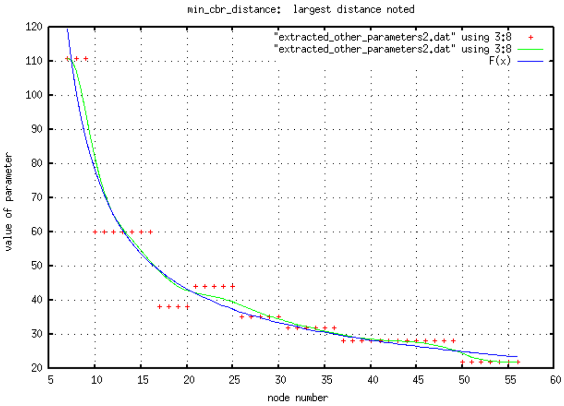

Figure 2: Min_CBR_Dist Critical Value 2

The potentially applicable equations are:

1. $F(x) = ((a*x)+f)/(\exp((b*x)+c)+d)$

   Ch_sq =39.952 7 F(80) = 18.805 047 552

   F(100)= 16.056 292 410 F(120)= 13.832 243 524

2. $F(x) = ((a*x^2)+f)/(\exp((b*x)+c)+d)$

   Ch_sq = 38.643 F(80) = 13.154

   F(100) = 7.858 F(120) = 4.414

3. $F(x)=((a*x^{1.5})+f)/(\exp((b*x)+c)+d)$

   Ch_sq = 39.302 1 F(80) = 15.95

   F(100) = 11.572 F(120) = 8.17

Choice of best fit for Min_CBR_Dist Critical value 2

The equation in part 1 above has been selected because of more smooth extendability even if ch_sq is not least. The parameters for best fit are:

a = 0.087 045 8 , b = 0.010 392 3 , c = -1.062 48 , d = -0.355 979 , f = 1.267 02

4. Conclusion.

This work of further empirical analysis, though with few novel outputs, was aimed at identifying the relevant CVs observable for metric Min_CBR_Dist and scrutinise their corresponding trends over varying node densities in a MANET topography of 300 x 300 m^2. The models portrayed in this paper, consist of quite complex mathematical equations. The output delivered here will reinforce the existing tools for better studies of MANETs for ubicomp environments from the viewpoint of software engineering. These output may be admissibly incorporated into computational algorithms to produce better simulation scenarios which will consequently serve for enabling more refined testing methodologies over communication and middleware components.

This experiment was carried out in NS-2 over Linux. Attempts for plottings and "Fit" were done with gnuplot. Choice of best fit was based on values of least reduced chi-square and most acceptable extendability produced at higher node numbers for both CVs. Assumptions stated earlier [28, 44] are continued here.

This study is positioned as a follow-up of prior studies [1-59]. The results extended here are open for future upgrades. One possible future work identified remains the formulation of predictability for metric Min_CBR_Dist and its trend.

References

[1] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Towards Dependable Pervasive Systems-A Position and Vision Paper, CEET 2014

[2] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Energy Savings achievable with Location-aware Node-to-Node Transmission in UbiComp , CEET 2014

[3] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Energy Savings achievable with Location-aware Node-to-Node Transmission in UbiComp Using Location Refresh Intervals, CEET 2014

[4] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Energy Savings achievable with Location-aware Transmission in UbiComp Using Relays, CEET 2014

[5] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Mathematical modeling of need of exact number of relays to ensure seamless mobility in mobile computing, CEET 2014

[6] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Modelling of need for multiple relays for ensuring seamless mobility, CEET 2014

[7] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Investigation of prominence of placements of relays in a ubicomp topography,

[8] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of energy savings achievable with location-aware transmission in ubicomp using optimised number of relays.

[9] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Investigation of Prominence of Placements of Optimised Number of Relays in a Ubicomp Topography using Location-Aware Transmission, CEET 2015.

[10] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Extending Node Battery Availability in Ubicomp with Location-Aware Transmission, CEET 2015.

[11] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Extending Node Battery Availability in Ubicomp with Location-Aware Transmission using Location Refresh Intervals, CEET 2015.

[12] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Extending Node Battery Availability in Ubicomp with Location-Aware Transmission using Uniformly Placed Relays, CEET 2015.

[13] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Extending Node Battery Availability in Ubicomp with Location-Aware Transmission Using Optimally Placed Relays, CEET 2015.

[14] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Sender Node Energy Savings Achievable with Location-Aware MANET Transmission in Ubicomp. ACCN 2016

[15] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Overall Node Energy Savings Achievable with Location-Aware MANET Transmission in Ubicomp. ACCN 2016

[16] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Sender Node Extra Energy Savings Achievable in MANET Against Direct Node-to-Node Transmission Using Location-Aware Transmission in Ubicomp. ACCN 2016

[17] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Overall Node Extra Energy Savings Achievable in MANET against Direct Node-to-Node Transmission Using Location-Aware Transmission in Ubicomp. ACCN 2016
[18] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Energy Consumption Ratio Achievable in MANET Using Location-Aware Transmission in Ubicomp. ACCN 2016
[19] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Minimum Energy Consumption Ratio Achievable in MANET Using Location-Aware Transmission in Ubicomp. ACCN 2016
[20] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Maximum Energy Consumption Ratio Achievable in MANET Using Location-Aware Transmission in Ubicomp. ACCN 2016
[21] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Overall Energy Consumption Fairness Ratio Achievable in MANET Using Location-Aware Transmission in Ubicomp. ACCN 2016
[22] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Overall Energy Consumption Fairness Proportion Achievable in MANET Using Location-Aware Transmission for Ubicomp, CEET 2016
[23] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Minimum Fairness Proportion Achievable in MANET Using Location-Aware Transmission for Ubicomp, CEET 2016
[24] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Maximum Fairness Proportion Achievable in MANET Using Location-Aware Transmission for Ubicomp, CEET 2016
[25] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Sender Fairness Proportion Achievable in MANET Using Location-Aware Transmission for Ubicomp, CEET 2016
[26] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Distance Travelled by packets in MANETs using Location-Aware Transmission for Ubicomp, CEET 2016
[27] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Maximum CBR Distance Travelled by packets in MANETs using Location-Aware Transmission for Ubicomp, CEET 2016
[28] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Minimum CBR Distance Travelled by packets in MANETs using Location-Aware Transmission for Ubicomp, CEET 2016
[29] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Model of Range CBR Distance Experienced by Transmissions in MANETs using Location-Aware Transmission for Ubicomp, CEET 2016
[30] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Sender Node Energy Savings Achievable in ubicomp MANETs using Location-Aware Transmission, ACCN 2017.
[31] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Overall Node Energy Savings Achievable in ubicomp MANETs using Location-Aware Transmission, ACCN 2017.
[32] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Sender Node Extra Energy Savings Achievable in MANET against Direct Node-to-Node Location-Aware Transmission, ACCN 2017.
[33] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Overall Nodes Extra Energy Savings Achievable in MANET against Direct Node-to-Node Location-Aware Transmission, ACCN 2017.
[34] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Energy Consumption Ratio Achievable in Ubicomp MANET Using Location-Aware Transmission, ACCN 2017.
[35] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Minimum Energy Consumption Ratio Achievable in Ubicomp MANETs Using Location-Aware Transmission, ACCN 2017.
[36] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Maximum Energy Consumption Ratio Achievable in Ubicomp MANETs Using Location-Aware Transmission, ACCN 2017.
[37] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Overall Fairness Ratio Achievable in Ubicomp MANETs Using Location-Aware Transmission, ACCN 2017.
[38] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Energy Consumption Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[39] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Minimum Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[40] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Maximum Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[41] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Sender Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[42] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Packets Per Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[43] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Maximum CBR Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[44] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Minimum CBR Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[45] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Parameters of Equations for Range CBR Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[46] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Sender Node Energy Savings Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[47] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Overall Node Energy Savings Achievable in Ubicomp MANETs Using Location-Aware Transmission, CEET 2017
[48] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Sender Node Extra Energy Savings Achievable in Ubicomp MANET Against Direct Node-to-Node Location-Aware Transmission, CEET 2017
[49] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Overall Nodes Extra Energy Savings Achievable in Ubicomp MANET Against Direct Node-to-Node Location-Aware Transmission, CEET 2017
[50] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Energy Consumption Ratio Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, CEET 2017
[51] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Minimum Energy Consumption Ratio Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, CEET 2017
[52] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values

Obtained for Maximum Energy Consumption Ratio Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, CEET 2017

[53] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Overall Fairness Ratio Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, CEET 2017

[54] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Energy Consumption Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, ACCN 2017.

[55] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Minimum Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, ACCN 2017.

[56] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Maximum Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, ACCN 2017.

[57] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Sender Fairness Proportion Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, ACCN 2017.

[58] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Packets Per Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, ACCN 2017.

[59] M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY, Trend Analyses of Critical Values Obtained for Maximum CBR Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission Strategies, ACCN 2017.

[60] Markus Bylund and Zary Segall, Towards seamless mobility with personal servers, 2004.

[61] Masugi Inoue, Mikio Hasegawa, Nobuo Ryoki and Hiroyuki Morikawa, Context-Based Seamless Network and Application Control, 2004

[62] Xiang Song, Umakishore Ramachandran, MobiGo: A Middleware for Seamless Mobility, College of Computing Georgia Institute of Technology, Atlanta, GA, USA, August 2007

[63] Budzisz, Ferrús, R., Brunstrom A., Grinnemo, K, Fracchia, R., Galante, G., and Casadevall, F. Towards transport-layer mobility: Evolution of SCTP multihoming, March 2008

[64] Paul Dourish & Genevieve Bell, Divining a digital future, 2011.

[65] Xiang Song, Seamless Mobility In Ubiquitous Computing Environments, PhD Thesis, Georgia Institute of Technology, August 2008

[66] Kevin O Mahony, Jian Liang, Kieran Delaney, User-Centric Personalization and Autonomous Reconfiguration Across Ubiquitous Computing Environments, NIMBUS Centre Cork Institute of Technology, Cork, Ireland, UBICOMM 2012

[67] Pablo Vidales, Seamless mobility in 4G systems, *Technical Report, University of Cambridge,* Computer Laboratory, Number 656, November 2005

[68] João Pedro Sousa and David Garlan, Aura: An Architectural Framework for User Mobility in Ubiquitous Computing Environments, School of Computer Science, Carnegie Mellon University, USA, *August 2002*

[69] Dennis Lupiana, Ciaran O'Driscoll, Fredrick Mtenzi, Defining Smart Space in the Context of Ubiquitous Computing, Dublin Institute of Technology, Ireland, Special Issue on ICIT 2009 Conference - Web and Agent Systems, 2009

[70] N.S.V.Shet1, Prof.K.Chandrasekaran2 and Prof. K.C.Shet3, *WAP Based Seamless Roaming In Urban Environment with Wise Handoff Technique,* International Journal of UbiComp (IJU), Vol.1, No.4, October 2010

[71] Yipeng Yu Dan He Weidong Hua Shijian Li Yu Qi Yueming Wang Gang Pan, FlyingBuddy2: A Brain-controlled Assistant for the Handicapped, Zhejiang University, *UbiComp'12,* September 5-8, 2012.

[72] Jing Su, James Scott, Pan Hui, Jon Crowcroft, Eyal de Lara Christophe Diot, Ashvin Goel, Meng How Lim, and Eben Upton, Haggle: Seamless Networking for Mobile Applications, 2007

[73] Rui Han, Moustafa M. Ghanem, Li Guo, Yike Guo∗, Michelle Osmond, Enabling cost-aware and adaptive elasticity of multi-tier cloud applications, Future Generation Computer Systems, 2012

[74] Byrav Ramamurthy, K. K. Ramakrishnan , Rakesh K. Sinha, Cost and Reliability Considerations in Designing the Next-Generation IP over WDM Backbone Networks, 2012.

[75] Bhavish Aggarwal, Aditya Akella, Ashok Anand, Athula Balachandran, Pushkar Chitnis, Chitra Muthukrishnan, Ram Ramjee and George Varghese, EndRE: An End-System Redundancy Elimination Service for Enterprises, NSDI 2010, San Jose, CA

[76] Ashok Anand, Vyas Sekar and Aditya Akella, SmartRE: An Architecture for Coordinated Network-wide Redundancy Elimination, SIGCOMM 2009, Barcelona, Spain

[77] John Breeden II, "Smart-phone battery life could double – without better batteries", Nov 14, 2012

[78] Andy Boxall, "When will your phone battery last as long as your kindle", December 5, 2012.

[79] Imielinski, T. and Navas, J.C. (1999). GPS-based geographic addressing, routing, and resource discovery. *Comms. ACM*, Vol. 42, No. 4, pp. 86-92.

[80] Hightower, J. and Borriello, G. (2001). Location Systems for Ubiquitous Computing. *IEEE Computer*, Vol. 34, No. 8, August, pp. 57-66.

[81] Harter, A., Hopper, A., Steggles, P., Ward, A. and Webster, P. (2002). The Anatomy of a Context-Aware Application. Wireless Networks, Vol. 8, No. 2-3, Mar-May, pp. 187-197.

[82] Hightower, J., Brumitt, B. and Borriello, G. (2002). The Location Stack: A Layered Model for Location in Ubiquitous Computing. *Proceedings of the 4th IEEE Workshop on Mobile Computing Systems & Applications (WMCSA 2002)*, Callicoon, NY, USA, June, pp. 22-28.

[83] Graumann, D., Lara, W., Hightower, J. and Borriello, G. (2003). Real-world implementation of the Location Stack: The Universal Location Framework. *Proceedings of the 5th IEEE Workshop on Mobile Computing Systems & Applications (WMCSA 2003)*, Monterey, CA, USA, October, pp. 122-128.

[84] Ko, Y., & Vaidya, N. H. (2000). Location-aided routing (LAR) in mobile ad hoc networks. *Wireless Networks*, *6*(4), 307-321.

[85] Liao, W.-H., Tseng, Y.-C., & Sheu, J.-P. (2001). GRID: a fully location-aware routing protocol for mobile ad hoc networks. *Telecommunication Systems*, *18*(1), 37-60.

[86] Kuhn, F., Wattenhofer, R., Zhang, Y., & Zollinger, A. (2003). Geometric ad-hoc routing: of theory and practice. In *Proceedings of the ACM (PODC'03)* (pp. 63-72).

[87] Jiang, X., & Camp, T. (2002). Review of geocasting protocols for a mobile ad hoc network. In Proceedings of the *Grace Hopper Celebration (GHC)*.

[88] Ko, Y. & Vaidya, N. H. (1999). Geocasting in mobile ad hoc networks: location-based multicast algorithms. In *Proceedings of the IEEE (WMCSA'99)* (pp. 101).

[89] Mauve, M., Fuler, H., Widmer, J., & Lang, T. (2003). *Position-based multicast routing for mobile ad-hoc networks* (Technical Report TR-03-004). Department of Computer Science, University of Mannheim.

[90] Xu, Y., Heidemann, J., & Estrin, D. (2001). Geography-informed energy conservation for adhoc routing. In *Proceedings of the ACM/IEEE (MOBICOM'01)* (pp. 70-84).

[91] Hu, Y.-C., Perrig, A., & Johnson, D. (2003). Packet leashes: a defense against wormhole attacks in wireless ad hoc networks. In *Proceedings of the INFOCOM' 03* (pp. 1976-1986).

[92] Patwari, N., Hero III, A. O., Perkins, M., Correal, N. S., & O'Dea, R. J. (2003). Relative location estimation in wireless sensor networks. *IEEE Transactions on Signal Processing*, *51*(8), 2137-2148.

[93] Baldauf, M., Dustdar, S., & Rosenberg, F. (2007). A Survey on Context Aware Systems. *International Journal of Ad Hoc and Ubiquitous Computing*, Inderscience Publishers. forthcoming. Pre-print from: http://www.vitalab.tuwien.ac.at/~florian/papers/ijahuc2007.pdf

[94] Hong, D., Chiu, D.K.W., & Shen, V.Y. (2005). Requirements elicitation for the design of context-aware applications in a ubiquitous environment. In *Proceedings of ICEC'05* (pp. 590-596).

[95] Neeraj Tantubay, Dinesh Ratan Gautam and Mukesh Kumar Dhariwal, A Review of Power Conservation in Wireless Mobile Ad hoc Network (MANET)", International Journal of computer Science Issues, Vol 8, Issue 4, No 1, July 2011.

[96] Wenrui Zhao, Mostafa Ammar and Ellen Zegura, "A Message Ferrying Approach for Data Delivery in Sparse Mobile Ad Hoc Networks", *MobiHoc'04,* May 24–26, 2004, Roppongi, Japan.

[97] Sgroi et al., "Designing Wireless Protocols: Methodology and Applications, February 2000.

[98] Gyula et al., "Simulation-based optimization of

communication protocols for large-scale wireless sensor networks", 10 October 2002

[99] Rao and Sharma, "Cross Layer Protocols For Multimedia Transmission in Wireless Networks", June 2012

[100] Herms et al, "Realism in Design and Evaluation of Wireless Routing Protocols", 2007.

About Author (s):

Associate Professor Nawaz Mohamudally works at University of Technology, Mauritius (UTM) and has undertaken supervision of MPhil/PhD Students for many years.

M. Kaleem Galamali is a part-time student (achieved M Phil Transfer on 28.10.2014, currently PhD student) at UTM under supervision of A.P. Nawaz Mohamudally.