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Gateway Routing Protocol

Reliability, Availability

Combined Credit Risk

Discovering Thoughts, Inventing Future

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Complete Simulation of an IEEE 802.11 Wireless Network using a Full Wave Electromagnetic Tool Dynamically Coupled to a RF System Simulator

By J.F. Mologni, C.L.R. Siqueira & M.A.R. Alves

Abstract - The purpose of this study is to fully evaluate a short range IEEE 802.11g channel at 2.4 GHz frequency by dynamic linking Ansys HFSS, a full wave electromagnet tool, and Ansys Designer, a system level design simulator. The study presented in paper shows the integration of a 3D field solver and a circuit solver that enables the calculation of radiation patterns, electric field plots, bit error rate, constellation plots while incorporates the actual transmitter and receiver antennas and devices as well as TX/RX system with numerous modulation schemes. Multipath effects are also considered because the entire physical environment is modeled. Frequency and time domain responses are seamlessly combined in order to yield a complete response of the entire system. The scenario of the WiFi network is a room comprised of a router, a notebook and a phone. The concepts shown in this paper can be applied to Zigbee, Bluetooth, WiMax and many other wireless network types.

Keywords : *IEEE 802.11, WiFi, finite element method, full wave simulation, system simulation, QAM, BPSK, BER.*

GJCST-E Classification : *C.2.1*

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Keywords : IEEE 802.11, WiFi, finite element method, full wave simulation, system simulation, QAM, BPSK, BER.

I. Introduction

The mainly Wireless Local Area Networks (WLANs) standards are IEEE 802.11 [1] and HyperLAN [2]. The IEEE 802.11 protocol set; commonly known as Wireless Fidelity (WiFi) can reach transmission rates up to 54 Mbps [3] using Quadrature Amplitude Modulation with 64 symbols (QAM-64). Numerous devices including notebook and smart phones can be connected to the network wirelessly and simultaneously. The network performance is affected by the surrounding environment and possible third party electromagnetic sources. If the transmission channel is found to be noisy or the path loss is too high, the router and electronic devices connected to it may adapt itself automatically using a more robust modulation in order to decrease bit error rate (BER). Usually a WiFi network is an indoor environment, and for that reason, many authors have reported experimental and theoretical studies of indoor propagation [4–9]. Nevertheless, these models tend to assume a particular feature like temporal fading or inter-floor losses. In order to create an exact model of any telecommunication channel, every geometric detail such as antenna geometry, orientation, reflections, component coupling and mismatch, needs to be modeled and calculated by a full wave 3D simulator. Ansys High Frequency Structure Simulator (HFSS), a solver based on the very well renowned Finite Element Method (FEM) is used for this purpose. A full room environment, including a router, a smart phone, a notebook and all the objects that are considered to affect the transmission channel are modeled. Two different 3D models of the room were analyzed: in the first condition the room has no walls and it is assumed to be in a free space. This first model considers the walls as an absorbing boundary condition (ABC) with perfect matched layers (PML) elements to fully absorb any incoming electromagnetic wave. In the second condition, the walls are modeled as concrete, which will likely result in a channel with multipath. The excitations of the 3D model is usually a sinusoidal source with a given frequency and phase, however, in order to obtain a realistic far field patterns and electric field distribution, the modulated WiFi time domain signal needs to be calculated in an external tool. For this purpose, the complete WiFi system design, which includes bit generator, header and preamble according to IEEE 802.11, modulators, filters, are accomplished using Ansys Designer. A full dynamic link between HFSS and Designer models enable a full system analysis, with BER and constellation plots using the 3D model as well as real far field patterns and electric field distribution due to modulated signals resulted from the system analysis showing the state of the art in terms of electromagnetic and circuit coupled simulation.

II. Full Wave 3D Electromagnetic Model

Ansys HFSS uses the FEM where a structure is subdivided into smaller subsections called finite elements. The finite elements in HFSS are tetrahedra, and the entire collection of tetrahedra is called a mesh. A solution is found for the fields within the finite elements, and these fields are interrelated so that Maxwell's equations are satisfied over inter-element boundaries,

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generating a field solution for the original 3D model. Once the field solution has been solved, the generalized S-matrix solution can be determined. HFSS solves equation 1, also known as wave equation, for each tetrahedra element on the model:

$$\nabla \times \left(\frac{1}{\mu_r} \nabla \times E_m(x,y) e^{-\gamma_m{}^2} \right) - k^2 \varepsilon_r E_m(x,y) e^{-\gamma_m{}^2} = 0 \quad (1)$$

Where $k = w/c$ is the wave number of free-space; c is the speed of light; $w = 2\pi f$ is the angular frequency; $\mu_r(x,y)$ is the complex relative permeability and $\varepsilon_r(x,y)$ is the complex relative permittivity. By solving the equation, the electric field mode pattern $E_m(x,y)$ and the propagation constant γ_m are both calculated for all the modes specified. The magnetic field is calculated according to equation 2:

$$H = \frac{1}{\omega \mu_r} \nabla \times E_m(x,y) \quad (2)$$

The above implies that HFSS solve equations in terms of electric and magnetic fields and not voltages and currents. As a result, it is very important that an HFSS simulation encompasses a volume within which electric and magnetic fields exist. Voltages and currents can then be calculated by integrating field values over surfaces and volumes.

The complete 3D room geometry is modeled with all the details including the router, phone, notebook, table, file cabinet, couch, chair, monitor, computer housing, vase and external walls as ABC boundary (radiating in free space) and later as concrete. Figure 1 shows the full model including the three electronic devices (router, notebook and phone) whose communications are going to be evaluated and all the surrounding objects that affect the transmission channel.

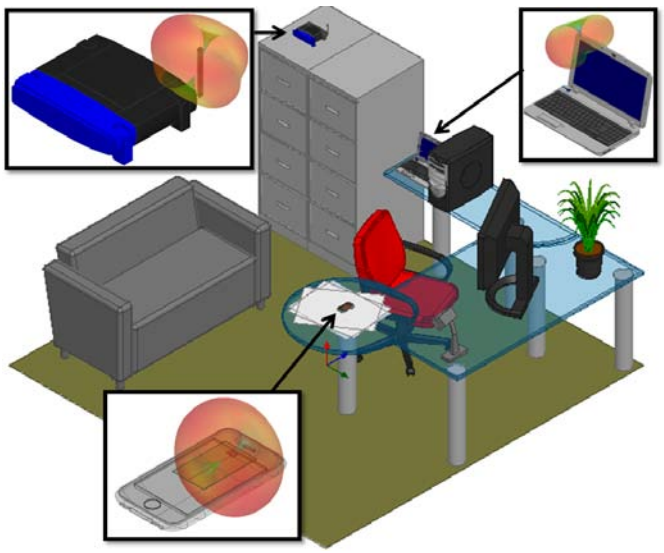

Figure 1 : Full HFSS model including the router, phone and notebook

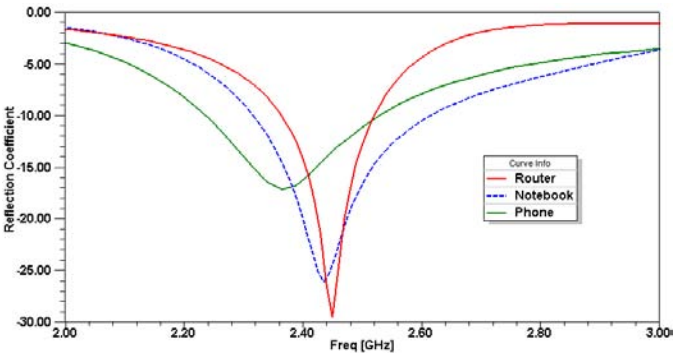

Figure 2 : Reflection coefficient S_{11} for all three electronic devices

The inset in figure 1 shows the far field pattern of all three electronic devices considering them radiating to be isolated and in a free space environment (not in the room). Note that all radiation patterns are for a 2.4GHz sinusoidal excitation. The antenna used in the notebook is a Planar Inverted F Antenna (PIFA); in the router the antenna is a monopole and in the phone it is a ceramic chip antenna. The far field patterns are in the typical shape of a "donut", which is expected for those types of antennas operating at their resonant frequency [10]. The reflection coefficient of the antennas (S_{11}) are observed in figure 2 where all values are below -10dB at the WiFi bandwidth which goes from 2.4 to 2.4835GHz and thus the devices are all operational at this frequency.

III. IEEE 802.11 System Design

Ansys Designer was used to create the full IEEE 802.11 system due to its complete library which already includes a complete schematic including all components already set for this standard. Some IEEE 802.11 characteristics includes fixed 22MHz channels, data rates from 6-54 Mbps depending on the Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), QAM-16 or QAM-64 modulation, low sensitivity to time synchronization errors, 64 sub-carriers, coding rates of 1/2, 2/3 or 3/, channel correction through the use of pilot channels for magnitude and phase and cyclic prefix (CP) which mitigates synchronization and multi-path.

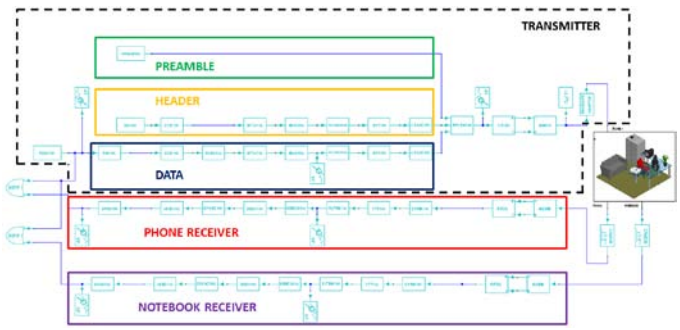

Figure 3 : IEEE 802.11 Schematic in Ansys Designer

Figure 3 shows the complete schematic including in the transmitter and receiver components plus the HFSS 3D model. The transmitter is comprised of a preamble, header and the data generation which includes a bit source that yields a random binary sequence, taking the value 1 or 0 with equal probability, followed by a convolutional encoder, a puncture to increase the coding rate [1], a interleaver since all encoded data bits shall be interleaved with a block size corresponding to the number of bits in a single Orthogonal frequency-division multiplexing (OFDM) symbol, a modulator to create a signal according to Gray-coded constellation mappings [11], a pilot addition, an inverse Fast Fourier Transform (IFFT) component that integrates OFDM signal to extract modulated data and a cyclic prefix addition component. The pilot addition is important because in each OFDM symbol, four of the subcarriers are dedicated to pilot signals in order to make the coherent detection robust against frequency offsets and phase noise. These pilot signals shall be put in subcarriers –21, –7, 7 and 21. The pilots are BPSK modulated by a pseudo binary sequence to prevent the generation of spectral lines. A data frame is then formed using this data plus the preamble and header information.

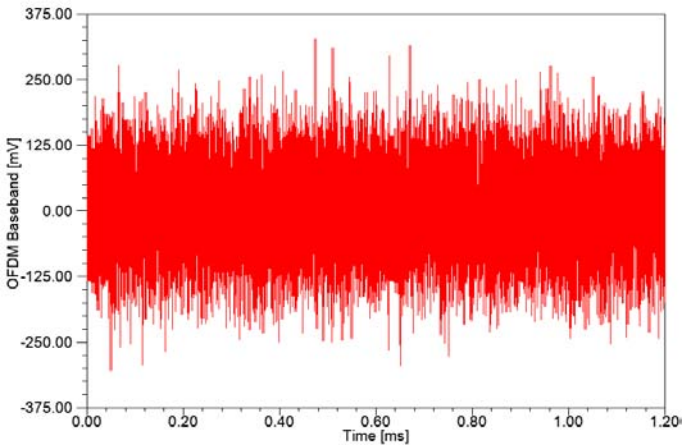

Figure 4 : OFDM Baseband transmission signal

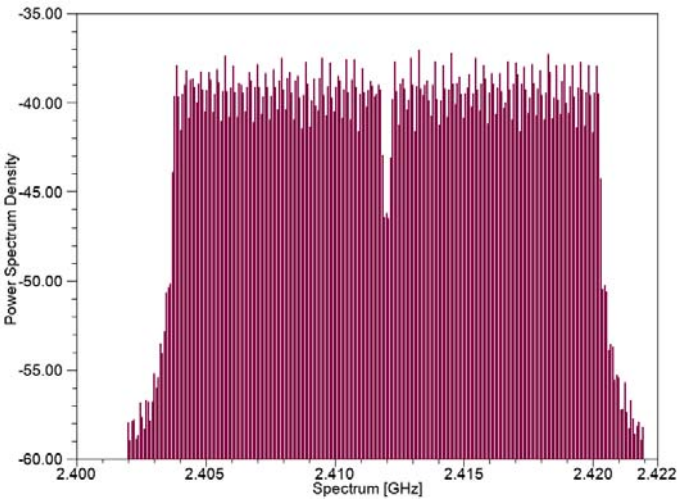

Figure 5 : OFDM Spectrum

The OFDM baseband transmission signal in time domain is extracted from the schematic and is displayed in figure 4. The OFDM spectrum showing the 64 sub carriers in the range of 2.4 to 2.4835GHz is plotted in figure 5. This data is then pushed into the router antenna in the HFSS 3D model, and the signal is then received by the phone and notebook antennas.

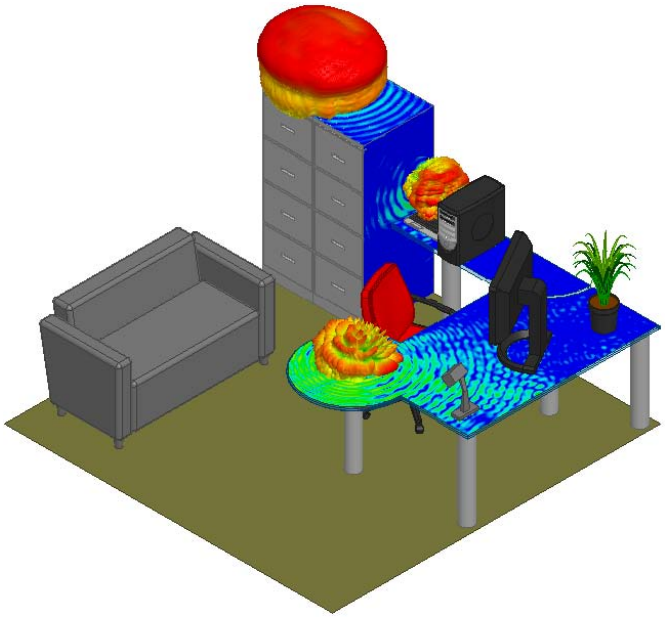

Figure 6 : E-field and radiation patterns of the room with ABC on the walls

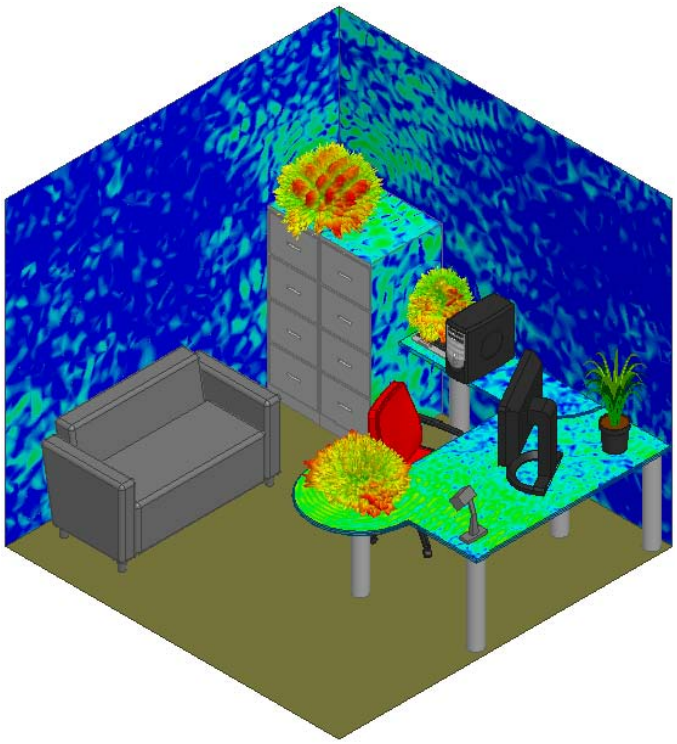

Figure 7 : E-field and radiation patterns of the room with concrete walls

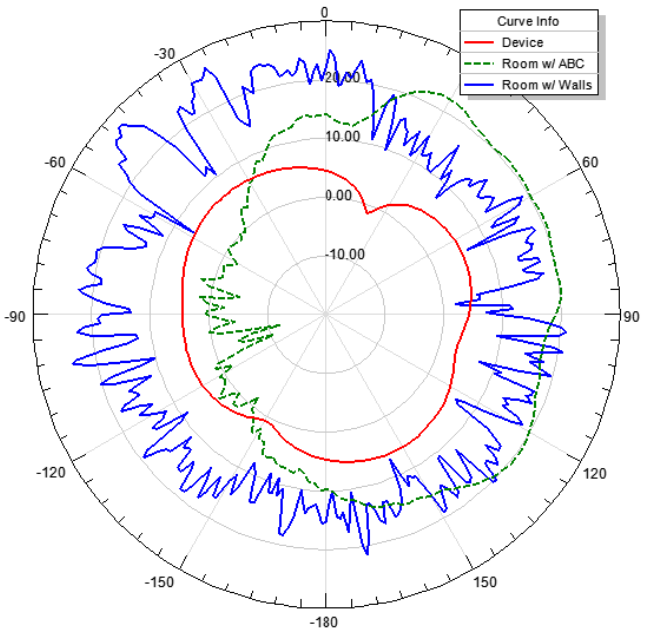

Figure 8 : Router far field pattern at $\phi = 90^{o}$ for three cases

Figure 6 shows the radiation patterns of the three electronic devices by having the QAM-16 modulated signal generated in Ansys Designer as an excitation in a full room environment with no walls. The walls in this model are considered as an ABC. By comparing figure 1 and 6, one can observe the distortions in the radiation patterns due to their different excitations and the objects that are now modeled in figure 6. A second case was created, where the walls are modeled as concrete, and the results are shown in figure 7. An even more evident distortion can be observed on the antenna patterns for this second case. This is mainly due to the reflections of the electromagnetic wave into the walls, which causes multipath. The distortions can be better visualized in figure 8 for the three cases where the router radiation pattern is displayed at $\phi = 90^{o}$. The red curve represents the far field of the router only in a free space environment excited with a 2.4 GHz sinusoidal signal. The dashed green line is the router far field excited with the QAM-64 modulated signal from Designer and within a room whose walls were modeled as an ABC (simulating free space). The blue pattern is the router with modulated signal and within a room with the walls modeled as concrete.

The communication channel can now be analyzed taking into consideration the full wave 3D electromagnetic model and the realistic waveforms. For this simulation, the second case where the room is modeled with concrete walls is taking into consideration since it represents a more realistic environment.

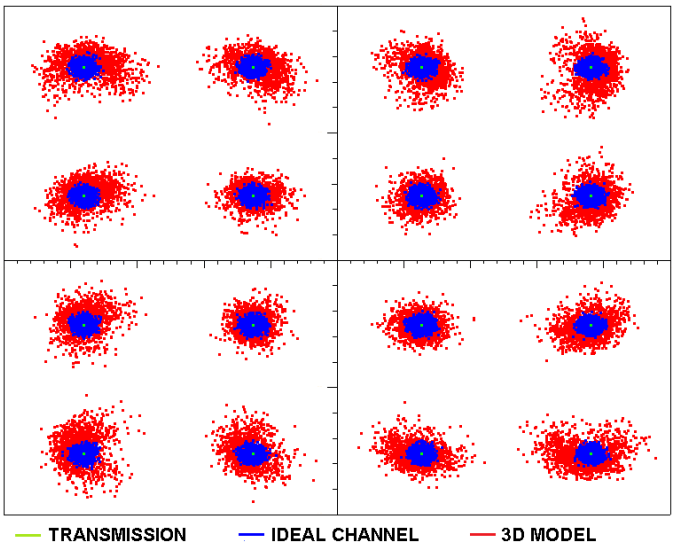

Figure 9 : QAM-16 constellation plot at the phone receiver

Figure 9 shows the QAM-16 constellation plots at the transmitter, the notebook receiver and in an ideal channel. An ideal channel, where a numerical additive white Gaussian noise (AWGN) is mathematically inserted into the system design is modeled for comparisons purposes.

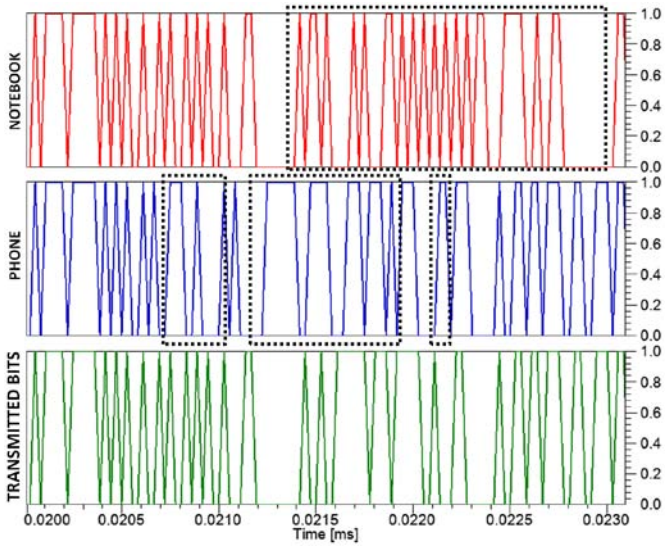

Figure 10 : Transmitted and received bit waveforms

Pilot subcarriers contain signal values that are known in the receiver. These pilot signals are used in the receiver for correcting the magnitude and phase shift offsets of the received symbols. For the phone demodulator, the sensitivity was calculated to be 290 for magnitude correction and the phase offset is 2.04 degrees; for the notebook demodulator these values are 50 and 2.6 degrees respectively. A phase distortion, frequently caused by multipath, is clearly observed in the red constellation, where the 3D model is considered. Also, the red constellation plot shows that there is a higher probability of intersymbol interference (ISI) to occur, which accurately represents the real world environment. When there is an ISI, a symbol, which carries 4 bits in a QAM-64 signal, is incorrectly received (typically by an adjacent symbol in the constellation) and as a result there is also a bit error at the receiver. BER is the ratio between the counts of wrong received bits divided by the total number of bits. A time frame of the bit sequence of all devices is displayed in figure 10. The black dotted line shows some wrong bits received by the notebook and the phone. This simulation was performed with QAM-16 and a SNR (signal to noise ratio) equal to 10 to force a high BER. For this scenario, the BER at the notebook is 25E-2 and at the phone is 18E-2.

By choosing a more robust modulation (e.g. BPSK) the BER values decreases, as well as the trasmittion rate. Figure 11 shows the BER as a function of the SNR plots for the notebook, phone and the ideal channel using BPSK, QAM, QAM-16 and QAM-64. These modulations yields a transmittion rate of 9Mbps, 18Mbps, 36Mbps and 64Mbps, respectively. Higher transmittion rates requires more bits per symbols, which in turn increases the ISI probability. According to figure 11, the network performance is very similar for the phone and notebook when using BPSK, QAM and QAM-16 modulations. Nevertheless, for QAM-64, the performance of the phone is higher than the notebook due to the transmittion link, which in the case of the notebook is done through multipath because there is no direct path to the router. In this scenario, the ideal channel also permforms better, as expected.

IV. Conclusions

A full simulation integrating the IEEE 802.11 system with a full wave 3D electromagnetic room model where the the performance of a router, a notebook and a phone is evaluated in details. Multipath, component coupling, wave reflections and scaterring parameters may only be obtained through the use of a full wave simulation tool, in this case Ansys HFSS, and these parameters are dynamically coupled to the system design in order to characterize the IEEE 802.11 communication channel in terms of BER as a function of SNR and constellation plots. When using BPSK, QAM and QAM-16 modulations, the network performance is very similar for the notebook and the phone, however, when using QAM-64, the transmittion rate is higher and the phone performs slightly better than the notebook due to a direct link between the router and the phone. Far field patterns and electric field plots were also calculated by having an accurate IEEE 802.11 signal as excitation. The depth of this analysis is only possible with a dynamic link between a 3D full wave electromagnetic simulation and a system design tool. The concepts presented in this paper can also be applied to numerous wireless networks including Zigbee, WiMax, Bluetooth, WCDMA and GSM among many others.

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Social Media Tools on the Eve of E-Learning 3.0

By Prof. Anna Nedyalkova, Dr. Sc., Prof. Teodora Bakardjieva, Dr. & Prof. Krassimir Nedyalkov, Dr.
Varna Free University, Bulgaria

Abstract - In the present paper, we'll explore how social media tools provide an opportunity for new developments of the e- Learning in the context of managing personal knowledge. There will be a discussion how social media tools provide a possibility for helping knowledge workers and students to gather, organize and manage their personal information as a part of the e-learning process. At the centre of this social software driven approach to e-learning environments are the challenges of personalization and collaboration. We'll share concepts of how organizations are using social media for e- Learning and believe that integration of these tools into traditional e-Learning is probably not a choice, but inevitability. Students' Survey of use of web technologies and social networking tools is presented. Newly developed framework for semantic blogging capable of organizing results relevant to user requirements is implemented at Varna Free University (VFU) to provide more effective navigation and search.

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GJCST-E Classification : *C.2.m*

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Social Media Tools on the Eve of E-Learning 3.0

Prof. Anna Nedyalkova, Dr. Sc. [α], Prof. Teodora Bakardjieva, Dr. [σ] & Prof. Krassimir Nedyalkov, Dr. [ρ]

Abstract - In the present paper, we'll explore how social media tools provide an opportunity for new developments of the e-Learning in the context of managing personal knowledge. There will be a discussion how social media tools provide a possibility for helping knowledge workers and students to gather, organize and manage their personal information as a part of the e-learning process. At the centre of this social software driven approach to e-learning environments are the challenges of personalization and collaboration. We'll share concepts of how organizations are using social media for e-Learning and believe that integration of these tools into traditional e-Learning is probably not a choice, but inevitability. Students' Survey of use of web technologies and social networking tools is presented. Newly developed framework for semantic blogging capable of organizing results relevant to user requirements is implemented at Varna Free University (VFU) to provide more effective navigation and search.

Keywords : semantic blogging, social media tools, e-learning, web 2.0, web 3.0 .

I. Introduction

Social software supports active social networking processes and a community model to foster knowledge sharing and collaboration. Social media tools represent new repositories of information and knowledge for personal and organizational purposes. High quality contributions are assured not only by guidelines, but also by reputation and rating the contributions (Mott, 2010).

Web 2.0 (O'Reilly, 2005) or the Social Web has introduced new concepts and tools that are able to operationalise a more social-centric vision. This trend has appeared so relevant and so promising that many specialists consider this approach to be the future of knowledge management, hoping that these tools will contribute to realizing the challenge of managing knowledge (Kakizawa, 2007; McAfee, 2006). This perspective raises a number of questions related to the application of a vision that was born from the need to incorporate more of the social dimension (Nabeth et al., 2002) and to better fit the individual needs of knowledge workers (Razmerita, 2005). PKM on Web 2.0 is achieved by a set of tools that allow people to create, codify, organize and share knowledge, but also to socialize, extend personal networks, collaborate on organizing knowledge and create new knowledge (Jarche & Downes, 2009). In this highly interconnected, dynamic world, new ways of cultivating and exploiting knowledge sharing with customers, suppliers and partners are forcing companies to expand their knowledge management concepts and agendas (Mentzas et al., 2007).

Chatti et al. (2006, 2007) discuss the use of social software in learning environments. Open blogs and cloud platforms such as Facebook have great educational potential (Meyer, 2010).

Semantic blogging has recently been associated with a decentralised form of knowledge management (Cayzer, 2004, Breslin & Decker 2007) and is a technology that builds upon blogging and enriches blog items with metadata. Newly developed framework for semantic blogging capable of organizing results relevant to user requirement (Shakya, 2006) is implemented at Varna Free University (VFU) to provide more effective navigation and search.

II. Background

Nowadays setting up an e-learning system is very easy. Almost anyone can now establish an online learning community using open source learning tools that comprise Web 2.0 features (Rogers, 2011). That's why it is possible for any organization to afford personalized online courses with a learning management system having advanced features to support mutual communication and collaboration. Production and delivery of e-learning programs are far easier with the arrival of Web 2.0.

Students get more tools and more encouragement to use these tools for learning, there is a possibility of creating 'personal learning environments', software interfaces that the learner can add to or edit, to facilitate their learning. These might include a portal to their courses that would include access to an LMS, but would also include links to their blog, e-portfolio, and social networks (Paul & Schofield, 2010). Online learning is increasingly appearing as strategic initiatives within institutional plans (Bates, 2013).

Open source LMS, such as Moodle, have an advantage here in that designers in universities with access to open source developers can build and integrate open source web 2.0 tools into the LMS quite easily.

The platform, developed and prototypical in use at Varna Free University, is based on concepts like social tagging and networking and therefore offers its users a new perspective of Web 2.0 driven learning (Nedyalkova and Bakardjieva, 2011).

There are numerous ways that faculties can use the Web 2.0 tools to enhance student's interaction in online learning. Incorporation of Web 2.0 tools such as

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blogs and wikis into online and hybrid courses has the potential for improving student engagement in learning. As shown through examples from our teaching and from the literature, these tools can facilitate rich interaction among students, the faculties, and the online interaction, the cornerstone of effective online learning.

III. Observations and Discussions

Web 2.0 changes fundamentally the e-Learning experience. At a minimum, they encourage a level of sociability, sharing, and connection among learners we've not experienced before. Instead of inviting learners to be passive consumers of information, with interactions limited to those specified by the "learning professionals," social media tools empower learners to be much more actively involved in constructing their own learning. Social media tools also provide learners with avenues for connecting with a much broader network of people as part of their learning experience.

Varna Free University (VFU) understands the power of social media and Eschool is our networking platform with more than 41,000 users. Like any other organization we use social media in our daily work processes. Whether blogs, wikis, and social networks are set up behind the firewall, or brought in through the internet cloud, these applications are finding their way into organization everywhere (Nedyalkova and Bakardjieva, 2011).

An inquiry was made among 257 MBA students at Varna Free University and as a result they had mainly positive reactions to the Web 2.0 technologies.

Response	Ease of Use	Enhanced Learning	Useful for Exam Prep	Fair Assessment of Students' Efforts
1 – Strongly Agree	18	18	25	22
2 - Agree	68	54	47	49
3 - Neutral	10	29	20	21
4 – Disagree	4	2	8	8
5 - Strongly Disagree	0	0	0	0

Table 1 : Students' Survey of use of Web 2.0 Technologies (MBA 325 - 65% Response Rate)

	Notebook or Netbook Computers	Smartphones	Ipads or Tablets	Social Networking Tools
Use	78%	62%	35 %	79%

Table 2 : Students' Survey of use of techniques and social networking tools

	Social Networks	Wikis, Blogs And Forums	Podcasts Or Video Podcasts	Shared Video Media (Youtube)
Use	85%	61%	42%	79%

Table 3 : Students' Survey of use of Web 2.0 technologies

These social media tools are used most often to find new information, connect with colleagues, and keep track of interesting people or topics. Seventy percent of survey respondents believe that their investment in Web 2.0 technologies is valuable.

	Web 1.0	Web 2.0*	Web 3.0**
Use	89%	82%	29%

Table 4 : Student Survey of use of Web technologies

* 82% say that they increased collaboration through Web 2.0 implementation. In terms of specific technologies being used, simulations, multi-player games, mobile learning and personalized learning portals were most popular. Most of the students believe that they can find what they are looking for on the first search, but personalized learning content is still not as prevalent as many would like it to be. Learning from multiple resources and having a learning history, publishing user content to university training sites, and focusing learning or IT resources on Web 3.0 still have a long way to go, with only about 30% of departments doing well.

** 72% of those surveyed see Web 3.0 as "the intelligent Web," which includes "the semantic Web" and natural language search. Location awareness and recommendation engines are also popularly believed to be part of Web 3.0. 61% feel that the biggest benefit from Web 3.0 is the ability to filter and personalize search results. The ability to interact with more types of Web content and search using natural language were seen as the second- and third biggest benefits. Web 3.0 adoption is dependent on the increasing use of video, on the importance of collaboration and cloud topologies. E-Learning 3.0 will happen when learners are better engaged for setting up their own blogs, wikis, and podcasts and for creating their own networks. Among the reasons given for this improvement are: wider use by employees, better collaboration, more personalized and flexible technology, the ability of learning to be embedded in work processes, and better support for mobile learning, as well as lowering costs.

	Web 3.0 is having a high impact on learning	Web 3.0 as real after 2015	Web 3.0-barriers: adoption of learning and workspace technologies	Web 3.0-barriers: security concerns	Web 3.0 - use of a virtual assistant
Students' claim	25%	90%	64%	36%	38%

Table 5 : Students' Survey of Web 3.0 technologies

A lot of students commented that Wiki was a useful tool and a good way to put a summary of the lecture content together in a way that all students could benefit. Others mentioned that it allowed them to carry on dialogue with varying view-points that offered a more holistic learning experience. There was dissatisfaction about the fact that it is hard to grade participation because often people post the same things. Pointing out the pedagogical benefits from the project we have to stress on the assessment. As seen in the survey results above, this is one area in which students were the least satisfied. Students were assessed on their participation in the Wiki. Any user can see who has made a contribution, the date and time of each contribution.

Another difficulty in integrating Wikis successfully comes from the switch to a student-centered approach. Using student-created Wikis as a major content source shifts the creation and ownership of knowledge base from the teacher to the student. The role of student in this Wiki project is that of primary content producer. The teacher's role changes to one of facilitating and correcting errors. As mentioned above, Wikis are quite straightforward, and Moodle has Wiki interface that resembles common word processing programs, so students may find it easy to use.

Other useful tools for publishing information such as research publications are semantic blogs where there is need of some structure and semantic blogging provides this. Items may be classified using ontologies. Semantic links may exist between items (Cayzer, 2004b). Semantic blogging uses desirable features of both blogging and the semantic web to deal with the challenges of traditional blogging. The semantic web is well suited for incrementally publishing structured and semantically rich information. On the other hand, the easy publishing nature of blogging can boost the semantic web by publishing enough data and resources (Cayzer 2004a; Cayzer, 2004b).

Semantic blogging can help users discover items of interest in blogs. Navigation through the blogosphere can be more flexible and meaningful due to interconnections among various items and topics. Aggregation of useful materials across multiple blogs and the semantic web is possible. Semantic blogging can extend blogging from simple diary browsing to informal knowledge management (Cayzer, 2004b). Publication is easy in semantic blogs too because only some additional metadata data have to be added compared to traditional blogs. The users do not need to put any effort to enjoy the additional features provided. Hence, there is not much effort added in using a semantic blog instead of a conventional one. The rich metadata and semantic structure work behind to give the user the added value experience of semantic blogging. However, the semantic capabilities currently implemented for semantic blogging are still limited. It is difficult to obtain blog entries relevant to a topic in an aggregated and organized form.

Attempts for implementation of a framework for semantic blogging capable of organizing results relevant to user requirements are made at Varna Free University (VFU) to provide more effective search by exploring semantic relations in blogs.

The system is built upon a blogging infrastructure backed up by an RDF metadata store. The metadata schema enriches the blog entries input. The metadata schema also helps the query processor to search by metadata. Users input queries to the system according to their information requirement. The query processor searches for matching blog entries and instances in the ontology of the domain of application. Integrated with the ontology is the inference engine, which can deduce implicit relations from the ontology. All the blog entries related to the relevant ontology instances are obtained from the blogontology mapping. The total relevant blog entries obtained are finally organized into an aggregated and navigable collection by the organizer. The system also produces output in RSS format which computers can understand and aggregate.

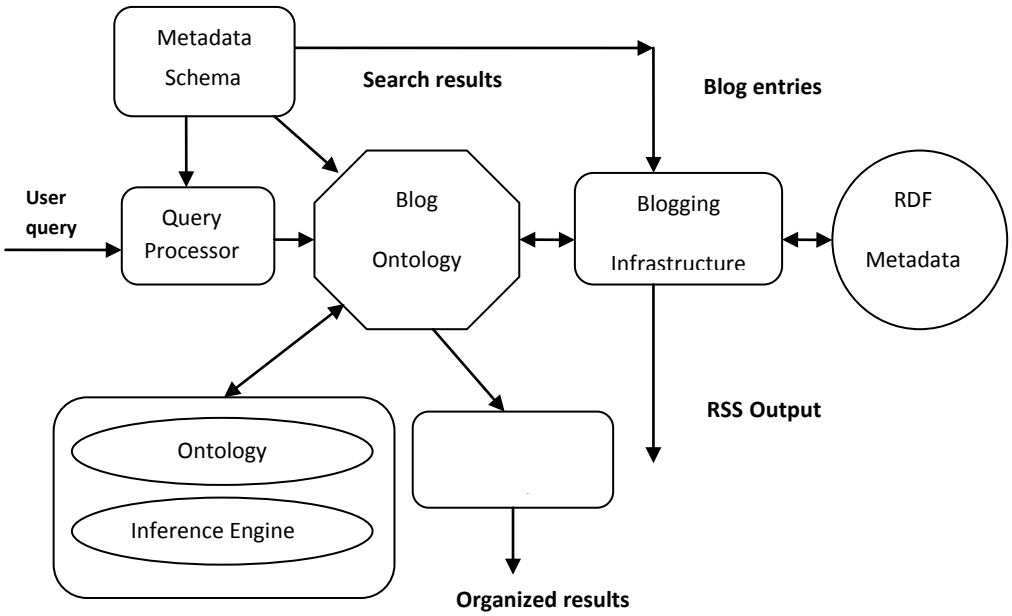

Figure 6 : System architecture of the semantic blogging framework

IV. Conclusions

Newly developed framework for semantic blogging capable of organizing results relevant to user requirements is implemented at Varna Free University (VFU) to provide more effective navigation and search by exploring semantic relations in blogs.

Ontology has been introduced to utilize semantic relations, enhanced by inference. Blog entries are mapped to the ontology using language processing. Search results are organized by introducing semantic aggregation. Blog entries are enriched by metadata and an annotation mechanism has also been developed. The framework has been tested and evaluated by implementing a system for the Institute of Technology domain ontology at VFU. Experiments have shown quite good results. Single sample ontology is created for demonstration.

The social software driven approach reflects the nature of learning and knowledge as being social, personal, distributed, flexible and dynamic. It represents a shift towards a more personalized, open and knowledge-pull model for learning. The platform, developed and prototypical in use at Varna Free University, is based on concepts like social tagging and networking and therefore offers its users a new perspective of Web 2.0 driven learning.

This paper suggests that social media tools provide an opportunity for new developments of the e-learning concept and discusses these new approaches developed with the objective of operationalising this social perspective in the context of managing personal knowledge. Web 2.0 enables a new model of e-learning that contributes to collective intelligence through formal and informal communication, collaboration and social media tools. This new model facilitates virtual interaction, social processes, collaboration and knowledge exchanges on the web. A characteristic of such systems is the fact that they are open and designed to invite collaboration and to facilitate social interaction.

In blogs and wikis externalisation of personal knowledge is self-initiated. Furthermore, despite using social networking tools it is still difficult to find the right piece of information. Better search functionalities and sorted entries are an issue that needs to be addressed in further development. Semantic Web 3.0 technologies enhance Web 2.0 tools and their associated data with semantic annotations and semantic-enhanced knowledge representations, thus enabling a better automatic processing of data which in turn will lead to enhanced search mechanisms.

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Performance Analysis of CDMA System using Direct Sequence Spread Spectrum and Frequency Hopping Spread Spectrum Techniques

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Abstract - In digital communication system, selection of the most appropriate access method is a challenging task. To meet this challenge we have to be familiar with the technologies and system architectures on the CDMA digital cellular system. The demand for high speed mobile wireless communications is rapidly growing. DS-CDMA plays the best competitive role for achieving the high data capacity and spectral efficiency requirements for communication systems. This paper represents the performance analysis of CDMA using direct sequence and frequency hopping technique in a Fading & AWGN Channel. It also concerned with how well DS-CDMA performs when transmitted over an Additive White Gaussian Noise (AWGN) channel and/or both AWGN and the fading channels. In order to investigate this, a simulation model created and implemented using MATLAB. The Modulated signal transmitted over the fading, AWGN, and/or both channels for various signal-to-noise ratio (SNR) values. To evaluate the performance, for each SNR level, the received signal demodulated and the received data compared to the original information. The result of the simulation is shown in a plot of the bit error rate (BER)/error probability versus SNR, which provides the information about the systems performance.

Keywords : *AWGN, CDMA, DS-CDMA, BER, ISI, FFT, OFDM, SNR.*

GJCST-E Classification : *C.2.3*

Strictly as per the compliance and regulations of:

Performance Analysis of CDMA System using Direct Sequence Spread Spectrum and Frequency Hopping Spread Spectrum Techniques

Md. Imran Hossain [α], Md. Kislu Noman [σ], Md. Mojahidul Islam [ρ] & Md. Rashedul Islam [ω]

Abstract - In digital communication system, selection of the most appropriate access method is a challenging task. To meet this challenge we have to be familiar with the technologies and system architectures on the CDMA digital cellular system. The demand for high speed mobile wireless communications is rapidly growing. DS-CDMA plays the best competitive role for achieving the high data capacity and spectral efficiency requirements for communication systems. This paper represents the performance analysis of CDMA using direct sequence and frequency hopping technique in a Fading & AWGN Channel. It also concerned with how well DS-CDMA performs when transmitted over an Additive White Gaussian Noise (AWGN) channel and/or both AWGN and the fading channels. In order to investigate this, a simulation model created and implemented using MATLAB. The Modulated signal transmitted over the fading, AWGN, and/or both channels for various signal-to-noise ratio (SNR) values. To evaluate the performance, for each SNR level, the received signal demodulated and the received data compared to the original information. The result of the simulation is shown in a plot of the bit error rate (BER)/error probability versus SNR, which provides the information about the systems performance.

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I. Introduction

CODE-DIVISION multiple-access communication (CDMA) is an important emerging technology for underwater acoustic networks for both civilian and military purposes. CDMA permits random, overlapping access to a shared communication channel as required in an autonomous ocean-sampling network (AOSN) scenario. In combination with code-division multiple-access (CDMA) techniques, multicarrier modulation has attracted a lot of attention in the past decade for the future-generation wireless communications on account of countering channel frequency selectivity and removing inter-symbol interference (ISI) while supporting high-rate applications, providing frequency diversity, collecting the entire energy spread in the frequency domain, and simple implementation through Fast-Fourier-Transformation (FFT) techniques [1].

On the one hand, different configurations of multicarrier CDMA (MC-CDMA) schemes as combinations of direct-sequence CDMA (DS-CDMA) and orthogonal frequency-division multiplexing (OFDM) were developed after 1993 [1][2]. The performance and design of such systems have been investigated extensively in different non-fading and fading channels since then [2-8].

On the other hand, frequency-hopping spread-spectrum (FH-SS) techniques in combination with OFDM or MC-CDMA received considerable attention recently, and as a result, various multicarrier frequency-hopping (MC-FH) systems were proposed [9-11][13]. MC-FH schemes, on account of fewer subcarriers transmitted in each symbol interval, have smaller peak-to-average-power ratio (PAPR) than MC-CDMA systems, making the implementation of MC-FH systems less complex than MC-CDMA schemes especially in the uplink, where linear amplification with a large dynamic range at the transmitter side is not viable. The MC-FH system studied in this paper is the one described in [13][14], wherein the frequency spacing between diversity hopping sub-carriers in distinct frequency sub-bands is implemented in a way to diminish the correlation of fading gains on different sub-carriers, while keeping the region of hopping for a single sub-carrier so small that phase-shift keying (PSK) modulation and coherent detection are practically feasible [13]. This scheme was developed from a frequency-diversity spread-spectrum system, called FD-SS [12], for countering band-limited jamming interference [13]. It has been examined in a single-user fading channel [14], as well as in multi-user non-fading and fading channels with and without coding [15].

The purpose of this paper is to simulate and analysis the performance of CDMA system for that we will present: Signal to noise ratio on the BER performance using QPSK modulation techniques, Effect of number of multi-user on the BER performance and bit error performance(BER) for various estimation rates with a maximum Spread Spectrum.

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a) Introduction Code Division Multiple Access (CDMA)

The third multiple access technology which was designed to increase both the system capacity and the service quality is called CDMA. CDMA is a form of spread spectrum technology a family of digital communication techniques that have been used in military applications for many tears. It spreads the information contained in a particular signal of interest over a much greater bandwidth than the original signal at the same data rate, the capabilities of the spread spectrum technique for both anti-jam and low probability of undesired interception; make this technology suitable for multi-user applications. Fig.1 shows a general scheme of a CDMA system.

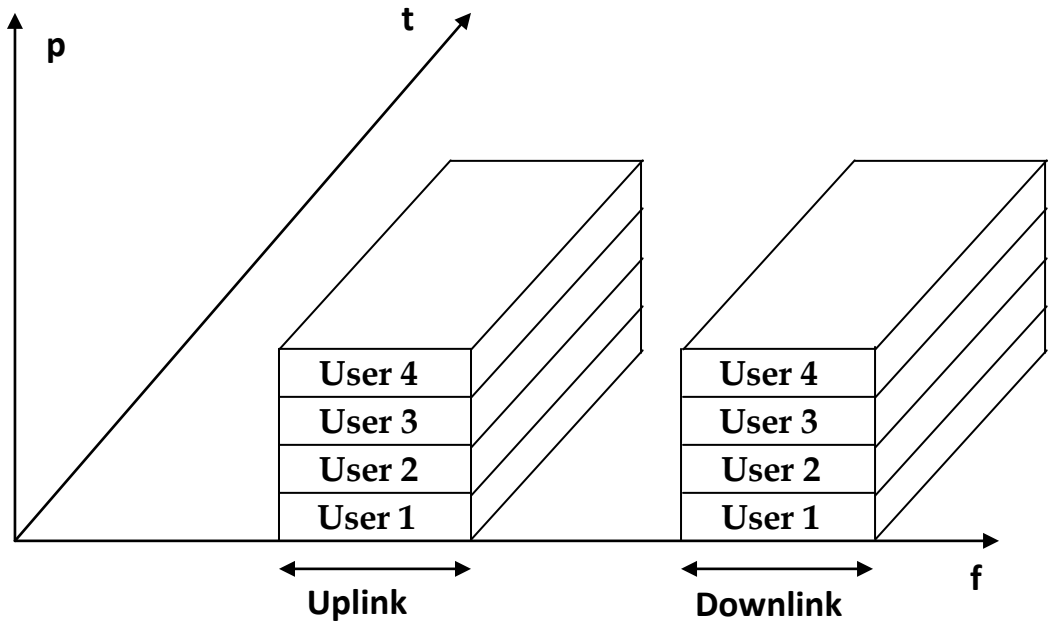

Figure 1 : General Scheme of a CDMA system

When CDMA is implemented in cellular systems, all users share a common channel in time and frequency. The separation is done using a code. Each user transmits with unique code, the spreading sequence, and since the receiver knows the user's code it can demodulate and extract the information. Usually, within a network there are two channels, one for the uplink (mobile to base station) and one for the downlink (base station to mobile). All users share both channels at the same time. The number of users which can communicate simultaneously is dependent, among other factors, such as, the length of the spreading sequence (code, a series of binary data), channel quality, receiver type, etc.

b) Spread Spectrum Concept

DS-CDMA systems are based on spread spectrum communications principles that provide a flexible and efficient framework for coverage and capacity sharing. The spread spectrum schemes are increase the radio links robustness against fading and interference.

1. Direct Sequence Spread Spectrum (DSSS) and
2. Frequency Hopping Spread Spectrum.

c) Direct Sequence Spread Spectrum (DSSS)

A pseudo-noise sequence pnt generated at the modulator, is used in conjunction with an M-ary PSK modulation to shift the phase of the PSK signal pseudo randomly, at the chipping rate Rc (=1/Tc) a rate that is an integer multiple of the symbol rate Rs (=1/Ts).The transmitted bandwidth is determined by the chip rate and by the base band filtering. The implementation limits the maximum chip rate Rc (clock rate) and thus the maximum spreading. The PSK modulation scheme requires a coherent demodulation.

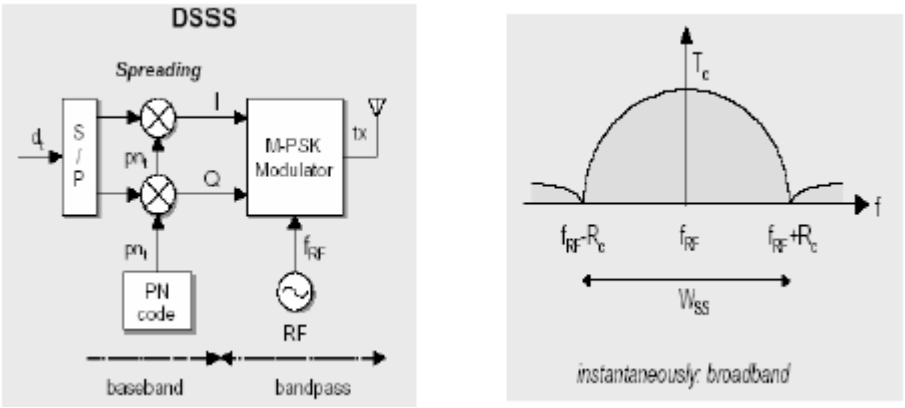

Figure 2 : Direct Sequence Spread Spectrum

A short-code system uses a PN code length equal a data symbol. A long-code system uses a PN code length that is much longer than a data symbol, so that a different chip pattern is associated with each symbol.

d) Frequency Hopping Spread Spectrum

A pseudo-noise sequence pni generated at the modulator is used in conjunction with all M-ary FSK modulation to shift the carrier frequency of the FSK signal pseudo randomly, at the hopping rate Rh .The transmitted signal occupies a number of frequencies in time, each for a period of time Th (=1/Rh), referred to as dwell time . FHSS divides the available bandwidth into N channels and hops between these channels according to the PN sequence. The PN generator feeds the frequency synthesizer a frequency word FW (a sequence of n chips) which dictates one of 2n frequency positions fhi transmitter and receiver follow the same frequency hop pattern.

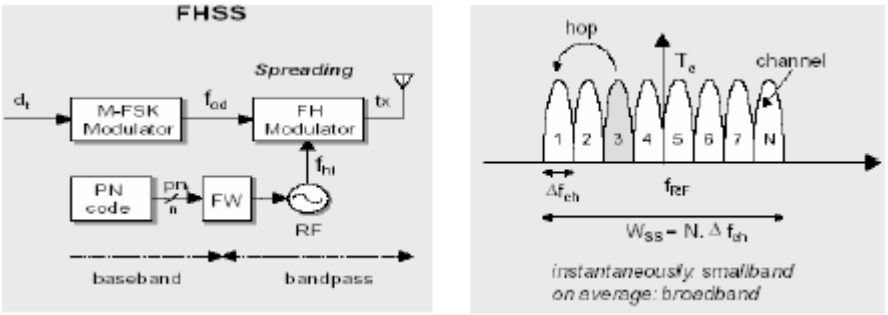

Figure 3 : Frequency Hopping Spread Spectrum

The transmitted bandwidth is determined by the lowest and highest hop positions and by the bandwidth per hop position (fch). For a given hop, the instantaneous occupied bandwidth is identical to bandwidth of the conventional M-FSK, which is typically much smaller than Wss. So the FSSS signal is a narrowband signal, all transmission power is concentrated on one channel. In the transmitter, the binary data dt is 'directly' multiplied with the PN sequence.

e) Pseudo Random (PN)

The pseudo random (PN) sequence is a bit stream of '1's and '0's occurring randomly, or almost randomly, with some unique properties. The pseudo random (PN) is widely used in direct sequence spread spectrum wireless communication systems, for example, synchronous CDMA or asynchronous CDMA. Due to the periodic nature of the PN sequence the frequency spectrum has spectral lines which become closer to each other with increasing sequence length Nc. Each line is further smeared by data scrambling, which spreads each spectral line and further fills in between the lines to make the spectrum more nearly continuous. The DC component is determined by the zero-one balance of the PN sequence.3.5 Spreading and Scrambling in the Uplink of DS-CDMA.

The most common PN code families are Walsh-Hadamard codes, m-sequences, Gold codes and Kasami codes. Walsh-Hadamard codes are orthogonal on zero code delay whereas the m-sequence, Gold codes and Kasami codes are nonorthogonal with varying cross-correlation properties. Walsh-Hadamard codes and Gold codes are used in uplink communication of WCDMA. In this section, we will emphasize Walsh-Hadamard codes and Gold-codes.

f) Hadamard Hadamard-Walsh Codes

The Hadamard-Walsh codes are generated in a set of N=2n. The generating algorithm is simple:

$$H_N=\begin{bmatrix} H_{N/2} & H_{N/2} \\ H_{N/2} & -H_{N/2} \end{bmatrix} \quad \text{with } H_0=[1]$$

The rows (or columns) of the matrix HN are the Hadamard-Walsh codes. In each case the first row (row 0) of the matrix consists entirely of 1s and each of the other rows contains N/2 0s and N/2 1s. Row N/2 starts with N/2 1s and ends with N/2 0s.

$$H_2=\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} \quad H_4=\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \quad H_8=\begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 & 1 & -1 & -1 & 1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 \end{bmatrix}$$

The distance (number of different elements) between any pairs of rows is exactly N/2

Figure 4 : PN Sequence generator

g) DS-CDMA Simulation Model

There are many features of an DS-CDMA system that are more easily manipulated in a software situation. A very powerful and useful engineering software package is Matlab by MathWorks. It has many useful digital signal processing functions and features, which will prove to be useful in DS-CDMA simulation. A DS-CDMA system was modeled using Matlab to allow various parameters of the system to be varied and tested. The model is shown in Figure 5.6.

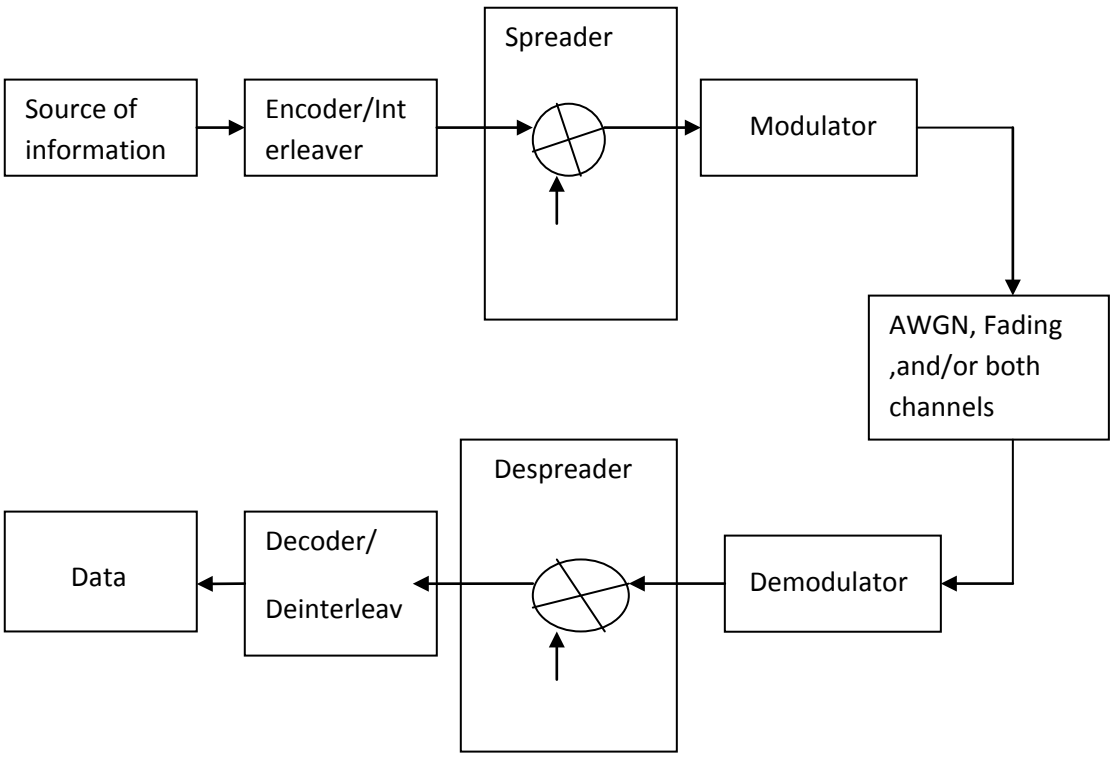

Figure 5 : Block diagram of the baseband model of DS-CDMA

The aim of doing these simulations was to measure the performance of DS-CDMA under different channel conditions, and to allow for different DS-CDMA configurations to be tested. Using Matlab7 the DS-CDMA Transmitter and Receiver was modeled and simulated. The Simulation includes all the stages for Transmitter and Receiver, according to the figure. A brief description of the model is presented below.

h) Simulation of BER Performance vs. SNR using AWGN channel

The signal is modulated using QPSK modulation technique. The signal is passed away through AWGN channel. Here, the number of user=12, the desired user=12, the chips length=7, using coding technique with and without Hamming code.

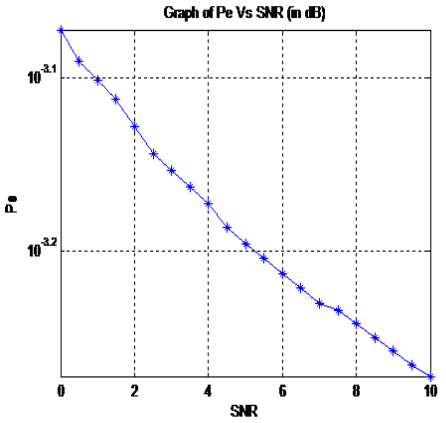

Figure 6(a) : Hadamard – Walsh

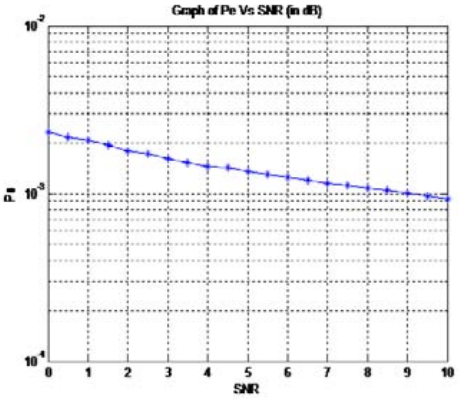

Figure 6(b) : PN Sequence

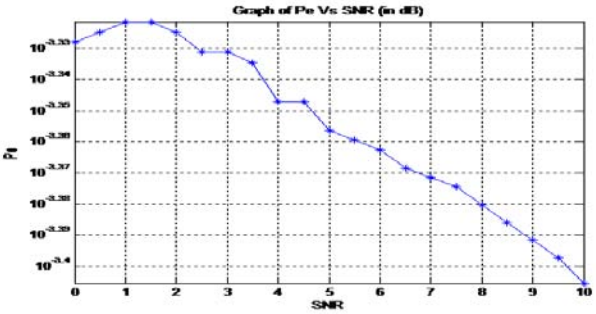

Figure 6(c) : Gold Code

Figure 6 : The signal passed away through the AWGN channel without coding

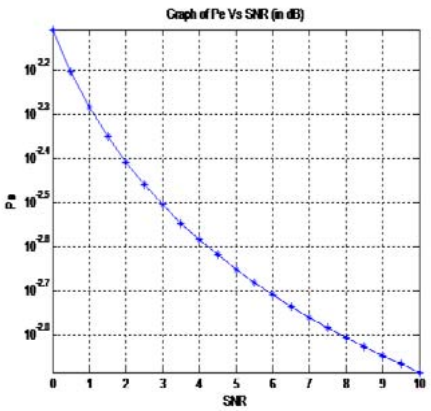

Figure 7(a) : Hadamard – Walsh

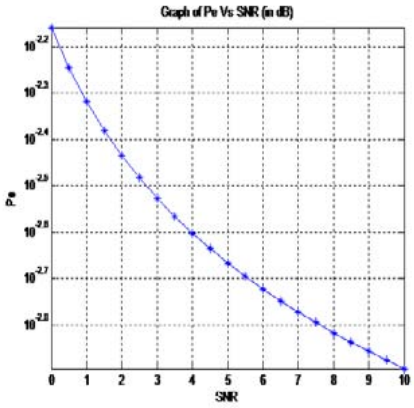

Figure 7(b) : PN Sequence

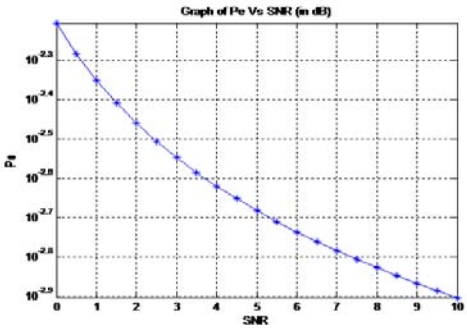

Figure 7(c) : Gold Code

Figure 7 : The signal passed away through the AWGN channel with Hamming coding

II. Conclusion

CDMA, which has been very attractive for future high rate wireless communication is providing high transmission data rate with high spectral efficiency. One drawback of WCDMA is its multipath fading and AWGN noise. This noise destroys the original signal, leading to the significant performance degradation. The transmitted signal is corrupted by multipath and multiple access interference. The signal is further corrupted by AWGN at the front end of the receiver. Several simulations were carried out for estimation of the performance of CDMA with spreading and scrambling, error correct and detection coding technique. The error detects and correct coding technique leads to significant increase performance of CDMA. In this paper, the Additive White Gaussian Noise (AWGN) corrupted the transmitted signal and this resulted in a different received constellation than the original constellation. For small SNR values the calculated error rate was quite large and Multipath fading was produce due the relative high power of noise. As SNR was increased the error rate was decreasing, as expected. In fact, for SNR value greater than 10 dB for QPSK, the error was zero. From Fig-6 show that the signal-noise ratio (SNR) increase then BER non-linearly decrease. From fig-7 show that the signal-noise ratio (SNR) increase then BER linearly decrease. AWGN channel with Hamming coding is better than AWGN channel without Hamming coding

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Are Network Management Systems, Which are Becoming More and More Critical to the Reliability, Availability and Recoverability of Today's Data and Voice Networks Cost Effective?

By Steven Thomason
East Carolina University

Abstract - Network management systems are a necessary part of every production network. Nowadays management is always scrutinizes every dollar spent on hardware and software. The costs of these systems need be justified in the same manner that infrastructure and data center upgrades need to be justified. Network management systems not only are cost affective but also benefits the network management team in giving them the ability to look into their network to see what is going on. Without NMS you cannot answer questions such as why did the network go down or why is the network slow?

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I. Introduction

One of the most important requirements of an IT organization is to maximize the uptime and availability of the network and its resources. Without having constant monitoring, the ability to look at historical data, proactive monitoring, and change management this becomes almost impossible to accomplish. Many times without a management solution you first find out about a problem when users start calling the helpdesk with complaints. This wastes time and extends the length of the outage costing companies anywhere from hundreds to hundreds of thousands of dollars an hour. In this paper we will use current monitoring system response data to demonstrate how efficient a managed WAN can be and compare that to possible scenarios that show what could happen using a manual process. The data has been derived from the WAN ticketing system provided by an outside vendor and compared to a separate internal help desk system.

The midsize company network I will be using as an example has 300 switches, 100 access points, 20 routers, 3 wireless LAN controllers and 16 WAN accelerators. There are also multiple firewalls and IPS' that are not part of this paper but are logged and monitored. 90% of the devices are Cisco hardware or software running on IBM or Cisco UCS systems. From this point forward they will be referred to ABC Company.

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Why have managed networks? First of all to define what is a network management tool we have rfc1470[i], which states that a network management tool is a tool that is used for monitoring and debugging TCP/IP Internets and interconnected devices. With an unmanaged network the only method you have of knowing when there is a problem is by word of mouth; a user calls the helpdesk after they lose connectivity to their application or someone shows up at your door asking if there is an issue with the network. The helpdesk personnel then do some basic trouble shooting which takes time. After determining that there is an actual problem and having determined whose area of responsibility it probably is then passes the ticket to the networking group. The ticketing system then generates an email to the person in the group designated to assign the tickets. At this point the networking group finally knows that there exists a problem with the communications network. The average time from initial call to making the appropriate people aware of the problem is between 30 minutes to 4 hours and this is only during normal 8 to 5 work hours. If an entire segment is down the time is closer to 30 minute. The more people affected the faster the problem is passed on. After the networking group has ownership of the issue they then begin their trouble shooting procedures. This again takes additional time, which translates to lost productivity, which translates to money.

Nowadays networks carry more than just data and are much more critical to the wellbeing of the business [ii] . There are data, voice, and video requirements placed on the network infrastructure at an ever-increasing rate. If the network goes down and carries the companies voice traffic problems are compounded since no one may be able to report any problems. So what is needed to help make the networking group more efficient and the network more reliable? At a minimum, networking groups need the ability to monitor and react to any issue that can affect

performance and reliability of the communications infrastructure.

The International Organization for Standardization Network Forum has divided network management into five functional areas[iii]:

1. Fault Management
2. Configuration Management
3. Performance Management
4. Accounting Management
5. Security Management

The primary purpose of having a network management system is to alert on network issues and aid in the quick recovery of the network and its services. Alerts can instantly notify personnel of a problem quickly and at times with the actual issue identified so that resolution can take place quickly. Fault management increases the ability to help identify faults and problems before they lead to actual downtime.

Configuration management is necessary to be able to keep track of the configurations on the devices running the network. By tracking changes and keeping historical copies of device configurations the system helps to restore devices that have had issues or need replacing. It also helps in the trouble shooting process in that you can determine when the last change was made, who made the change, and what that change was.

Performance management gives the networking team the ability to track device and component utilization, network throughputs, error rates, and other statics that help track usage and identify possible problems and bottlenecks. You can use this to answer questions such as why is the network slow? Is it due to a hardware issue or is an unauthorized process over utilizing it?

Two functional areas not addressed by this paper are accounting management, which involves tracking user utilization of network services and security management, which involves the protection of information through the network. While they are part of the ISO definition of network management they are not always part of most network management systems software. Individual logons for the management system addresses some of the concerns.

Below are two real life examples for ABC Company where monitoring would have aided in the ability to keep the network running as efficiently as possible.

In the first example demonstrating the need for network monitoring, there was an access point in a manufacturing area that saw very little usage. That access point stopped working. Users in that area saw slower performance but did not report the problem because they were still connected to a distant access point in another isle. Without proactive monitoring the performance would remain slow and if the next closest AP had an issue users would not be able to connect at all. A proactive system would have shown that the AP was down and made it possible to address the issue before it affected production. The down access point was found out about when the switch it was attached to had an issue.

Another issue that network management would help with is looking at what is using a network segment and how it is affecting the network. One instance occurred when the connection between a distribution center and the main server room experienced very poor performance. By connecting to the switches and routers at that site using SSH you could see that the interfaces were being highly utilized and there were no errors being generated. The line was up and VoIP phone calls were not affected. Knowing this information you could deduce that QoS was working correctly as calls were not affected but you did not have any idea what type of traffic was on the circuit and what it was doing. Was it a denial of service attack or someone copying a very large file or virus updates being pushed to all of the computers at an inappropriate time of day?

Management systems measure and keep track of metrics such as availability, uptime, latency, error rates, and other network characteristics. They give you the ability to manage very large networks from a central location[iv]. Networks that carry voice traffic also need to have the ability to look at voice statics such as jitter and echo. A good management system also has the ability to create a graphical map. A big advantage of this is the ability to see where the break in the network is located. Without this you would need to go device to device until you found the end of the working segment. Trace route is an example of command that can help determine where there is a break in communication but that only works for layer 3 devices.

ABC Company has several critical applications that cannot tolerate even brief drops lasting less than a few seconds. Handheld scan guns being used for warehouse management do not tolerate any downtime. The main ERP program will not handle any drop that lasts for more than a few milliseconds. Uptime is critical. A single blip in connectivity can cause the need to reprocess orders and shipments and manufacturing processes to be reentered or restarted.

A third party[v] that works with the MPLS provider monitors wide area network and WAN accelerators for ABC Company. They are responsible for monitoring the connections and performance of the WAN and its components. The third party has a system within the ABC Company network that gathers and monitors network statics. If an alert is received they review that alert with a combination of filters and human interaction. All interactions are logged in their management system. ABC Company looked at having them monitor the entire infrastructure but that cost was prohibitive and harder to justify. The performance of the monitoring company's system is compared to the internal systems within ABC

Company. This consists of a manual entry help desk system dependent on user interaction and an older network management system with limited abilities that monitors the LAN. It has the ability to determine if a device is completely down but not what types of issues may be occurring.

Reporting data for this paper was taken from an existing WAN monitoring system that is monitored 24x7x365 by a third party system. The data points used included the following: ticket creation time, 1st human response time, the number of human interactions per ticket, whether the local site contact or Telco was contacted, the time the site was fully functional and the total number of minutes before the ticket was closed. The network has a monitoring station that receives snmp and icmp packets to track uptime and interface errors. If there is an error then the system sends out an alert to the monitoring company where the alert is evaluated and the appropriate predefine action takes place. An example of a predefined action might be to ignore the error until 8:00 am due to the fact that the site is remote and no one is available until that time, call a local site contact, or wake someone up. An alert can signify anything that can lead to degradation in performance or availability. The management company first tries to resolve the issue if possible. If it looks like as if the problem is with a circuit the local Telco is notified and a technician is dispatched per predefined scripts.

In 2012 there were 75 interactions that generated alerts that required examination. The average response time it took for an actual person to review the alert was 13.3 minutes. The average time it took to resolve the issue was 481.9 minutes. An alert did not necessarily mean that a circuit or connection was down but it did mean that performance was degraded. The percentage of interactions that required local site personal to be contacted was 21 and 35% of the alerts required a technician from the local circuit provider.

Data from the first 10 tickets. Sample ticket at the end of the document.

Ticket Creation	1st Incident Response	Live Response Time	Number of Ticket Interactions	Contact local Site	Contact Telco	Circuit Fully Functional	Ticket Closure	Length of Downtime – minutes	Man-Minutes Spent on Issue
2/27/12 8:356	2/27/12 8:36	0.5	5	No	Yes	2/27/12 8:44	2/27/12 13:00	8.3	263.6*
2/28/12 20:41	2/28/12 20:49	8.1	5	No	No	2/28/12 20:51	2/29/12 1:55	1.9	306.1
3/13/12 22:56	3/13/12 23:01	5.7	3	No	No	3/13/12 23:01	3/14/12 3:07	0	245.8**
3/14/12 7:46	3/14/12 7:51	5.9	3	No	No	3/14/12 7:53	3/14/12 7:57	1.1	5.8
4/10/12 16:46	4/10/12 17:02	16.4	11	No	No	4/10/12 17:13	4/10/12 20:37	10.6	214.6
4/14/12 10:46	4/14/12 117:02	42.5	8	No	Yes	4/14/12 10:51	4/14/12 16:40	0.1	673.4*
4/19/12 21:26	4/19/12 21:28	2.3	39	No	Yes	4/23/12 11:31	4/23/12 18:00	5162.7	5551.8#
…	…	…	…	…	…	…	…	…	…
12/4/12 14:01	12/4/12 14:51	.5	1	No	No	12/4/12 14:56	12/4/12 14:56	5.1	5.1
12/17/12 20:21	12/17/12 20:28	7.6	4	No	No	12/17/12 20:46	12/18/12 0:16	17.8	227.9
12/31/12 21:06	12/31/12 21:12	6.8	4	No	Yes	12/31/12 21;21	1/1/13 5:19	8.8	13.34

Notes:

*Extended times were due to slow response times from the MPLS provider in determining what caused the actual drop with BGP routing.

** Riverbed outage – failed open so no downtime – however performance degraded for until restart.

Intermittent issues tracked down to bad card in Telco switch.

II. Out Sourced Management System

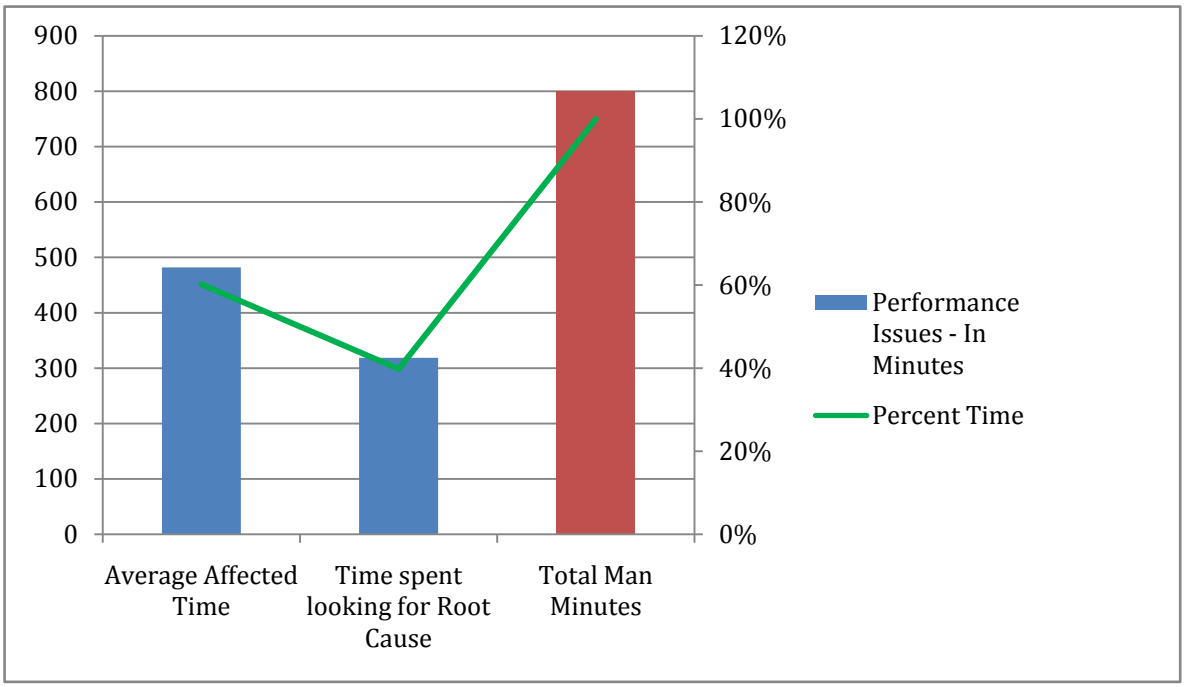
- Average time before an actual human looks at the event – 13.3 minutes.
- Average number of human interactions before the ticket is closed – 8.4.
- Average length of downtime or network impairment – 481.9 minutes or 8.3 hours.
- Average man-hours spent before closing the ticket – 13.34 or 800.6 minutes.

- Percentage of time spent to determine root cause after performance had been restored to previous state – 40% or 318.8 minutes.
- Percent of human involvement taking less than 15 minutes – 76%.
- Percent of human involvement taking less than 30 minutes – 95%.
- Keeps historical data for 1 year showing amount of traffic based upon IP ports.

III. Manual Help Desk System

- Due to the way the help desk system functions internal tickets can take well over 30 minutes before the 1st person in the networking groups is even aware of the issue.
- Percent of human involvement taking greater than 30 minutes – 95%.
- Help desk system creates tickets that are hard to research for past issues due to a lack of historical indexing.
- Keeps track of tickets but because it is not a dedicated network system it is hard to research past issues.

Finding out what the root cause of an alert is required and having the issue resolved was is the first step in the process. The average man-minutes spent until the ticket was closed was 800.6 meaning that 40% of the time on ticket was spent after resolution determining what the cause was.



By having the monitoring system in place for the WAN it meant that 76% of all tickets were initially addressed in less than 15 minutes. 91% were addressedin less than 30 minutes. Comparing this to an existing system within the company for the local area network shows a major difference in time to reaction.

The average time before being notified using the internal helpdesk system ranged from 30 minutes to over 6 hours especially if the issue occurred after hours and the after hour answering service was not able to notify the appropriate personnel. This system depended upon user input for notifications. A completely down system was easy to detect but in instances where performance was degraded it was not as easy to determine since often the end user did not report it until it became severe. A management notification system could have seen the performance issue and notified someone so that the issue could have been addressed before any downtime had taken place.

Management systems can vary quite a bit depending on the vendor and features. Retail cost for the Cisco Prime infrastructure and Collaboration software is approximately 85 thousand dollars for an average SMB. Using the data taken from the WAN monitoring service we found that out of 75 incidents there were 16 that took over 4 hours to address. ABC Company has determined that after 4 hours of downtime to manufacturing processes can cost over $100,000 per hour. If you take the best effort of the manual helpdesk system and add 30 minutes to each of those tickets you would have increased the loss by an additional $200,000. This would more than cover the cost of installing a management system for the network and the example does not even address the internal LANs in each location.

Cisco Prime Infrastructurevi, being reviewed by ABC Company, is only one of many management systems available. One of the main reasons for looking

at Prime is the current investment in Cisco equipment, training, and services. Some of the other more common management systems are Solarwinds[vii], SpiceWorks[viii], Paessler[ix], Tivoli Framework[x], and WhatsUp Gold[xi]. This is not an exhaustive list as there are many different vendors each with its own set of features. Prime manages wired and wireless access over local and wide area networks. It gives the user a combination of inventory, configuration management, visibility, and wireless management features. The system allows for the use of Netflow, NBAR, and Medianet agents for reporting. Prime also keeps historical data and gives the user a drill down functionality to help with trouble shooting issues. When combined with Cisco ISE – Integrated Service Engine it also give the user security and accounting functionality meeting all of the ISOs five functional areas.

A good management system allows for a smart notification system that analyses alerts and prevents alert overload. Is the alert identifying a critical issue or a temporary over utilization of a port?This way only the critical alerts get through so any notifications that are sent to a technician are the ones that are really important. The system needs to be able to differentiate between an end user reboot their PC and a connection to a MPLS network. The alerts not defined as critical are logged so that they can be review from the management console.

With budgets tight and executives wanting a positive ROI network monitoring needs to show it savings potential. According to white paper by Intermapper[xii]. There are several areas of potential savings that are generated by a network monitoring system.

a) Savings

- Staff/salary time savings
  - Automating processes and monitoring frees staff for other tasks and projects.
  - May not need to increase the number of staff personnel as the network grows.
- Minimizing or avoiding outages
  - Proactive actions when issues appear allow for action to take place before downtime occurs.
- Reducing support calls
  - If the network is up and functioning correctly there will be fewer trouble tickets created.
- Reducing time to fix
  - The sooner IT is alerted to a problem, the sooner the issue can be resolved.
- Guaranteeing and managing SLAs
  - Using the historical data retained by the management system it can be determined whether or not SLAs are being met.
- Reducing downtime
  - Configuration and change management allows for quicker restore of down devices and services.

Network management systems are not in expensive. They range from just sending alerts when a ping to a device fails to be able to meet all of the requirements for the 5 functional areas listed by the ISO.

b) Costs to Take into Account

- Initial purchase of solution
  - Unless you create the solution in house you will need to purchase the solution and in house solutions still require a developer's time.
- Product upgrades and support
  - All commercial products require maintenance contracts for support and upgrades.
- Required hardware and OS software
  - The purchased solution has to be installed on something. Even virtual solutions require disk space and licensing.
- Installation/implementation consulting
  - It takes time to learn a new solution even when installed by an outside consultant. Knowledge transfer is required.
- Training
  - Some of the larger products may require staff to attend training classes in person or over the web.
- Solution administration/management
  - While the solution can save many hours doing tedious tasks such as device management, configuration, and changes, it still requires human interaction.

To be successful a management system needs to have several metrics that can be used to justify its purchase and operation. According to a study by Solarwindsxiii one client determined the metrics to the number of man-hours/time spend each day trouble shooting issues, revenue generated, and costs saved. Each issue or ticket then was tagged to any SLA agreements. Having a network performance monitor allowed them to save over 20% in equipment replacement costs and gave them the ability to keep historical data so it became much easier to determine root cause of each issue. Another side benefit of using a management system is the reduction in human caused errors. Over 80% of critical network outages are caused by human error[xiv].

As companies grow and expand manufacturing can expand to become a 24-hour endeavor. As production schedules expand it becomes more critical to either have staff working all 3 shifts or a system that monitors all of the networking components and can alert staff of any issues at any time of the day.

Other functionality that can greatly reduce staff time is the ability to manage multiple devices from one central system. Using ABC Company as an example, they have 300 switches that at some point will need to be upgraded due to an increase requirement of security for functionality. Based on the average time of 30 minutes spent by a network administrator to manually upgrade each switch, it would take 15 hours to complete these tasks. This does not include the time it takes to research what the latest approved version is, can the switch handle the upgrade, downloading the software, or setting up the tftp server for distribution. Another part of the process would be to backup each configuration and save the current running configuration before even starting. Using a management system such as Prime Infrastructure [xv], the network administrator would only need to run a report to see if everything could be upgraded, plan on when the upgrades could take place, and create a job that would handle all of the upgrades automatically.

In another example the company managing the WAN devices that consisted of Cisco routers and Riverbed accelerators were able to automate the upgrade of all 13 WAN accelerators form version 6.x to version 7.0.x. This was done in order to keep the devices up to date for support requirements. Using an automated management console every Riverbed was upgraded to the latest code using a simple script reducing downtime and labor costs. Setting up the script took approximately 1 hour, running the upgrade on 15 devices took 30 minutes for a total of 2 man-hours. Manually upgrading 15 devices would take approximately 45 minutes per device resulting in a requirement of 11.25 man-hours. The ability to have process take place in a batch mode further demonstrates the usefulness and cost savings ability of management software.

Using the data derived from the third party monitoring service and comparing that to the information derived from the internal help desk system, can be shown that an automated system is obviously faster than a manual system. Adding on average over 30 minutes to every ticket costs time and as stated before when an incident is affecting down time that runs over 4 hours the costs to the company is well over the cost of using a network management system. As with the example above assuming that you have to upgrade the companies 300 switches once a year, which at 30 minutes per switch takes 150 man hours automating that saves you over 100 hours of a person's time based on a 75% savings in time. At $25 per hour that is a savings of over $2,800 and that is being conservative. So anyway you look at the benefits of using a network management system, you will save time and money, whether in reducing downtime, meeting SLAs, or reducing maintenance downtime.

To review, network management systems have the ability to save companies money and increase profitability and productivity. This gives existing employees more time to be proactive or keeps management from having to hire more highly trained and expensive engineers. Uptime of the network is increased and downtimes are shortened.

Using historical data, it also becomes much easier to justify increasing bandwidth when there is data demonstrating the overutilization of existing circuits. You also have the ability to remove any underutilized circuits to save money. Monitoring can also help to point out potential problems by measuring network metrics such as packet loss and error rates. Without monitoring you do not have the ability to know if the number of errors on an interface is from a temporary problem or a potential issue. Network Management software is not only cost affective but critical to the well being of a company's communication infrastructure.

End Notes:

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```
--------------------------------
This is a summary of your case and its current status

Customer Name :
=============
STM Industries (AT&T NI)

Site Name :
=========
Catawba, NC (Oxford DC)

Status :
=======
Closed

Priority :
=======
Informational

Opening Summary :
=======
Network alarm occured.

Opening Description :
===========
Ticket generation based on a network alarm. NOC investigating.

Equipment :
=========
STM_RTR_Catawba - Router - Cisco - 2811

Event Logs for this case :
========================

04/25/2012 11:31:01 -- close -- Smith, Amber
Ticket Closure: ATT ticket had no further updates (closed ticket)

BGP uptime 06:55:28

no errors

Serial0/0/0 is up, line protocol is up
  Hardware is GT96K with integrated T1 CSU/DSU
  Description: AT&T Circuit ID DHEC.918563.ATI
  Internet address is 192.168.199.37/30
  MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 12/255, rxload 72/255
  Encapsulation PPP, LCP Open
  Listen: CDPCP
  Open: IPCP, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters 06:48:04
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: Class-based queueing
  Output queue: 0/1000/0 (size/max total/drops)
  30 second input rate 442000 bits/sec, 76 packets/sec
  30 second output rate 76000 bits/sec, 78 packets/sec
     980698 packets input, 487014126 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     1086429 packets output, 112190832 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 unknown protocol drops
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up

04/25/2012 04:50:28 -- priority change -- Smith, Jeromie
Priority change, from New Investigation to Informational.

04/25/2012 04:50:17 -- log -- Smith, Jeromie
continue to monitor and check carrier ticket at scheduled time
```

04/25/2012 04:50:17 -- log -- Smith, Jeromie
Priority Status change, from NOC Working Ticket to Awaiting Carrier Update. Priority status schedule is set to 04/25/2012 09:00.

04/25/2012 04:49:35 -- log -- Smith, Jeromie
Adding carrier ticket ID: 000000153625574

04/25/2012 04:47:29 -- log -- Smith, Jeromie
Opening ticket with the carrier:

ticket was already open

Checking carrier ticket:

04/25/2012,01:42:12:[AT&T] Activity Type Code Desc: PROGRESS COMMENTS
Activity Type Code: PROG
CGW ... hello csr, we have set this up for extensive testing, we will advise of test results accordingly, thanks, AT&T ...

04/25/2012,01:41:55:[AT&T] Activity Type Code Desc: TEST COMMENTS
Activity Type Code: TEST
User cc7965 has scheduled Complete Auto Test (force intrusive) to run at 04/25/2012 01:41:00 for 15 minutes with an estimated run time of 185
minutes.

04/25/2012,01:41:37:[AT&T] Activity Type Code Desc: TEST COMMENTS
Activity Type Code: TEST
unable to read the csr's CSU registers ...

04/25/2012 04:47:29 -- log -- Smith, Jeromie
Priority Status change, from NOC Working Ticket to NOC Working Ticket. Priority status schedule is set to 04/25/2012 05:00.

04/25/2012 04:42:58 -- log -- Smith, Jeromie
Logging into device to gather status:

STM_Catawba_RTR uptime is 45 weeks, 1 day, 18 hours, 49 minutes
System returned to ROM by power-on

bgp= 00:06:25

Serial0/0/0 is up, line protocol is up
Hardware is GT96K with integrated T1 CSU/DSU
Description: AT&T Circuit ID DHEC.918563.ATI
Internet address is 192.168.199.37/30
MTU 1500 bytes, BW 1544 Kbit/sec, DLY 20000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, LCP Open
Listen: CDPCP
Open: IPCP, loopback not set
Keepalive set (10 sec)
Last input 00:00:00, output 00:00:00, output hang never
Last clearing of "show interface" counters 32w6d
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 29508
Queueing strategy: Class-based queueing
Output queue: 0/1000/0 (size/max total/drops)
30 second input rate 7000 bits/sec, 8 packets/sec
30 second output rate 10000 bits/sec, 10 packets/sec
442685557 packets input, 3444254842 bytes, 0 no buffer
Received 0 broadcasts, 1 runts, 8 giants, 0 throttles
29581 input errors, 29581 CRC, 12182 frame, 5090 overrun, 0 ignored, 18545 abort
529237866 packets output, 968859321 bytes, 0 underruns
0 output errors, 0 collisions, 4 interface resets
0 unknown protocol drops
0 output buffer failures, 0 output buffers swapped out
16 carrier transitions
DCD=up DSR=up DTR=up RTS=up CTS=up

04/25/2012 04:42:58 -- log -- Smith, Jeromie
Priority Status change, from NOC Working Ticket to NOC Working Ticket. Priority status schedule is set to 04/25/2012 05:00.

04/25/2012 04:36:04 -- log -- Manager, Event
STM_RTR_Catawba - PING - OK - 192.168.199.37: rta 14.875ms, lost 0%

04/25/2012 04:36:03 -- log -- Manager, Event
STM_RSH_Catawba - Riverbed Status - Steelhead 250 (250M): Healthy, optimisation service: running

04/25/2012 04:36:03 -- log -- Manager, Event
STM_RSH_Catawba - PING - OK - 172.25.1.4: rta 15.498ms, lost 0%

04/25/2012 04:36:03 -- log -- Manager, Event
STM_RTR_Catawba - HOST - OK - 192.168.199.37: rta 14.840ms, lost 0%

04/25/2012 04:36:03 -- log -- Manager, Event
STM_RSH_Catawba - HOST - OK - 172.25.1.4: rta 20.992ms, lost 0%

04/25/2012 04:28:12 -- log -- Smith, Jeromie
Reviewing ticket and ticket procedures

04/25/2012 04:28:12 -- log -- Smith, Jeromie
Priority Status change, from System Generated to NOC Working Ticket. Priority status schedule is set to 04/25/2012 04:30.

04/25/2012 03:56:04 -- log -- Manager, Event
STM_RTR_Catawba - PING - CRITICAL - 192.168.199.37: rta nan, lost 100%

04/25/2012 03:56:03 -- log -- Manager, Event
STM_RSH_Catawba - Riverbed Status - (Service Check Timed Out)

04/25/2012 03:56:03 -- log -- Manager, Event
STM_RSH_Catawba - PING - CRITICAL - 172.25.1.4: rta nan, lost 100%

04/25/2012 03:56:03 -- log -- Manager, Event
STM_RSH_Catawba - HOST - CRITICAL - 172.25.1.4: rta nan, lost 100%

04/25/2012 03:56:03 -- log -- Admin, System

STM_RSH_Catawba - Added equipment to the ticket.

04/25/2012 03:51:03 -- log -- Manager, Event
STM_RTR_Catawba - HOST - CRITICAL - 192.168.199.37: rta nan, lost 100%

04/25/2012 03:51:03 -- open -- Admin, System
Initial Ticket Creation.

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Review on Enhanced Interior Gateway Routing Protocol

By Aditi Chadha & Anuj K. Gupta
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Abstract - Routing means to select path in a network and forward a packet through the network to another device on different network. Routing protocols play a vital role in computer network infrastructures. In this research comparison of various routing protocols is made. It been seen that OSPF and EIGRP are the protocols mostly used nowadays. On comparison, EIGRP is considered as the best routing protocol because it maintains the backup routes and also due to its simple configuration and also it supports the unequal cost load balancing which is not supported by other routing protocols.

Keywords : *EIGRP, DUAL, OSPF, RIP, hybrid.*

GJCST-E Classification : *C.2.2*

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Review on Enhanced Interior Gateway Routing Protocol

Aditi Chadha [α] & Anuj K. Gupta [σ]

Abstract - Routing means to select path in a network and forward a packet through the network to another device on different network. Routing protocols play a vital role in computer network infrastructures. In this research comparison of various routing protocols is made. It been seen that OSPF and EIGRP are the protocols mostly used nowadays. On comparison, EIGRP is considered as the best routing protocol because it maintains the backup routes and also due to its simple configuration and also it supports the unequal cost load balancing which is not supported by other routing protocols.

Keywords : EIGRP, DUAL, OSPF, RIP, hybrid.

I. Introduction

Routing means to select path in a network and forward a packet through the network to a device on a different network. Routing protocols play a vital role in computer network infrastructures. Routers know that how to find the remote network if a network is directly connected to the router but if network is not directly connected to the router then there are two ways to get to the remote network: Dynamic routing and Static routing. Static routing means to manually type all network locations into the routing table whereas dynamic routing protocols automatically inform all the routers about the event. Thus in large networks the combination of both static as well as the dynamic routing protocol are used. IP routing is to move the packets from one network to another network by using routers. There is a difference between routed protocol and routing protocol. Routers use routing protocol to dynamically find all the networks in the internetworks and ensure that all routers have the same routing table. Routing protocol also determines the path of a packet through an internetwork. Some of the examples of routing protocol are RIP, EIGRP, OSPF. Whereas, routed protocol is used to send packets through the established enterprise. Examples of routed protocol are IP and IPv6. To route a packet the router must know the following:

- Destination address.
- Neighbor routers which tells about remote networks.
- Routes possible to all remote networks.
- Determines the best route to each remote network.
- How to verify and maintain routing information.

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II. Classification of Routing Protocols

a) Distance Vector Routing Protocol

This protocol finds the best path to a remote network by determining the distance. In this every time packet travels through a router which is named as a 'hop'. The route that has the least number of hops is considered as the best route. The direction of the network is indicated by using the vector. RIP and IGRP is the distance vector routing protocols which sends the entire routing table to directly connected neighbors.

- RIP (Routing Information Protocol): In this the best path to a network is determined by using only hop counts. But if more than one link with same hop count to the network is obtained then RIP automatically perform a round-robin load balancing. RIP can consider up to six equal-cost links. The disadvantage of this protocol is that the problem arises when the two links to a remote network have the different bandwidth but same hop counts.
- IGRP (Interior Gateway Routing Protocol): It is the protocol which is used in large networks. It uses an autonomous system number for activation and gives a full route table update after every 90 seconds. It uses use the bandwidth and delay as a metric to determine the best route to an internetwork. IGRP has the maximum hop count of 255(default as 100). IGRP is no longer supported by the Cisco.

b) Link-State Routing Protocol

In this the routers maintain the three separate tables. One table keeps the record of directly connected neighbors, one determines the topology of the entire internetwork and one is considered as the routing table. Link state protocol sends the updates which contains the state of their own links of the other routers on the network. One of the examples of link state protocol is OSPF which is completely Link state.

- *OSPF (Open Shortest Path First):* It is an open standard routing protocol which can be implemented by number of vendors, including Cisco. OSPF use the Dijkstra algorithm which firstly constructs the shortest path tree then populates the routing table with the resulting best paths. OSPF converges quickly and also supports multiple, equal –cost routes to the same destination. Various features of OSPF are:

- Area and autonomous system
- Minimizes routing update traffic
- Scalability
- Supports VLSM/CIDR
- Unlimited hop counts

c) Hybrid Routing Protocol

Hybrid routing protocol use the characteristics of both distance vector and link state routing protocol. One of the examples of hybrid routing protocol is EIGRP.

- *(EIGRP)Enhanced Interior Gateway Routing Protocol:* It is a proprietary Cisco protocol that runs on Cisco routers. It is the most popular routing protocol which is used these days. EIGRP is a classless, enhanced distance- vector protocol as compare to the other Cisco proprietary protocol like IGRP. It is an independent system which describes the set of contiguous routers that run the same routing protocol and share routing information. In EIGRP while designing a network the subnet mask in its routes updates is included and thus advertisement of subnet information allows us to use variable length subnet masks (VLSMs) and summarization which is impossible in IGRP. EIGRP is also considered as Hybrid Routing Protocol as it has the characteristics of both distance-vector as well as the link-state routing protocol. It sends traditional distance-vector updates containing information about the network and the cost of reaching them from the aspect of advertising router unlike OSPF. It act as link-state also as it synchronizes routing tables between neighbors at startup and then sends specific updates only when topology changes occur. Thus EIGRP is suitable for very large networks. EIGRP can load-balance up to four equal-cost links. But while configuring it is determined that EIGRP can load-balance across up to six equal-/unequal cost links to a remote network. Various terms used in EIGRP are:

- Neighbor Discovery: EIGRP routers must become neighbors to exchange the routes with each other. To establish the neighbor ship three conditions that are considered are Hello or ACK received, AS numbers match and Identical metrics (K values).
- Feasible distance: It is considered as the best metric among all paths to a remote network, also includes the metric to the neighbor which advertises the remote network. This route is considered as the best path and is available in the routing table. The metric of a feasible distance is the metric reported by the neighbor and the metric to the neighbor reporting the route.
- *Reported/advertised distance:* The neighbor that reports the metric of a remote network is known as the advertised distance. It is also defined as the routing table metric of the neighbor.
- *Feasible successor:* The path whose reported distance is less than the feasible distance is the feasible successor. It also considers the backup routes. It maintains six feasible successors in the topology table and only one best metric (the successor) is copied and placed in the routing table.
- *Successor:* A successor route is the best route to a remote network which is used by EIGRP to forward traffic to a destination and is then stored in the routing table. Feasible successor routes are backed up in the routing table only if one is available. The feasible distance and the feasible successors in the topology table as backup links are used to converge network instantly, and updates to any neighbor are the only traffic sent from EIGRP.

Characteristics of EIGRP are classified as

- Backup Routes: EIGRP is the only routing protocol that supports backup routes. As in other routing protocols like OSPF, loose its best route in a network due to some failure then it has to broadcast for a help whereas EIGRP simply look at its backup routes which are maintained in the topology table.
- Simple Configuration: EIGRP considers the best of both distance-vector and link-state routing protocol. Thus from the distance vector routing protocols it attains the ease of configuration.
- Flexibility of Summarization: This means to summarize anywhere in the network rather than having the specific routers that do summarization. It is wide open to summarize while designing.
- Unequal Cost Load Balancing: No other routing protocol does it. EIGRP can take unequally load distribution by considering the metric calculations.
- Supports Multiple Networks Protocol: EIGRP can replace Novell RIP and Apple Talk Routing Table Maintenance Protocol (RTMP), serving both IPX and Apple Talk networks with powerful efficiency.

Three Tables of EIGRP

- Neighbor table: Each router maintains the state information of the adjacent neighbors. When a newly discovered neighbor is discovered, the address and interface of the neighbor is recorded, and this information is available in the neighbor table, which is stored in RAM. Each protocol-dependent module has one neighbor table. Update packets are matched to the acknowledgements by using the sequence numbers. The last sequence number received from the neighbor is recorded so that out-of-order packets can be detected.
- Topology table: The topology table is occupied by the protocol-dependent modules and acted upon by the Diffusing Update Algorithm (DUAL). All

destinations are maintained in the routing table that are advertised by neighboring routers and also holds the each destination address and a list of neighbors that are advertised to the destination. The advertised metric value of each neighbor is recorded. When neighbor advertises the destination, then it must use the route to forward packet.

- Routing table: EIGRP selects the best routes to a destination from the topology table and place these routes in the routing table.

III. Methodology

- Diffusing Update Algorithm (DUAL): EIGRP uses Diffusing Update Algorithm (DUAL) which selects and maintains the best path to each remote network. DUAL provides the fastest route convergence time to EIGRP as compare to other protocols. The two factors of EIGRP which provide speedy convergence are: Firstly, In EIGRP routers a copy of all of their neighbors' routes are maintained, which is used to calculate their own cost to each remote network. If the best path fails or goes down, it simply as examine the contents of the topology table for selecting the best replacement route. Secondly, if better alternative is not available in the local topology table, then EIGRP routers very quickly ask their neighbors for help to find the one. DUAL is meant to select and maintain information about the best paths.
- Summarization: EIGRP summarizes the network automatically at their classful boundaries. EIGRP also creates the manual summaries at any and all EIGRP routers which significantly reduces the size of the route table. Figure1. shows that how EIGRP routers see that network and the boundaries are auto summarized.

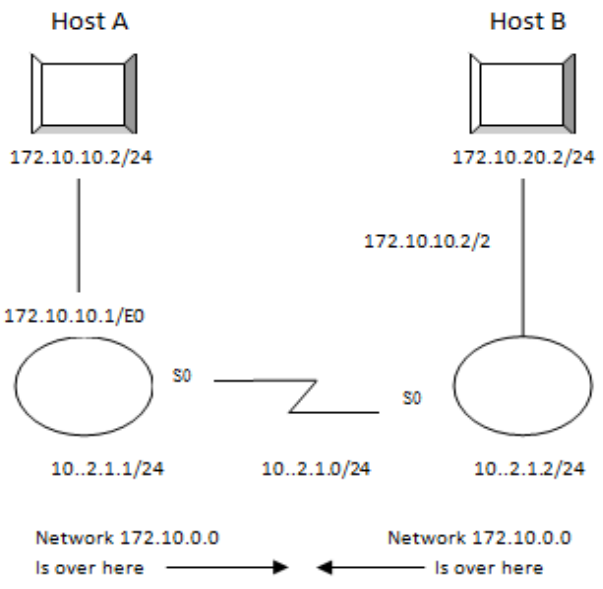

Figure 1 : Auto Summarization

- *EIGRP Metrics:* Unlike other protocols that use a single factor to compare routes and select the best possible path, EIGRP can use a combination of Bandwidth, Delay, Load, Reliability, MTU. Formula Used for default Metric Calculation: **Metric= 256*(BW + Delay)**
- *Stubbing:* Stubbing is used to improve the network stability, reduces resource utilization, and also to simplify the stub router configuration.

Table 1 : Comparison between RIP, OSPF and EIGP as in [10]

Protocol	RIP	OSPF	EIGRP
Type of protocol	Distance vector	Link –State	Hybrid
Knowledge of network topology	None	Maintain stable with complete knowledge of each area	Maintains limited topology table
Routing updates	Complete routing table sent to all neighbors every 30 seconds	Incremental updates sent to all routers in an area when necessary	Incremental updates sent to affected routers when necessary
Sends acknowledgements after receiving routing updates	No	Yes (LSAck packet)	Yes (ACK packet)
Convergence	Slow	Fast	Fast
Prone to routing loops	Yes	No	No
Supports VLSMs	No	Yes	Yes
Supports route summarization on arbitrary boundaries	No	Yes	Yes
Supports hierarchical routing	No	Yes	Yes
Proprietary to Cisco	No	No	Yes
Supports multiple protocols	No	No	Yes

IV. Conclusion

In this paper, the taxonomy of routing protocol is discussed and also classifies the different routing protocols. From the whole it is concluded that Distance vector routing protocol finds which sends the entire routing table to directly connected neighbors whereas link state routing protocols maintain the three tables.

Hybrid protocol considers the best of both above mentioned routing protocols. Thus hybrid routing protocol that is EIGRP is the best of other routing protocols like OSPF and RIP. But sometimes it is seen that while configuring EIGRP is not able to achieve maximum efficiency due its some in-built features.

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Improving the Performance of Mobile Ad Hoc Network using a Combined Credit Risk and Collaborative Watchdog Method

By S. J. K. Jagadeesh Kumar, R. Saraswathi & R. Raja
Sri Krishna College of Technology, Combat Tamil Nadu, India

Abstract - In mobile ad hoc networks, nodes can move freely and link/node failures occur frequently. This leads to frequent network partitions, which may significantly degrade the performance of data access in ad hoc networks. When the network partition occurs, mobile nodes in one network are not able to access data hosted by nodes in other networks. In mobile ad hoc network, some nodes may selfishly decide only to cooperate partially, or not at all, with other nodes. These selfish nodes could then reduce the overall data accessibility in the network. In this work, the impact of selfish nodes in a mobile ad hoc network from the perspective of replica allocation is examined. We term this selfish replica allocation. A combined credit risk method & collaborative watchdog is proposed to detect the selfish node and also apply the SCF tree based replica allocation method to handle the selfish replica allocation appropriately. The proposed method improves the data accessibility, reduces communication cost and average query delay and also to reduce the detection time and to improve the accuracy of watchdogs in the collaborative method.

Keywords : *mobile ad hoc network, collaborative watchdog, selfish replica allocation, SCF tree, AAS, DCG.*

GJCST-E Classification : *C.2.5*

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Improving the Performance of Mobile Ad Hoc Network using a Combined Credit Risk and Collaborative Watchdog Method

S. J. K. Jagadeesh Kumar [α], R. Saraswathi [σ] & R. Raja [ρ]

Abstract - In mobile ad hoc networks, nodes can move freely and link/node failures occur frequently. This leads to frequent network partitions, which may significantly degrade the performance of data access in ad hoc networks. When the network partition occurs, mobile nodes in one network are not able to access data hosted by nodes in other networks. In mobile ad hoc network, some nodes may selfishly decide only to cooperate partially, or not at all, with other nodes. These selfish nodes could then reduce the overall data accessibility in the network. In this work, the impact of selfish nodes in a mobile ad hoc network from the perspective of replica allocation is examined. We term this selfish replica allocation. A combined credit risk method & collaborative watchdog is proposed to detect the selfish node and also apply the SCF tree based replica allocation method to handle the selfish replica allocation appropriately. The proposed method improves the data accessibility, reduces communication cost and average query delay and also to reduce the detection time and to improve the accuracy of watchdogs in the collaborative method.

Indexterms : mobile ad hoc network, collaborative watchdog, selfish replica allocation, SCF tree, AAS, DCG.

I. Introduction

a) Mobile Ad Hoc Network

Mobile ad hoc networks (MANETs) have attracted a lot of attention due to the popularity of mobile devices and the advances in wireless communication technologies [4][6].A "mobile ad hoc network" (MANET) is an autonomous system of mobile routers (and associated hosts) connected by wireless links - the union of which forms an arbitrary graph. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. The strength of the connection can change rapidly in time or even disappear completely. Nodes can appear, disappear and re-appear as the time goes on and all the time the network connections should work between the node that are part of it. As one can easily imagine, the situation in ad hoc networks with respect to ensuring connectivity and robustness is much more demanding than in the wired case.

Mobile Ad hoc Network (MANET) is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. These networks are fully distributed, and can work at any place without the help of any infrastructure. A MANET can be used in many areas such as Military applications, Disaster relief operations, and Robot data acquisition system. A mobile P2P file sharing system is another interesting applications [6][27].The characteristics of these networks are summarized as follows:

1. Communication via wireless means.
2. Nodes can perform the roles of both hosts and routers.
3. No centralized controller and infrastructure.
4. Dynamic network topology. Frequent routing updates
5. Autonomous, no infrastructure needed
6. Can be set up anywhere.
7. Energy constraints and Limited security

b) Selfish Node in Data Replication

In Mobile Ad Hoc Network, the mobile nodes can move freely, so that the network partitions can occur frequently. Hence the data accessibility is very lower in the network and the query delay was increased. By reducing the query delay in the network, replicate the data in some other nodes. In the data replication, the data accessibility also increased. So there is a trade off between query delay and the data accessibility in the network [11]. In mobile ad hoc network, some of the nodes can't forward packets to the other nodes. These nodes are called selfish or malicious nodes. These selfish nodes cannot allocate replica to other nodes and it does not share the memory space for the other nodes. These selfish nodes can lead to a wide range of problems in the networks. To solve such problem, in this paper, we propose a selfish node detection algorithm and reduce the detection time of the node using the collaborative watchdog method.

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c) Selfish Node in Replica Allocation

In this fig. 1 illustrates an existing replica allocation scheme called, Dynamic Connectivity based Grouping (DCG) [5] [6]. In this method, the access frequency of each data item and the whole network topology are taken into account. In DCG, the nodes N, N_2, . . ., N_6 maintain their memory space M_1,M_2, . . .,M_6, respectively. In Fig. 1, a straight line denotes a wireless link between the nodes and the first data item in each node is the original data and the remaining data items in each node is the replicated data items. Fig. 1, DCG seeks to minimize the duplication of data items in a group to achieve high data accessibility. In this diagram, the node N_3 behaves "selfishly" by maintaining M_3, instead of M_3'. In the original case, D_3, D_9, and D_2 were allocated to N3. However, due to the selfish behavior, D_3, D_5, and D_2, the top three most locally frequently accessed items, are instead maintained in local storage. Thus, other nodes in the same group, i.e., N_1, N_2, and N_4, are no longer able to access D_9. This showcases degraded data accessibility. The proposed system has some advantages such as -

1. Easily detects the selfish node without collision.
2. SCF-tree based replica allocation is performed in a fully distributed manner.
3. Cooperative replica allocation techniques were performed.

In this paper, the problem of selfish node was addressed in the replica allocation. That is the selfish node may not share the memory space to the other nodes. This problem is called as selfish replica allocation. To propose a self centered friendship tree method to handle the selfish replica allocation problem is very efficient manner. This proposed method improves the communication cost, data accessibility and the query delay. The technical contributions of this paper can be summarized as follows:

1. Recognize the selfish replica allocation problem in the mobile ad hoc network.
2. Detect whether the node is partially selfish node or fully selfish node.
3. Apply the self centered friendship tree algorithm for replica allocation.
4. Verify the proposed strategy.

The Section 2 describes the related work .The overview of system model is described in Section 3. The proposed detection method and the replica allocation techniques are presented in Section 4. The simulation scenario is presented in section 5. The performance evaluation is presented in Section 6 and the conclusion of the paper is presented in Sections 7.

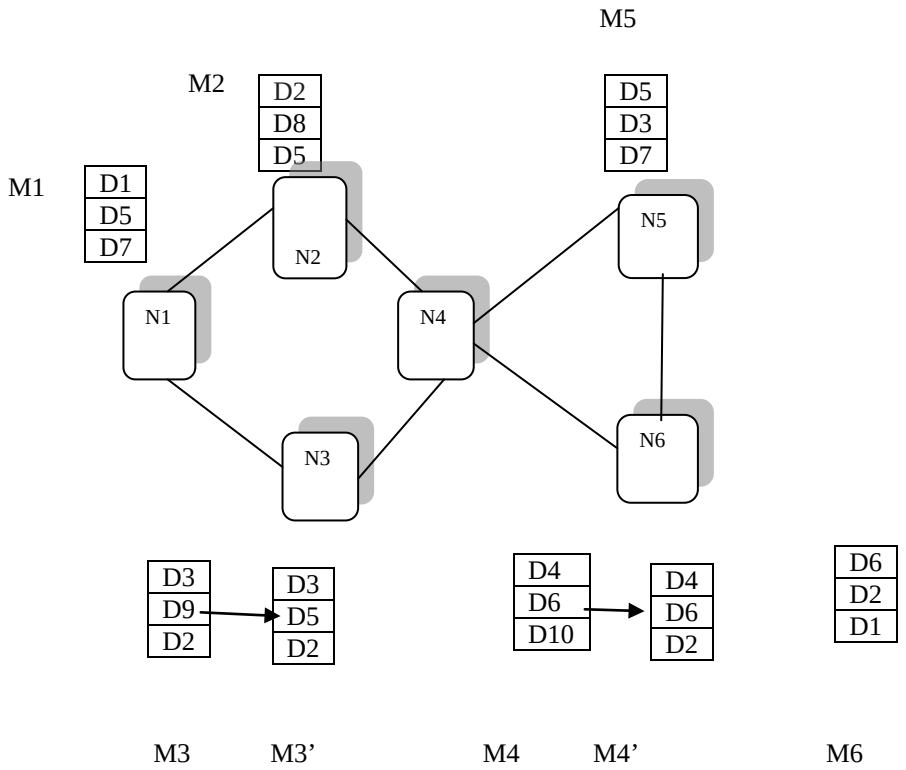

Figure 1 : Selfish Replica Allocation

II. Related Work

a) Selfish Node Detection

Multi-hop communication in mobile ad hoc networks (MANETs) requires collaboration among nodes, which forward packets for one another. In MANET, some of the nodes may refuse to forward packets in order to conserve their limited resources

resulting in traffic disruption. Nodes exhibiting such behaviour are termed selfish. Selfishness is usually passive behaviour. Selfish and malicious behaviours are usually distinguished based on the node's intent.

Various techniques have been proposed to handle the problem of selfish behaviour from the network perspective. As described, the techniques handling selfish nodes can be classified into three categories: reputation-based, credit-payment, and game theory-based techniques [12].

In reputation-based a large number of schemes belong to the first category, with varying implementations [2]. One advantage of such schemes could be their quick convergence in detecting node misbehaviour, especially in a large ad hoc network, due to increased information regarding a particular node's behaviour. However, this approach has two potential drawbacks: they often assume that nodes that send reputation information about their peers are themselves trustworthy; and they are subject to collusion among nodes that misreport reputation information. In credit-payment techniques, each node gives a credit to others, as a reward for data forwarding. The acquired credit is then used to send data to others [1]. The game theory-based techniques assume that all rational nodes can determine their own optimal strategies to maximize their profit. The game theory-based techniques want to find the Nash Equilibrium point to maximize system performance [8]. The AAS scheme is a network-layer technique to detect the selfish nodes and to mitigate their effects [7]. In [14] Sergio Marti et al proposed to mitigate the routing misbehaviour in MANET using watchdog and bathwater method. The watchdog method is used to identifies the misbehaving nodes in the network and the bathwater combines the knowledge of misbehaving nodes with link reliability data to pick the route most likely to be reliable In [15] Miranda et al proposed a novel algorithm that enhances the load balancing while banning the selfish node form the MANET. In [16] Yangchow et al proposed a secure incentive protocol to simulate the cooperation among the possible selfish nodes. It also provides highly secure incentives for the selfish nodes to cooperative in packet forwarding with low overhead. In [17], Hussein et al proposed a BAODV protocol, is an extension of the AODV protocol and this method is used to improve the performance and reliability of the wireless mobile ad hoc network in the presence of malicious or selfish node. It take the behaviour history of member nodes into account, to improve the network reliability. The BAODV model is based on the discovery of communication paths with minimal number of selfish or malicious nodes. In [18] Debut set al proposed a new intrusion detection system based on mobile agents to improve the network bandwidth consumption and reduce the computation overhead in the network.

b) Replica Allocation Methods

Some effective replica allocation techniques are suggested [5], including static access frequency, dynamic access frequency and neighborhoods (DAFN), and dynamic connectivity-based grouping. It has been reported that DCG provides the highest data accessibility, while SAF incurs the lowest traffic, of the three techniques. Although DCG performs best in terms of data accessibility, it causes the worst network traffic. Moreover, DCG does not consider selfish nodes in a MANET. The work [11] proposes data replication techniques that address the tradeoff between both query delay and data accessibility in a MANET. The work [2] introduces three cooperative caching-based data access methods, including Cache Path, Cache Data, and Hybrid. The work [9][11] introduces the non cooperative replica allocation game RAG)which provides the optimal performance of the mobile ad hoc network. The work[4] identifies the issues involved in MANET data replication and attempts to classify existing MANET data replication techniques based on the issues they address the performance of MANET replication techniques.

In [19], Datta, et al propose the Hybrid Replica Control protocol that attempts to maximize the data availability and communication overhead. In [20], Feras et al propose a Constrained Fast Spread (CFS) method to alleviate the main problems encountered in the current replication techniques and mainly concentrating on the feasibility of replicating the requested replica on each node among the network In[21],Chao-Tung et al proposed a One-way Replica Consistency Service (ORCS) for grid environment to resolve the consistency maintenance issues and also balancing the tradeoff between the improving data Access performance and replica consistency. In [22] Jean et al proposed a non cooperative behaviors of the selfish node. In [23] Show yang et al proposed a dynamic replication scheme which employs the user profile for recording user mobility schedules, access behavior and read/write patterns and actively reconfigure the replicas to adapt to changes in user locations, data request and system status. In [24] Padmanabhan et al identifies issues involved in MANET data replication and attempts to classify existing MANET data replication techniques based on the issues they address. In addition, this paper also proposes criteria for selecting appropriate data replication techniques for various application requirements. In [25] Yin et al proposed a various system settings and requirements to balance the tradeoffs between data accessibility and query delay under and also improve the system performance in MANET. Differing from all the above-mentioned replica allocation or caching techniques, we consider selfish nodes in a MANET.

III. System Model

In this paper, we assume that each node has limited memory space. Each node can hold replicas of data items and maintains the replicas in local memory space. There are m nodes, N1,N2, . . .,N_m. Constructing a model for MANET is an undirected graph G= (IN, IL) that consists of a finite set of nodes, IN, and a finite set of communication links, IL, where each element is a topple(N_j,N_k) of nodes in the network. The system environment in MANET is assumed to be the following [5][6]:

1. The mobile hosts access data items held by other mobile hosts (single or multiple hops).
2. Each mobile host creates replicas of the data and maintains the replicas in its memory.
3. Data item available if it is present locally or if it is available at one of the neighbours.
4. Each node has a unique host identifier: Mj (set of all mobile hosts M = {M1, M2,…, Mm}).
5. Each node has a unique data identifier: Dj (set of all data items D = {D1, D2,…, Dm}).
6. Assume all data items are of the same size.
7. Each host has a memory space of C data items for replicas (excluding the space for holding originals).
8. Data remains the same and does not change (simplifying assumption).
9. The access frequencies of the data item for each mobile host are known and it does not change for that node.

In fig 3a shows the communication established between the nodes. When a node N_i request data item means, it will checks its own memory space first. If the memory space is free means, it will allocate the original or replica copy of the data item to that memory. If it does not hold the original or replica of the data item, the request will be forwarded to the other node. If it is present, the node N_i receives reply from that node. Otherwise, the request will fails. In this selfish replica allocation point of view, there are three types of behavioural states for the nodes are available.

1. Type-1 node: These types of node are non selfish nodes. These nodes hold replicas allocated by other node within the limits of their memory space.
2. Type-2 node: These types of node are fully selfish nodes. These nodes do not hold replicas, but it allocates replicas to other nodes for their accessibility.
3. Type-3 node: These types of node are partially selfish nodes. These nodes use their memory space partially. Here the memory space is divided into two parts: i.e. selfish and public area. In this public area, the replica will be allocated.

Figure 3a : Simulation on System Model

IV. Proposed System

In this paper, propose a selfish node detection method and novel replica allocation techniques to handle the selfish replica allocation appropriately. The proposed strategies are inspired by the real-world observations in economics in terms of credit risk and in human friendship management in terms of choosing one's friends completely at one's own discretion. We applied the credit risk method to detect the selfish nodes and also propose the collaborative watchdog method to reduce the detection time of the node. Every node in a MANET calculates credit risk information on other connected nodes individually so that it is used to measure the degree of selfishness. Since the various traditional replica allocation techniques as described in the related work in section 2 was failed to consider the selfish nodes. In this paper, we propose a SCF tree based replica allocation techniques to handle the replica allocation effectively.

First we detect the selfish node by selfish replica allocation. The novel replica allocation techniques are based on the concept of a self-centered friendship tree (SCF-tree) and this method to achieve high data accessibility with low communication cost in the presence of selfish nodes. The SCF-tree is inspired by our human friendship management in the real world [26]. In the real world, a friendship, which is a form of social bond, is made individually. For example, although A and B are friends, the friends of A are not always the same as the friends of B [26]. The main aim of SCF tree is to reduce the communication cost, while achieving good data accessibility. The technical contributions of this paper can be summarized as follows.

1. Recognizing the selfish replica allocation problem.
2. Detecting the fully or the partially selfish nodes effectively.
3. Allocating replica effectively.
4. Verifying the proposed strategy

a) Selfish Node Detection

The network is modeled as a set of N wireless mobile nodes. The credit risk for the each node can be described by the following equation:

Credit Risk = expected risk / expected value (1)

From the equation (1), the credit score (CR) for each node is calculated. Based on the CR score, estimate the "degree of selfishness" for all of its connected nodes. The Selfish node features can be

divided into two categories: node specific and query processing-specific features.

The Node specific features can be used to represent the number of shared items & shared memory space used for that node. It is also used to represent the expected value of a node. If the node N_i requests the data to the node no means, the node no share the memory space and the data items for that node N_i. So the node no is treated as a valuable node.

Then the query processing feature is calculated for the node Ni. It is defined as the ratio of N_i's data request being not served by the expected node no. Because the node no is selfish node and it does not share its own memory space. This feature is used to measure the expected risk of a node.

The probability of the expected risk of the node pick is larger means, the node N_i will be treated as the risky for the node the node neck cannot serve N_i's requests due to selfishness in its memory usage. The value of the crack is the credit risk of node N_i. Each node has its own threshold value §. α is the system parameter, where $0 \leq \alpha \leq 1$.The formula for finding the credit risk is

$$nCR_i = \frac{P_k^i}{\alpha * ss_k^i / s_i + (1-\alpha) * ND_k^i / N_i} \quad (2)$$

In the Eq . (2) where,

1. SS_i^K is the size of N_k's shared memory space.
2. ND^k_i is the number of N_k's shared data items.
3. P_i^k is the ratio of N_i's data request being not served by the expected node N_k.
4. CR_i^k is the credit risk of node N_i.
5. § is the threshold value of node N_i.
6. α is the system parameter ,where $0 \leq \alpha \leq 1$.

In this fig 4.1 shows the simulation on the detection of selfish node using credit risk method.When the construction of the topology of the network, initailize the number of nodes in the network and also specify the location of the nodes in the network. After constructing nodes in the network,initialize the data set and the memory space for the node.In the initialization,first data in the node is original data and the remaing data is called replica copy of the data.

When the node request data in the another node, find what are all the nodes contains the data.If the node contains the relevant data means,specify the possible path for the node to the requested node.In these path, the shortest path of the node is selected. Based on the shared data items and shared memory space used for these selfish nodes, the degree of the selfishness is measured.And then find the credit risk for each node.

Steps for Detecting the Selfish Node

1. Find the credit risk for each node in the network by using the equation No (2).
2. Based on the credit risk of each node, we can set the threshold value for each ode.
3. If the credit risk value is less than the threshold value, set the node is non selfish node. Otherwise it is selfish node.
4. Find the behavior of the node whether it is partial selfish or fully selfish.
5. For each connected node in N_k , we allocate the number of replica and the total size of the allocated replica.
6. Find the query processing time for each requested node in the network.
7. Determine the expected node responds to the requested node or unexpected node responds to the requested node.

Figure 4.1 : Detection of Selfish Node using Credit Risk method

b) Collaborative Watchdog

i. *Identifying Selfish Contact*

In this module, detection time of sells nodes have to be reduced based on contact dissemination. If one node has previously detected as a sells node using its watchdog method, that information can be spread to other nodes when a contact occurs. So that if a node have positive value, if it knows the sells node. To model this fact, introduce a probability of detection (pd).This probability depends on the effectiveness of the watchdog and the type of contact. The network is modeled as a set of N wireless mobile nodes, with C collaborative nodes and S selfish nodes (N = C +S). It is assumed that the occurrence of contacts between two nodes follows a Poisson distribution λ. In this case, a collaborative node has 2 states: NOINFO, when the node has no information about the selfish node, and POSITIVE when the node knows who the selfish node is (it has a positive).

All nodes have an initial state of NOINFO and they can change their initial state when a contact occurs. Using a contact rate λ we can model the network using a Continuous Time Markov Chain (CTMC) with states si =(c), where c represents the number of collaborative nodes in the POSITIVE state. At the beginning, all nodes are in NOINFO state. Then, when a contact occurs, c can increase by one.

ii. *Collaborative Contact*

Assume both nodes are collaborative. Then, if one of them has one or more positives, it can transmit this information to the other node; so, from that moment,

both nodes have these positives. We can model this with the probability of collaboration (pc). The degree of collaboration is a global parameter of the network to be evaluated. This value is used to reject that either a message with the information about the sells nodes is lost or that a node temporally does not collaborate. In fig 4.2 shows the detection time of the selfish node by using combined credit risk & collaborative watchdog method.

Algorithm 1: Finding the detection time of the selfish node

1. The probability value p_{ij} is denoting the transition rate from transient state s_i to absorbing state s_j.
2. Given a state s_i =(c) the following transitions can occur:
   a. The state changes form (c) to (c+1). ie., the collaborative node may changes from NOINFO state to POSITIVE state.
   b. Calculate the transition probability

$$t_c = (\lambda p_d + \lambda p_c c)(C - c). \quad (3)$$

   c. In the equation (3), λp_d represents the probability of detection of a selfish node and $\lambda p_c c$ *is* the probability of transmission for the information of the selfish node.
   d. Finally, factor (C – c) represents the number of pending nodes.
3. Otherwise the state does not change to other state. This is the probability of no changes, and its detection time is calculated by the formula is $t_0 = 1 - t_c$..

Figure 4.2 : Simulation of the Collaborative Watchdog Method

c) Self Centered Friendship Tree

The Self Centered Friendship tree based replica allocation techniques are inspired by human friendship management in the real world, where each person makes his/her own friends forming a web and manages friendship by himself/herself. He/she does not have to discuss these with others to maintain the friendship. The main objective of the novel replica allocation techniques is to reduce traffic overhead, while achieving high data accessibility.

Before constructing the SCF-tree, each node makes its own partial topology graph G_i = in, IL_i), which is a component of the graph G. Gi consists of a finite set of the nodes connected to Ni and a finite set of the links, where N_i € IN_i, IN_i C IN, and IL_i C IL. Since SCF tree consists of only non selfish nodes, then we need to measure the degree of selfishness by using the credit risk (nCR_i) value of each node in the network. Before constructing the SCF tree, node Ni eliminates the selfish node from in. Since Ni removes every link containing the selfish nodes and the replace with the new edge that should not contain the selfishness in data forwarding.

Based on G N_i builds its own SCF-tree, denoted as T_i^{SCF}. Each node has a parameter d, the depth of SCF-tree. When Ni builds its own SCF-tree, Ni first appends the nodes that are connected to Ni by one hop to Ni's child nodes. Then, Ni checks recursively the child nodes of the appended nodes, until the depth of the SCF-tree is equal to d. 4.3a shows the simulation of the SCF tree.

Steps for Building the SCF-tree

1. Consider the network topology.
2. In this network, each node has a parameter depth of the SCF tree.
3. When a particular node builds its own SCF tree, it first appends the nodes that are connected to the appropriate node by one hop to its child nodes.
4. Then the appropriate node checks recursively the child nodes of the appended nodes, until the depth of the tree is equal to the parameter.

Figure 4.3a : Simulation of SCF Tree

d) SCF Tree Based Replica Allocation

After constructing the SCF-tree, each node allocates replica at its own discretion. At every relocation period, each node determines replica allocation individually without any communication with other nodes. The memory space of each node may be divided into two parts: s area M_s and public area M_p.

Each node may use its own memory space Mi freely as Ms and/or Mp. In each node, Ms will be used for data of local interest (i.e., to reduce query delay), while Mp for public data is asked to hold data by other node(s) (i.e., to improve data accessibility). A type-2 node uses Mi for only Ms, whereas a type-3 node uses Mi for Ms and Mp. Consequently, each node allocates replicas in descending order of its own access frequency. This is quite different from existing group-based replica allocation techniques (e.g., DCG in [5]) where replicas are allocated based on the access frequency of group members. Each node Ni executes this algorithm at every relocation period after building its own SCF-tree. At first, a node determines the priority for allocating replicas. The priority is based on Breadth First Search (BFS) order of the SCF-tree. After allocating a replica to the last target node, the next node will be the next target in a round-robin manner.

The target node will be the expected node in our strategy. Since a node allocates a replica to the target node in its SCF-tree once during a single relocation phase, a node has at most one expected node for each replica. When its own Ms is not full, Ni allocates replica to its Ms first. When its own Ms becomes full, the node requests replica allocation to nodes in its SCF-tree in the order of priority. In our allocation technique, if Ms is full and Mp is not full, a node may use Mp for data items of local interest temporarily. However, public data cannot be held in Ms.

Steps for forming the SCF tree Based Replica Allocation

1. Consider the SCF tree for each node in the network.
2. The SCF tree is based on only partial selfishness node.
3. Make the priority of the node to allocate the replica using Breadth First Search function.
4. If the selfish area of the node M_s is not full then, allocate replica of the data to the selfish area M_s. Otherwise, allocate replica of the data to the target node.
5. If the public area of the node M_p is not full then, allocate replica of the data to the public area M_p.
6. If the node N_k requests for the allocation of D_q then if the node N_k is in SCF tree T_i^{SCF} and N_i does not hold the data Dq.
7. If the public area of the node M_p is not full then, allocate the data D_q to M_p.
8. Otherwise, if the node $_{Ni}$ holds any replica of local interest in public area $_{Mp}$ then replace the replica with D_q;
9. Check the credit risk of the node nCR^h_i is greater than nCR^k_i then replace the replica requested by the node N_h with D_q;

V. Simulation Scenario

The simulation model is similar to that employed in [5][9]. In the simulation, the number of mobile nodes is set to 50. Each node has its local memory space and moves with a velocity from 0 ~ 1 (m/s) over 50 (m) x50 (m) .The movement pattern of nodes follows the random waypoint model [5], where each node remains stationary for a pause time and then it selects a random destination and moves to the destination. The radio communication range of each node is a circle with a radius of 1 ~ 19 (m). Suppose that there are 40 individual pieces of data, each of the same size. In the network, node N_i ($1 \leq i \leq 50$) holds data D_i as the original. Table 1 describes the simulation parameters.

The default number of selfish nodes is set to be 80 percent of the entire nodes in our simulation, based on the observation of a real application [1]. We set 75 percent of selfish nodes to be type-3 (i.e., partially selfish) and the remaining to be type-2 (i.e., fully selfish). Type-3 nodes consist of three groups of equal size. Each group uses 25, 50, and 75 percent of its memory space for the selfish area. Type-2 nodes will not accept replica allocation requests from other nodes in the replica allocation phase, thus being expected to create significant selfishness alarm in query processing. Type-3 nodes will accept or reject replica allocation requests according to their local status, thereby causing some selfishness alarms in subsequent query processing. We evaluate the following four performance metrics:

1. Overall selfishness alarm: This is the ratio of the overall selfishness alarm of all nodes to all queries that should be served by the expected node in the entire system.
2. Communication cost: This is the total hop count of data transmission for selfish node detection and replica allocation/relocation, and their involved information sharing.
3. Average query delay: This is the number of hops from a requester node to the nearest node with the requested data item. If the requested data item is in the local memory of a requester, the query delay is 0. We only consider successful queries, i.e., it is the total delay of successful requests divided by the total number of successful requests.
4. Data accessibility: This is the ratio of the number of successful data requests to the total number of data requests.

Table 1 : Simulation Parameters

Parameter	Value
Number of nodes	50
Number of data items	50
Radius of communication range	25
Size of the network	50X50
Size of the memory space	60
Relocation period	9000
Percentage of Selfish nodes	80 %
Maximum velocity of a node	1

VI. Performance Evaluation

This section is first devoted to evaluating the performance of our collaborative watchdog method using the combined credit risk method and the collaborative watchdog. All the model were implement and evaluated using NS2.The evaluation shows the impact of the number of nodes ranging from 0 to 100 . Three different sets of values for *pc* and *pd* were used. The first set (1, 0.8) is a full collaborative network with a high probability of detection, the second set has a reduced degree of collaboration (0.7), and finally the last set has a low probability of detection (0.3).

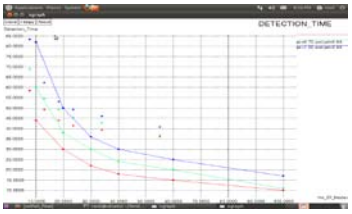

Figure 6a : Evaluation Depending on Node

In fig 6a, we observe that, in general, the greater the number of nodes, the lesser the detection time and the greater the number of messages. As expected, reduced values of collaboration and detection probabilities imply greater detection times. Figure 6b shows the influence of the number of selfish nodes S for $N = 50$. As expected, the detection time decreases when the number of selfish nodes is higher. The results confirm that the increasing the period p implies that the detection time is decreased and the overhead is reduced.

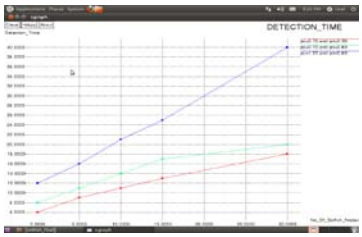

Figure 6b : Evaluation depending on selfish node

a) Communication Cost

Fig. 6c shows the communication cost of DCG, DCG$^+$ and SCF. In all cases, our techniques outperform DCG and DCG$^+$, while SCF shows the best performance in terms of communication cost and average query delay. As the communication range increases, the communication cost of all techniques increases at first, but it gets smaller from a certain point, except SAF. When the communication range is smaller than a certain point in Fig 6a, the communication cost increases as the Communication range gets larger, since the number of nodes connected to each other increases and thus the communication cost caused by replica relocation increases. Conversely, when the communication range is larger than a certain point, the number of hops among connected nodes decreases. Therefore, the communication cost caused by replica relocation decreases.

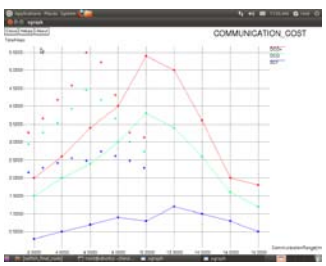

Figure 6c : Communication Cost

We see, in Fig. 6d, that the data accessibility improves with the wide range of communication, since more nodes become connected. In this figure, the performance of the SCF technique is improved than other techniques. This method is fully utilizing the memory space of the nodes.

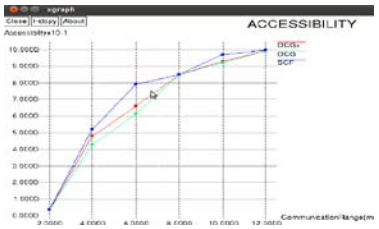

Figure 6b : Accessibility

VII. Conclusion

In this paper, the problem of selfish nodes is addressed from the replica allocation perspective. The selfish replica allocation could reduce the overall data accessibility in a MANET. Thus the solution has been proposed for the selfish node detection method to detect the selfish node appropriately and the detection time for the selfish node is also calculated. The proposed strategies are inspired by the real-world observations in economics in terms of credit risk and in human friendship management in terms of choosing one's friends completely at one's own discretion. The combined credit risk and the collaborative watchdog method were applied to detect the selfish nodes. Every node in a MANET calculates credit risk information on other connected nodes individually to measure the degree of selfishness. The collaborative watchdog method is used to reduce the detection time of the each node. We also proposed novel replica allocation techniques. Extensive simulation shows that the proposed strategies outperform existing representative cooperative replica allocation techniques in terms of data accessibility, communication cost, and query delay. We plan to identify and handle false alarms in selfish replica allocation and apply the clustering method to improve the efficiency of the algorithm and also to diagnose the behavior of misbehaving nodes using EDCA method.

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16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

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20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

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· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

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The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

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- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
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What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

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The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
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- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
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References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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