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Trend Analyses of Parameters of Equations for Overall Nodes Extra Energy Savings Achievable in MANET against Direct Node-to-Node Location-Aware Transmission.

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Abstract – **Quite extensive research is well ongoing concerning enhancement of Location-Tracking, functionalities and MANET transmission strategies in ubicomp environment [33-69]. Despite all these progress, the area of modelling in ubicomp to assess predictability features, is still in its embryonic stages. One particular sub-area is energy considerations in ubicomp. This is especially important since battery power of present date devices is still considered constrained. A previous research [17] was carried out to quantify and model the extra energy achievable in MANETs against direct node-to-node transmission under different sets of node densities in a ubicomp environment. The corresponding model was also observed to be following a normal distribution just as in two previous research [31, 32] for metric OES and SLNTNES but with different parameter values.**

In this paper, the next level of question to be investigated is legitimately put forward as: "What are the trends of variation observable within each parameter of the equation of normal curve obtained for metric OLNTNES [17] over varying node densities?"

The need for studying the behaviour of components of an applicable model for metric OLNTNES and successively model the behaviour of each component mathematically is felt required since it will cost effort. Results obtained also have refined purposes for designers to better predict ubicomp features and provide necessary algorithmic support for ubicomp architectures. This paper is a follow-up of previous papers [1-32].

Key terms: Ubicomp- Ubiquitous Computing, MAUC-Mobile and Ubiquitous Computing, ES- Energy Savings, SES- Sender ES, OES-Overall ES, SLNTNES- Sender Less Node-to-Node ES, OLNTNES- Overall Less Node-to-Node ES, MANET- Mobile Adhoc Network, CBR-Constant Bit Rate.

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1. Introduction

MANET transmission is one type of transmission strategy which affects the distribution of energy consumption in MAUC environment [2]. Within this type of transmission, a pertinent feature is node density. Three previous studies were made to find the particular trend/models depicting energy savings achievable [14-16]. A fourth study was made to depict the overall node extra energy savings achievable against direct node-to-node transmission in MANET (OLNTNES) compared to the theoretical/empirical models derived in simulations. The model put forward for metric OLNTNES was the normal distribution model of form:

$$F(x)=b*(1/(a*sqrt(2*pi)))*exp(-(x-c)^2/2*a*a)$$

Here also, just like in two previous paper [31, 32], the equation of the model involves three parameters: a, b and c. The difference, again, is that these parameters are of different values. The next milestone in this research for metric OLNTNES is to study the mathematical modelling of the parameters of the equation obtained above and successively deriving the model of variation of each parameter.

The key contributions of this paper is the establishment of the trend of variation for each parameter of the equation of the normal distribution model for metric OLNTNES presented in previous paper [17]. Reuse of tabular data in Table 1 in that paper [17] covering node numbers 7 until 56 is made here. The mathematical methods produced here will assist designers in better understanding the evolution and predictability of ubicomp features in such a fashion that it can be easily implemented into a software program for future adaptability requirements in ubicomp. The rest of this paper is organised as follows: section 2- Parameter Trend Analysis- Metric OLNTNES, section 3-Conclusion and References.

2. Parameter Trend Analysis – Metric OLNTNES.

<u>*2.0 General Procedure Adopted.*</u>

The tabulated data for each parameter of equation of model for OLNTNES is plotted on gnuplot over Linux. Graphical analysis using smooth bezier support and "fit" command is performed. General observations, for each such graph obtained is reported. Again, various equations of fit are attempted and their summary report is presented for parameters of metric OLNTNES.

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Ultimately, choice is made considering firstly the value of least reduced chi-square and secondly most plausible extendability produced at node numbers 80, 100 and 120. Finally, the values of parameters for each OLNTNES parameter of equation is also noted.

2.1 Trend Analysis – OLNTNES parameter "a".

Basically the curve obtained depicts an exponential decreasing trend.

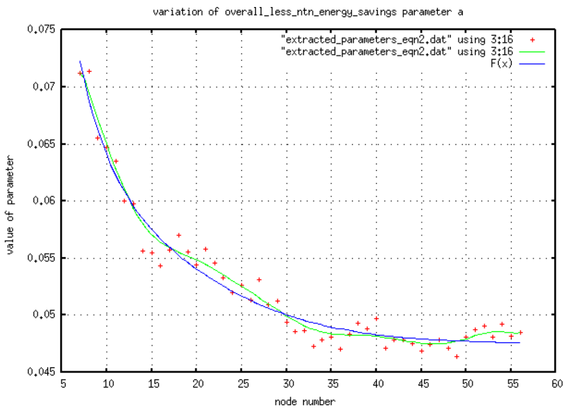

Figure 1: OLNTNES parameter a

The potentially applicable equations are:

1. F(x) = ((a*x+f)/exp (b*(x-c)))+d
   Ch_sq = 1.952 63(e^{-06}) F(80) = 0.047 640 015
   F(100) = 0.047 629 74 F(120) = 0.047 628 46
2. F(x)= ((a*x^2+f)/exp (b*(x-c)))+d
   Ch_sq = 1.843 72(e^{-06}) F(80) = 0.047 566 889 6
   F(100) = 0.047 559 937 5 F(120)= 0.047 559 380 56
3. F(x)= ((a*x^3+f)/exp (b*(x-c)))+d
   Ch_sq = 1.648 34(e^{-06}) F(80) = 0.047 504 9
   F(100) = 0.047 502 5 F(120) = 0.047 502 4
4. F(x)= ((a*x^4+f)/exp (b*(x-c)))+d
   Ch_sq = 1.935 74(e^{-06}) F(80) = 0.048 383 8
   F(100) = 0.048 564 4 F(120) = 0.048 625 5

Choice of best fit for OLNTNES parameter a

The equation in part 3 above has been selected because of both smallest reduced chi-square value obtained and good extendability. The parameters for best fit are:

a = 2.860 88(e^{-05}) , b = 0.196 014 , c = 0.299 056 , d = 0.047 502 5 , f = 0.082 393 3

2.2 Trend Analysis – OLNTNES parameter "b".

A similar trend as observed for OLNTNES parameter a, is observed here.

The potentially applicable equations are:

1. F(x) =((a*x+f)/exp (b*(x-c)))+d
   Ch_sq = 0.000 165 293 F(80) = 0.189 564 732 796 4
   F(100)=0.189 537 335 467 4 F(120)=0.189 535 002 200 5
2. F(x)=((a*x^2+f)/exp (b*(x-c)))+d
   Ch_sq = 0.000 150 58 F(80) = 0.188 447 031 740
   F(100)=0.188419431324 F(120)= 0.188 417 626 869
3. F(x)=((a*x^3+f)/exp (b*(x-c)))+d
   Ch_sq = 0.000 118 211 F(80) = 0.185 606 356 154
   F(100)=0.185 577 429 660 F(120) = 0.185 576 085 450
4. F(x)=((a*x^4+f)/exp (b*(x-c)))+d
   Ch_sq = 9.757 08(e^{-05}) F(80) = 0.183 698 216
   F(100) = 0.183 682 229 F(120) = 0.183 681 794
5. F(x)=((a*x^5+f)/exp (b*(x-c)))+d
   Ch_sq = 0.000 165 135 F(80) = 0.193 272 328
   F(100) = 0.192 965 297 F(120) = 0.192 993 916

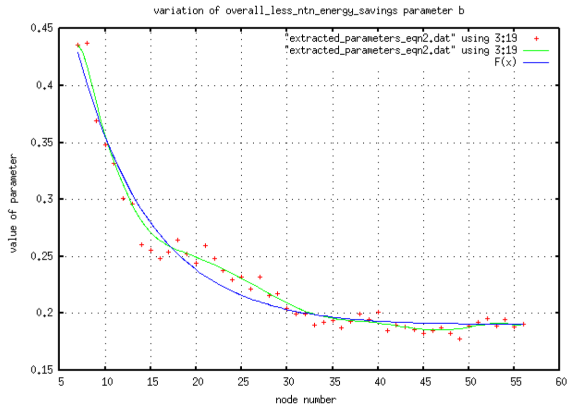

Figure 2: OLNTNES parameter b

Choice of best fit for OLNTNES parameter b

The equation in part 4 above has been selected because of both smallest reduced chi-square value obtained and good extendability. The parameters for best fit are:

a = 2.485 99(e^{-05}) , b = 0.225 033 , c = 0.263 749 , d=0.183 682 , f= 1.179 42

2.3 Trend Analysis – OLNTNES parameter "c".

Generally the curve shows exponential decrease.

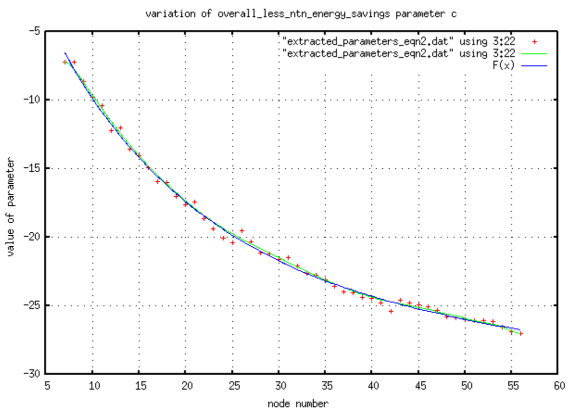

Figure 3: OLNTNES parameter c

The potentially applicable equations are:

1. F(x)= a * x * exp (b * x) +(c*x)

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Ch_sq = 0.185 023 F(80) = -26.505 931 367

F(100) =-25.404 509 822 F(120)= -24.173 034 259

2. $F(x)= a* x^2 * exp (b * x) +(c*x)$

Ch_sq = 0.169 3 F(80) = -34.483 701

F(100) = -42.016 F(120) = -50.091 75

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

Ch_sq = 0.117 198 F(80) = -31.596

F(100) = -36.854 F(120) = -42.982 98

4. $F(x)= a* x^{1.5} *exp (b * x^{0.5})+(c*x)$

Ch_sq = 0.172 629 F(80) = -49.614

F(100) = -106.096 8 F(120) = -219.989

5. $F(x)=a* x^{1.5} *exp (b* x^{0.5})+(c*x^{0.5})$

Ch_sq = 0.149 752 F(80) = -26. ……

F(100) = -24. …… F(120) = -23. ……

6. $F(x)=a* x^{1.5} *exp (b* x^{0.5})+(c*x)+d$

Ch_sq = 0.120 829 F(80) = -29.018 872

F(100) = -30.755 270 F(120) = -32.712 462

Choice of best fit for OLNTNES parameter c

The equation in part 6 above has been selected because of both smallest reduced chi-square value obtained and good extendability. The parameters for best fit are:

a = -1.512 99 , b = -0.475 118 , c = -0.205 545 , d=2.873 7

3. Conclusion.

This piece of research was aimed at and has developed the applicable models of trends of the parameters of equations for the metric OLNTNES in a MANET topography of 300 x 300 m^2. The models put forward comprise of complex mathematical equations and these will assist in studying MANETs for MAUC environment from a software engineering point of view. These mathematical procedure can be used to formulate computational algorithms to be integrated in software simulators for appropriate studies of MANET evolutions. The experiment concerned here was also carried out in NS-2 over Linux. The plottings and "fit" attempts were carried out in gnuplot. Criteria used for evaluating best fit are reduced chi-square values and best extendability of equations obtained.

Assumptions stated in previous paper [17] are maintained here also. Gnuplot is also acknowledged as appropriate in the sense that gnuplot constitutive constructs and accuracy levels it works with are not criticised here.

Further work identified remain: formulating methods of predictability for metric OLNTNES and its trend and reporting observations of certain critical values identified.

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]

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

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

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

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

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

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

[39] 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

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

[41] 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*

[42] 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

[43] 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

[44] 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.

[45] 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

[46] 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

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

[48] 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

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

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

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

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

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

[54] 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.

[55] 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.

[56] 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.

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

[58] 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.

[59] 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).

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

[61] 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).

[62] 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.

[63] 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).

[64] 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).

[65] 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.

[66] 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

[67] 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).

[68] 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.

[69] 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.

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