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Trend Analyses of Parameters of Equations for Range CBR Distance Achievable in Ubicomp MANETs Using Location-Aware Transmission.

M. Kaleem GALAMALI, Assoc. Prof Nawaz MOHAMUDALLY

Abstract **– The use of MANET transmission methods is considered as probable solution to the problem of inadequately equipped MANET environments. Such situations are very probable in the near future. Significant performance of MANET radically rely on correctly designed protocols for transmission [80]. Adjusting such strategies with location-awareness is believed to uplift the energy management standards and explains all endeavour input by many researchers. Some expected near future deliverables include land-based GPS systems, improved location refresh rates and accuracy, development of sophisticated transmission protocols and less expensive hardware with greater performance. Readily available empirically formulated knowledge concerning trends of distance coverages by transmitted packets in a ubicomp environment over varying node densities, is irrefutably conducive towards refining transmission protocols in MANETs. Accordingly, one such relevant study was conducted in a prior paper [29], whereby metric R_CBR_Dist was discussed.**

In this paper, the next piece of investigation required for metric R_CBR_Dist is put forward as: "What are the trends of variation observable within each parameter of the equation of curves obtained for metric R_CBR_Dist [29] over varying node densities?". The results presented here may be harnessed by programmers and designers for more judiciously develop ubicomp transmission protocols. This work remains a follow-up of previous work [1-44].

Key terms: Ubicomp- Ubiquitous Computing, MAUC-Mobile and Ubiquitous Computing, MANET- Mobile Adhoc Network, CBR- Constant Bit Rate, R_CBR_Dist – Range CBR Distance.

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1. Introduction

It is anticipated that not all future network environments would be plentifully equipped with networking and routing devices. This problem may be more severe in underdeveloped regions or emergency sites. Since ubicomp inherits a lot from distributed systems, it will be subject to lots of heterogeneities [1] which may also dripple into MANET transmission protocols. Yet, MANET transmission remain a salutary choice for such substandard topographies. The performance of such protocols may be further dignified by application of location-awareness and distance considerations. Studying distance related characteristics may be done from perspective of metrics. One such metric, R_CBR_Dist was investigated previously [29], whereby the pattern followed was expressed as the normal distribution model of form:

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F(x)=b*(1/(a*sqrt(2*pi)))*exp(-(x-c)^2/2*a^2)
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Here, a quite complex equation of the model is observed with 3 parameters: a, b and c. the next empirical upgrade required for metric R_CBR_Dist is the model equations for parameters of equation specified above.

The key contributions of this paper is the elaboration of equations involved for the model for metric R_CBR_Dist expounded previously [29], from which table 1 is re-applied here. The empirical methods extended here may be incorporated into software simulators so that designers and researchers are habilitated with better tools for further investigations of the evolution and predictability of distance features in future ubicomp. The rest of this paper is organised as follows: section 2- Parameter Trend Analysis- Metric R_CBR_Dist, section 3- Conclusion and References.

2. Parameter Trend Analysis – Metric R_CBR_Dist.

2.0 General Procedure Adopted.

A four step procedure has been defined:

i. The tabulated data for each parameter of the equations for the model for R_CBR_Dist is plotted on gnuplot.
ii. Graphical analyses are performed and general observations are noted.
iii. Different equations of fit are attempted gauged against values of least reduced chi-square and most appreciable extendability at node numbers 80, 100 and 120.

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iv. The parameter values for each R_CBR_Dist parameter of equation is recorded.

2.1 Trend Analysis – R_CBR_Dist parameter "a".

The curve depicts an oscillation along an axis which is itself increasing at a decreasing rate. This axis depicts a logarithmic tendency.

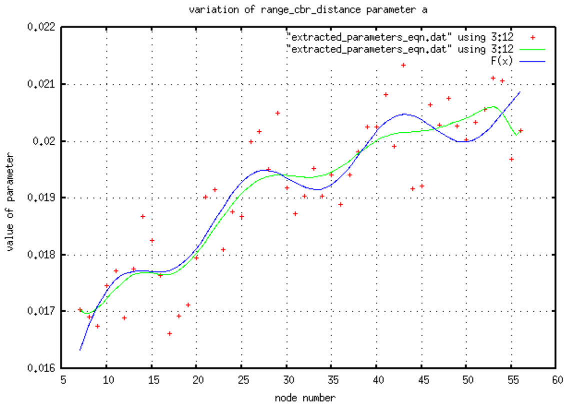

Figure 1: R_CBR_Dist parameter a

The potentially applicable equations are:

1. F(x)= a * x + b
   Ch_sq = 4.838 11 (e^{-07})   F(80) = 0.022 851
   F(100) = 0.024 386   F(120) = 0.025 921
2. F(x)=a*sin ((b*x)+c) + d*log (x) +f
   Ch_sq = 3.896 07(e^{-07})   F(80)=0.021 172 844
   F(100) = 0.021 522   F(120) = 0.022 464
3. F(x)= a * sin ((b*x)+c) + d*x + f
   Ch_sq =4.457 74(e^{-07})   F(80) = 0.022 877
   F(100) = 0.024 243   F(120) = 0.025 585

Choice of best fit for R_CBR_Dist parameter a

The equation in part 2 above has been selected because of both smallest reduced chi-square value obtained and good extendability. The parameters for best fit are:

a = 0.000 411 479 , b = 0.391 009 , c = 3.855 95 , d = 0.002 133 42 , f = 0.012 049 3

2.2 Trend Analysis – R_CBR_Dist parameter "b".

Again, the curve depicts an oscillation along an axis which is itself increasing at a decreasing rate. This axis itself depicts logarithmic increase.

The potentially applicable equations are:

1. F(x)= a * x + b
   Ch_sq = 4.027 7(e^{-06})   F(80) = 0.048 633 383
   F(100) = 0.053 750   F(120) = 0.058 868 465
2. F(x)= a * sin ((b*x)+c) + d*x + f
   Ch_sq = 3.738 48(e^{-06})   F(80) = 0.049 051 642
   F(100) = 0.052 740   F(120)=0.058 630 536
3. F(x)= a*sin ((b*x)+c)+ d*log (x)+f
   Ch_sq = 3.264 11(e^{-06})   F(80) = 0.042 828
   F(100) = 0.044 268   F(120) = 0.047 376

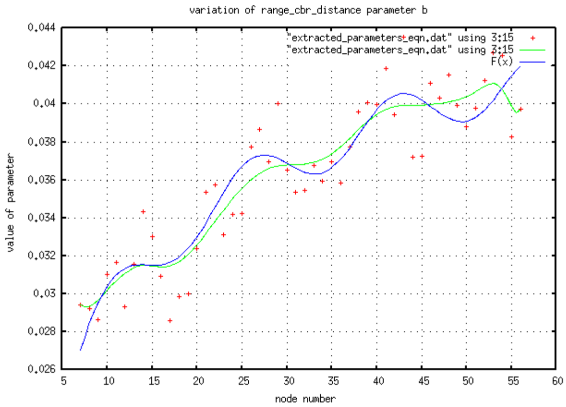

Figure 2: R _CBR_Dist parameter b

Choice of best fit for R_CBR_Dist parameter b

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 = 0.001 297 73 , b = 0.392 565 , c = 3.870 15 , d = 0.007 017 45 , f = 0.012 931 8

2.3 Trend Analysis – R _CBR_Dist parameter "c".

The curve depicts an increasing tendency at a decreasing rate. This is typical of logarithmic trends.

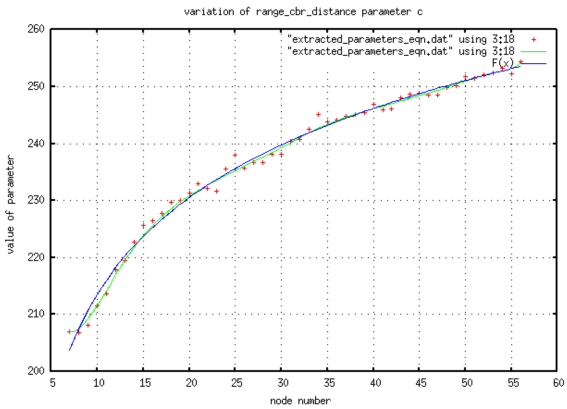

Figure 3: R _CBR_Dist parameter c

The potentially applicable equations are:

1. F(x)= a * log ((b * x) + c) + d
   Ch_sq = 1.599 33   F(80) = 261.254 717
   F(100) = 266.043 710   F(120) = 269.940 507
2. F(x)= a * x * log ((b*x)+c) + d
   Ch_sq = 18.139 5   F(80) = 280.203 188
   F(100) = 298.188 192   F(120) = 316.300 747
3. F(x)= $a*x^{0.5}$ * log ((b*x)+c) + d
   Ch_sq = 7.728 32   F(80) = 270.883 275
   F(100) = 281.185 803   F(120) = 290.564 033
4. F(x)= $a*x^{-0.5}$ * log ((b*x)+c)+d

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Ch_sq = 3.151 21 F(80) = 256.361 468
F(100) = 259.025 053 F(120) = 261.006 985

5. $F(x) = a*x^{-1}*\log((b*x)+c) + d$
Ch_sq = 11.783 4 F(80) = 251.194 431
F(100) = 252.358 918 F(120) = 253.141 250

Choice of best fit for R_CBR_Dist parameter c

The equation in part 1 above has been selected because of both smallest reduced chi-square value obtained and good extendability. The parameters for best fit are:

a = 20.990 6 , b = 49.630 1 , c = -97.191 5, d = 87.833 9

3. Conclusion.

This work of advancement of empirical analysis was devised to and has yielded applicable models of trends of the parameters of equations for the metric R_CBR_Dist in a MANET topography of 300 x 300 m^2. The models extrapolated here, comprise of mathematical equations of varying complexity. Such mathematical information may give rise to development of processing algorithms for simulator packages for the objective of advanced studies of MANETs. These empirical information will give rise to the pursuit of refined simulator packages for advanced studies of MANETs. The empirical investigation was conducted in gnuplot and criteria of selection of best fit have remained least reduced chi-square and best extendability produced at higher node numbers.

The tenable assumptions made in previous paper [29] are implied here also. The efficacy and accuracy characteristics of gnuplot is reckoned as commensurate for the purpose of this probing.

capability and accuracy level of gnuplot is deemed as adequate for the purpose of this investigation.

Additional work identified here remain: formulating a convenient method of predictability for metric R_CBR_Dist and its trend and reporting specific observations of certain critical values designated.

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