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

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***Abstract* – MANET transmission strategies represent one key to address the problem of scarce network amenities in ubicomp topographies. It is understandable that correctly designed protocols for this work can help in controlling energy issues in ubicomp [78]. The enforcement of location-aware transmission strategies is augured to enhance energy management and hence deserves all effort put in by researchers. A few enhancements awaited are: the application of land-based GPS systems, improved location refresh rates and accuracy, development of refined protocols optimised for transmission according to distance and direction criteria, and development of cheaper hardware to support such functionalities. The knowledge of distance coverages by transmitted packets in a ubicomp and corresponding tendencies over different node densities, is undoubtedly favourable for fine tuning transmission protocols in MANETs. Such a corresponding empirical study was conducted in a former paper [27], whereby the metric Max_CBR_Dist was depicted.**

In this paper, the next level of study needed for metric Max_CBR_Dist is stated as: "What are the trends of variation observable within each parameter of the equations of curves obtained for metric Max_CBR_Dist [27] over varying node densities?" Designers may potentially use the output detailed here, towards formulation of better ubicomp transmission protocols. This piece of research dwells a follow-up of previous research [1-42].

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

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1. Introduction

Ubicomp topographies, especially those located outdoor or in poor countries, may be scantly equipped with network routing devices. Ubicomp topographies may also be very heterogeneous in features like accuracy level of distance measurement, location refresh rates and level of sophistication and update of operating protocols. MANET transmission may be the favourable choice for such spots. This may be augmented with location-aware transmission. Methods of studying the observable distance related features experienced by CBRs in ubicomp exist in large variety. Following a previous paper [26], a derivative method was explained [27], in which the pattern of metric Max_CBR_Dist was explained as following the normal distribution of form:

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F(x)=b*(1/(a*sqrt(2*pi)))*exp(-(x-c)^2/2*a*a)
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Here, the equations of the model have necessitated 3 parameters: a, b and c. the next empirical formulation required for metric Max_CBR_Dist is the model equations for parameters of equation specified above.

The key contributions of this paper is the development of equations of trend of variations for each parameter of the equations involved for the model for metric Max_CBR_Dist presented previously [27] from which table 1 is re-exploited here. The empirical methods developed here remain at the disposal of designers and programmers, to be implemented into software simulators, giving rise to a tool assisting in more advanced 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 Max_CBR_Dist, section 3- Conclusion and References.

2. Parameter Trend Analysis – Metric Max_CBR_Dist.

2.0 General Procedure Adopted.

The procedure adopted consist of breaking the work required into four stages as follows:

i. Plot the tabulated data for each parameter of the equation for the model for Max_CBR_Dist onto gnuplot.
ii. Graphical analyses are performed and general observations are noted.
iii. Different equations of fit are noted. Best fit is based on values of least reduced chi-square and

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most appreciable extendability at node numbers 80, 100 and 120.

iv. The parameter values for each Max_CBR_Dist parameter of equation is noted.

2.1 Trend Analysis – Max_CBR_Dist parameter "a".

Generally the trend observed is an oscillation along a straight line (as axis) with positive gradient and not along a horizontal line.

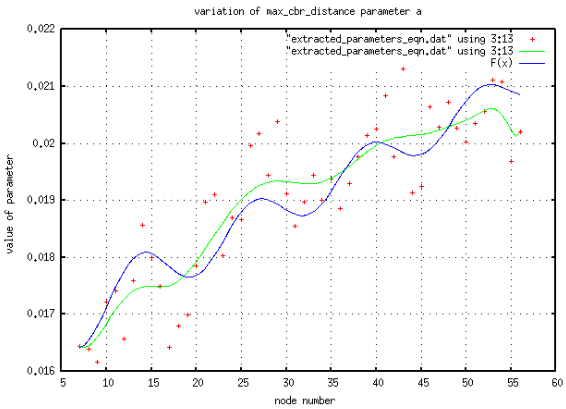

Figure 1: Max_CBR_Dist parameter a

The potentially applicable equations of best fit are:

1. F(x)= d * x + f
   Ch_sq = 5.348 67(e^{-07}) F(80)= 0.023 103 283
   F(100) = 0.024 785 033 F(120)= 0.026 466 783
2. F(x)= a * sin ((b*x)+c) + d*x + f
   Ch_sq = 4.888 08(e^{-07}) F(80) = 0.023 014 825
   F(100) = 0.024 810 030 F(120) = 0.025 949 942
3. F(x)= a*x * sin ((b*x)+c) + d*x+f
   Ch_sq = 5.224 23(e^{-07}) F(80)= 0.022 685 099
   F(100) = 0.025 560 F(120)= 0.025 489 111
4. F(x)= (a/x) * sin ((b*x)+c)+d*x+f
   Ch_sq = 4.896 41(e^{-07}) F(80) = 0.022 927
   F(100) = 0.024 587 F(120) = 0.026 088
5. F(x)= a * log (x) * sin ((b*x)+c) + d*x + f
   Ch_sq = 5.003 19(e^{-07}) F(80) = 0.022 988
   F(100) = 0.024 952 F(120) = 0.025 835
6. F(x)= (a/log (x)) * sin ((b*x)+c) + d*x + f
   Ch_sq = 4.813 92(e^{-07}) F(80) = 0.022 989
   F(100) = 0.024 713 319 F(120) = 0.026 005 255

Choice of best fit for Max_CBR_Dist parameter a

The equation in part 6 above has been selected because of smallest ch_sq and good extendability over larger node numbers. The parameters obtained for best fit are:

a = -0.001 247 85 , b= 0.497 044 , c= 4.153 76 , d = 8.123 23(e^{-05}) , f = 0.016 472

2.2 Trend Analysis – Max_CBR_Dist parameter "b".

Here also, the trend observed is an oscillation along a straight line with positive gradient and not along a horizontal line.

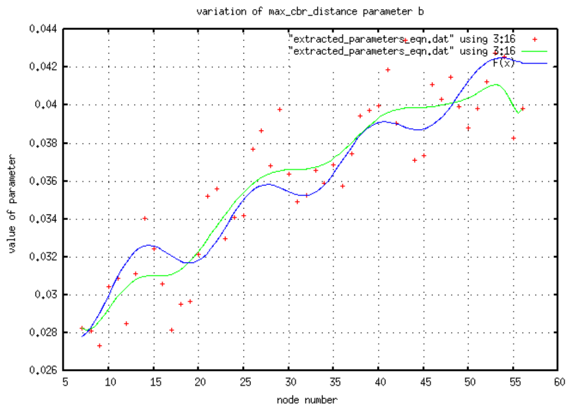

Figure 2: Max_CBR_Dist parameter b

The potentially applicable equations are:

1. F(x)= d * x + f
   Ch_sq = 4.286 29(e^{-06}) F(80) = 0.049 199 518
   F(100)= 0.054 652 232 F(120)= 0.060 104 946
2. F(x)= (a/log (x)) * sin ((b*x)+c) + d*x + f
   Ch_sq = 3.933 54(e^{-06}) F(80) = 0.049 235 966
   F(100)= 0.053 961 276 F(120)= 0.059 335 525

Choice of best fit for Max_CBR_Dist parameter b

The equation in part 2 above has been selected because of smallest ch_sq and good extendability over larger node numbers. The parameters obtained for best fit are:

a = -0.003 350 11 , b= 0.488 456 , c= 4.338 05 , d = 0.000 264 877 , f = 0.027 634 47

2.3 Trend Analysis – Max_CBR_Dist parameter "c".

Generally the curve depicts an increasing tendency at a decreasing rate, i.e. characteristic of logarithmic trends.

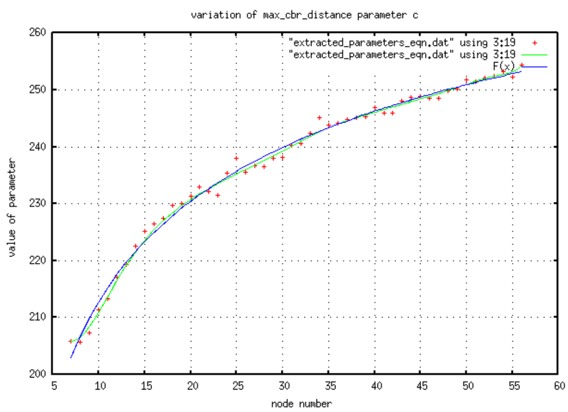

Figure 3: Max_CBR_Dist parameter c

The potentially applicable equations are:

1. F(x)= a * log (b * x) + c
   Ch_sq = 1.951 98 F(80) = 262.632 001 240
   F(100) = 267.923 032 F(120)= 272.246 119 584
2. F(x)= a * log ((b * x) + c) + d
   Ch_sq =1.615 04 F(80) = 261.220 827
   F(100)=265.990 177 737 F(120)=269.867 603 795
3. F(x)= a * log ((b*x) + c) + (d*x)
   Ch_sq =1.581 61 F(80)= 259.886 218
   F(100)= 263.586 175 F(120)= 266.267 974
4. F(x)= a * log ((b * x)+c) + (d/x)
   Ch_sq = 1.582 52 F(80) = 260.983 779
   F(100) = 265.641 831 F(120) = 269.420 161

Choice of best fit for Max_CBR_Dist parameter c

The equation in part 3 above has been selected because of smallest ch_sq and good extendability over larger node numbers. The parameters obtained for best fit are:

a = 24.309 7 , b = 750.543 , c = -937.153 , d = -0.090 077 6

3. Conclusion.

This work of scrutiny was targeted at and has procured applicable models of trends of the parameters of equations for the metric Max_CBR_Dist in a MANET topography of 300 x 300 m^2. The models exposed in this current paper embodies mathematical equations of varying complexity. Such empirical information may drive the development of processing algorithms for simulator packages for more cultivated studies of MANETs. This empirical research was undertaken in gnuplot and criteria for selecting best fit are retained as reduced chi-square values and smoothest extendability experienced at higher node numbers.

The straightforward assumptions mentioned in previous paper [27] are re-applied here. Gnuplot is credited as significantly powerful for the purpose of this study.

Additional work identified here are: formulating a suitable method of predictability for metric Max_CBR_Dist and its trend and reporting specific observations of pertinent critical values identified.

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