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Implementation of Dwell Timer For Fast WiMAX Handoff of Ping Pong Calls

[1]B.Sridevi,[2]K.Karthikeyan[3]T.Meenavishakan[4]P.Reminbabu,[5]Dr.S.Rajaram

[1]Assistant Professor,[2][3][4]Under Graduate[5]Associate professor

Velammal College of Engineering & Technology,Madurai.

aisveriya@yahoo.com,karthikeyankvcet@gmail.com,vishakan16@gmail.com

Abstract

The WiMAX technology is becoming the way to avert the impending crisis of rural Connectivity .The next-generation Wireless Metropolitan Area Networks, using the Worldwide Interoperability for Microwave Access (WiMAX) as the core technology is evolving as a Fourth-Generation (4G) technology for providing ubiquitous computing solutions. WiMAX has taken WMAN networks to next level. It is important to analyze the drawbacks in WiMAX networks. Ping pong effect has been one of the major issues in WiMAX networks. The best possible way of avoiding this effect is to prevent the MS from immediately switching to the TBS when communication is in process since it may result in call dropping. Introducing Dwell timer in BS's has been suggested to overcome this effect. This paper deals with the Analysis of the channel performance after implementing Dwell timer by various Modulation techniques. QPSK and BPSK were taken into consideration for the performance analysis. A Comparative study is made on these modulation techniques with respect to factors like throughput and delay.

Key Words: Ping Pong, Dwell Timer, Fast Handoff, WiMAX

Introduction

WiMAX the Worldwide Interoperability for Microwave Access, is a telecommunications technology that provides for the wireless transmission of data in a variety of ways, ranging from point-to-point links to full mobile cellular type access. The overall network may be divided logically into three parts:

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1.MS used by the end user to access the network.
2.The Access Service Network (ASN), which comprises one or more base station and one or more ASN gateways that form the radio access network at the edge.
3. Connectivity Service Network (CSN), which provides IP connectivity and all the IP core network functions.

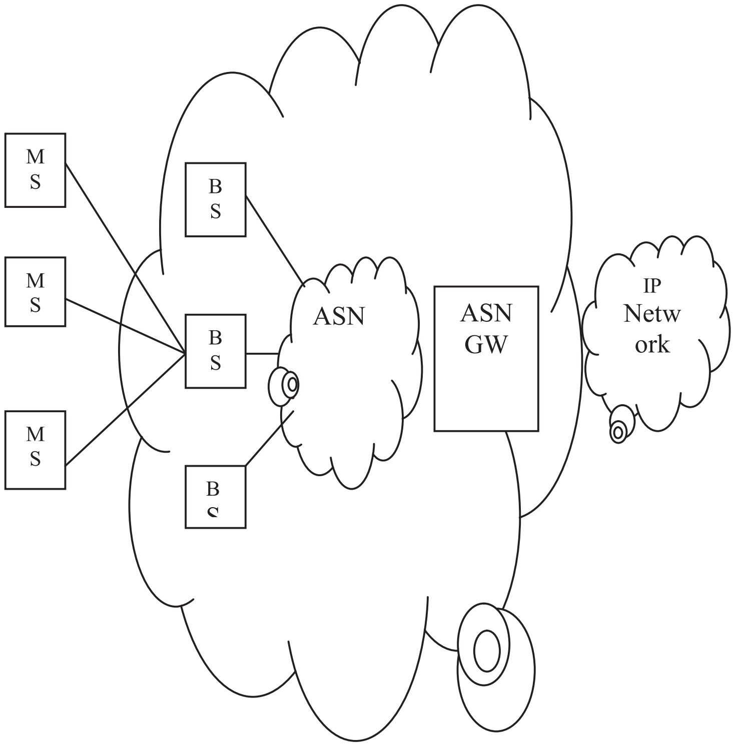

Fig.1: Architecture of WiMAX

The network reference model developed by the WiMAX Forum NWG defines a number of functional entities and interfaces between those entities. These entities are discussed briefly below

Base Station (BS): The BS is responsible for providing the air interface to the MS. Additional functions that may be part of the BS are micro mobility management functions, such as handoff triggering and tunnel establishment, radio resource management, QoS policy enforcement, traffic classification, Dynamic Host Control Protocol (DHCP)proxy, key management, session management and multicast group management[2].

Access Service Network Gateway (ASN-GW): The ASN gateway typically acts as a layer 2 traffic aggregation point within an ASN. Additional functions that may be part of the ASN gateway include intra-ASN location management and paging, radio resource management and admission control, caching of subscriber profiles and encryption keys, AAA client functionality, establishment and management of mobility tunnel with base stations, QoS and policy enforcement, foreign agent functionality for mobile IP and routing to the selected CSN.

Connectivity Service Network (CSN): The CSN provides connectivity to the Internet, ASP, other public networks and corporate networks. The CSN is owned by the NSP and includes AAA servers that support authentication for the devices, users and specific services. The CSN also provides per user policy management of QoS and security. The CSN is also responsible for IP address management, support for roaming between different NSPs, location management between ASNs and mobility and roaming between ASNs.

Handover

For implementing a mobile network, a handoff mechanism must be defined to maintain uninterrupted user communication session during the movement from one location to another. Handoff mechanism handles subscriber station (SS) switching from one Base Station (BS) to another. Different handoff techniques have been developed. In general, they can be divided into soft handoff and hard handoff[3].

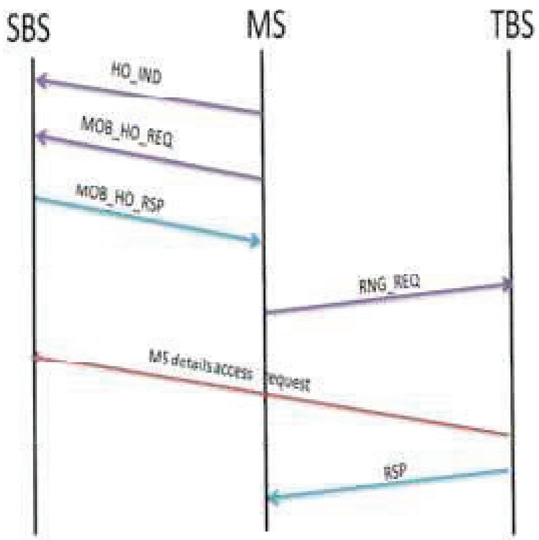

Fig.2: Handover process

The Fig2 explains the process of handoff
Step-1: MS indicates the hand over process to be takes place to the serving base station(SBS)
Step-2: MS sends the handoff request currently serving base station(SBS) Step-3:SBS responds to the mobile station with the parameters like Resource remain type, Resource retain time, Management details and 4.SBS id
Step-4: MS sends the ranging request to the target base station
Step-5: TBS sends the SBS id to the previously served base station
Step-6: TBS responds to the MS after the connection is established.

In cities or mountainous regions shadows blocking the line of sight can significantly change the signal strength at the receiver side. This can cause unnecessary handovers between adjacent cells when a stronger signal is received from an adjacent cell even though the receiver's position is still in the original cell. After a short while the original signal is stronger again causing the receiver to change the cell again. This is called Ping Pong effect[4]. It is shown in Fig.2. The ping-pong effect occurs if factors for vertical handover decision are changing rapidly and an MS performs the handover as soon as it detects a better BS. Therefore ping-pong effect can lead to inefficiency in network resource management.

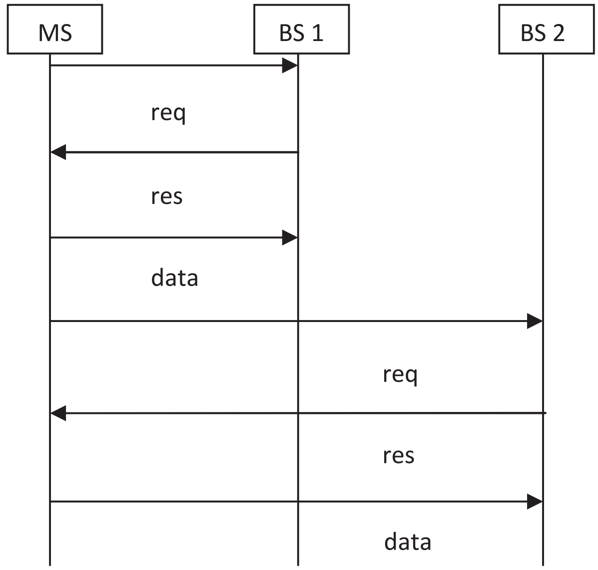

Fig.3: Steps in Ping Pong

All tables should be numbered with Arabic numerals. Headings should be placed above tables, left justified. Leave one line space between the heading and the table. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table, and immediately above and below the table. Tables must be embedded into the text and not supplied separately. Below is an example which authors may find useful.

Internetworking architecture for Ping Pong calls in WiMAX

In the early vertical handover research, homogeneous networks have used the radio signal strength (RSS) as the main factor of the handover decision . However, the vertical handover decision needs to consider more factors because heterogeneous wireless networks have different characteristics. Therefore in the policy-enabled handover decision algorithm using the utility function with various factors was proposed. It performs vertical handover to the best target BS determined by the utility functions[9]. The factors used in vertical handover are service types, monetary cost, network conditions, system performance, mobile node conditions, etc. Such policy-based vertical handover decision algorithms can be used to provide QoS to BSs. . In a homogeneous environment, the ping-pong effect is a phenomenon that rapidly repeats vertical handover between two BSs. In a heterogeneous environment, the ping-pong effect occurs if factors for the vertical handover decision are changing rapidly and an MS performs handover as soon as the MS detects the better BS . The dwell timer scheme has been used to avoid such ping-pong effects. It starts to work when the vertical handover condition is first satisfied. If the vertical handover condition persists during the dwell time, the MS performs vertical handover to the target BS after the dwell timer is expired. Otherwise, the MS resets the dwell timer. Consequently, the MS does not execute premature vertical handover until the target BS becomes stable. Otherwise, the MS resets the dwell timer. Consequently, the MS does not execute premature vertical handover until the target BS becomes stable. Ping pong effect can also occur if the speed of an MS is high or the moving direction of the MS is irregular. Thus, the proposed scheme in this paper adjusts the length of the dwell time adaptively according to the ping-pong movement of MS. In an MS selects a target BS with the least QoS level from neighbor BSs that can satisfy QoS requirement of the current application, i.e., an MS does not select the best BS as a target BS. Therefore, it remains with the serving BS as long as the BS satisfies the QoS requirement of the MS. When the type of the application used changes or an MS leaves the serving BS, the MS attempts to find another BS[8]. The proposed vertical handover decision algorithm in can avoid ping-pong effect since it is based on the need of the application, but not the RSS of the BS. On the other hand, we propose a vertical handover decision scheme that can avoid ping-pong effect as well as select the best among neighbor BSs.

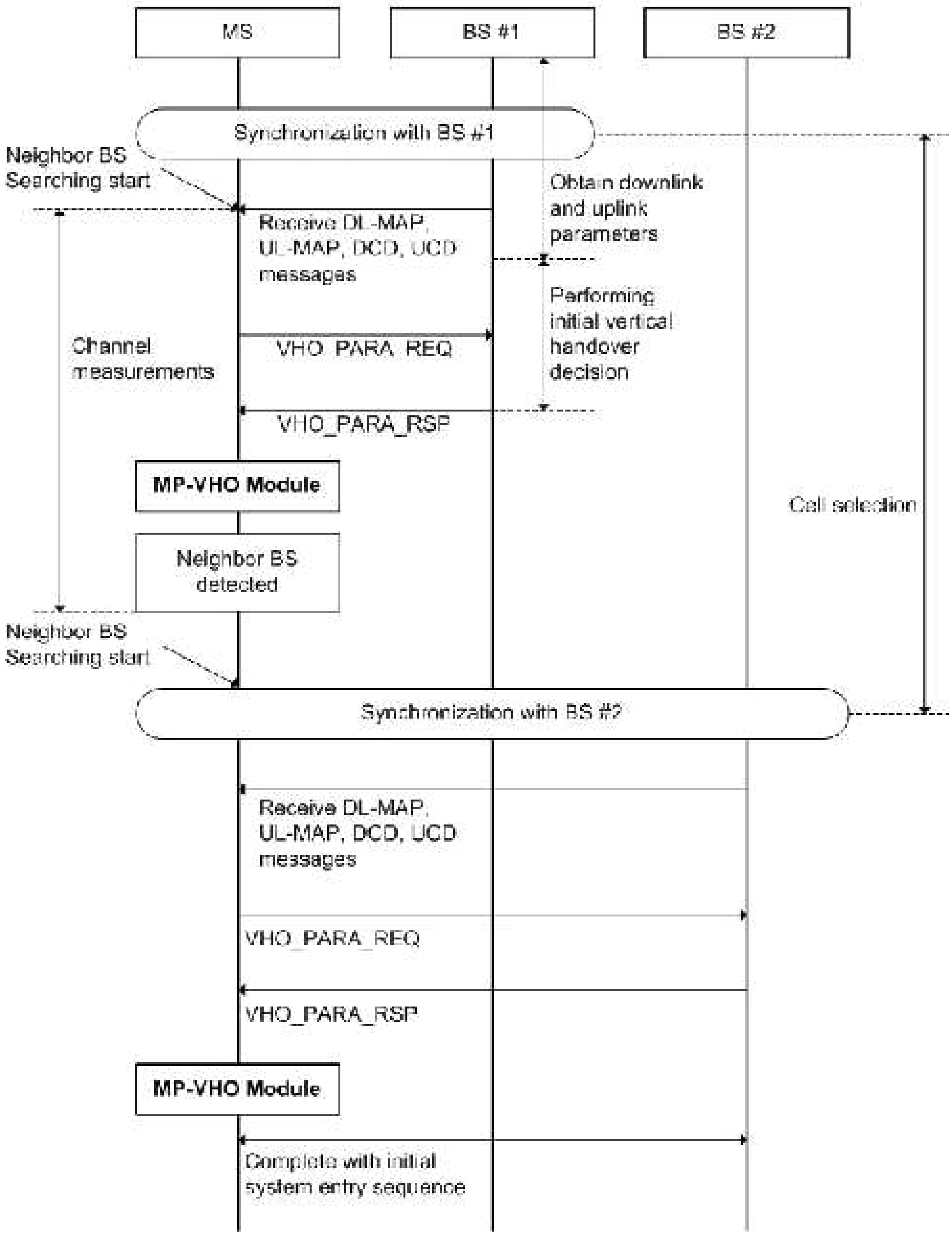

Fig.5: Architecture of Ping Pong in WiMAX

Proposed work

In a homogeneous environment, the ping-pong effect is a phenomenon that rapidly repeats vertical handover between two BSs. In a heterogeneous environment, the ping-pong effect occurs if factors for the vertical handover decision are changing rapidly and an MS performs handover as soon as the MS detects the better BS. The dwell timer scheme has been used to avoid such ping-pong effects By using the following handover algorithm, we can avoid ping-pong effect by using a dwell timer[6]. The given flowchart shows how dwell timer is used to avoid ping pong effect .It checks for conditions to activate the timer. Initially it is assumed that the MS is connected to a BS which is the serving BS .Now it checks for the condition $U_{sev.BS}$ is greater than $U_{trgt.BS}$ here $U_{sev.BS}$ is the utility of the serving BS and $U_{trgt.BS}$ is the utility of the target BS .The dwell timer is adaptable according to the utility ie) if the utility of the TBS is more than SBS then dwell timer is reduced. If the condition is satisfied then it checks for the next condition which is the Radio Signal Strength of TBS is less than threshold value of TBS and the condition for dwell timer (t_{res}) where it is less than the sum of makeup time (t_{mu}) and handoff delay time (t_{hd})

Modulation Techniques

BPSK

BPSK (also sometimes called PRK, Phase Reversal Keying, or 2PSK) is the simplest form of phase shift keying (PSK). It uses two phases which are separated by 180° and so can also be termed 2-PSK. It does not particularly matter exactly where the constellation points are positioned, and in this figure they are shown on the real axis, at 0° and 180°. This modulation is the most robust of all the PSKs since it takes the highest level of noise or distortion to make the demodulator reach an incorrect decision. It is, however, only able to modulate at 1 bit/symbol (as seen in the figure) and so is unsuitable for high data-rate applications. In the presence of an arbitrary phase-shift introduced by the communication channel , the demodulator is unable to tell which constellation point is which. As a result, the data is often differentially encoded prior to modulation.

QPSK

Sometimes this is known as *quaternary PSK*, *quadriphase PSK*, 4-PSK, or 4-QAM. (Although the root concepts of QPSK and 4-QAM are different, the resulting modulated radio waves are exactly the same.) QPSK uses four points on the constellation diagram, equispaced around a circle. With four phases, QPSK can encode two bits per symbol, shown in the diagram with gray coding to minimize the bit error rate (BER) — sometimes misperceived as twice the BER of BPSK. The mathematical analysis shows that QPSK can be used either to double the data rate compared with a BPSK system while maintaining the same bandwidth of the signal, or to maintain the data-rate of BPSK but halving the bandwidth needed. In this latter case, the BER of QPSK is exactly the same as the BER of BPSK - and deciding differently is a common confusion when considering or describing QPSK. Given that radio communication channels are allocated by agencies such as the FCC giving a prescribed (maximum) bandwidth, the advantage of QPSK over BPSK becomes evident: QPSK transmits twice the data rate in a given bandwidth compared to BPSK - at the same BER. The engineering penalty that is paid is that QPSK transmitters and receivers are more complicated than the ones for BPSK. However, with modern electronics technology, the penalty in cost is very moderate.

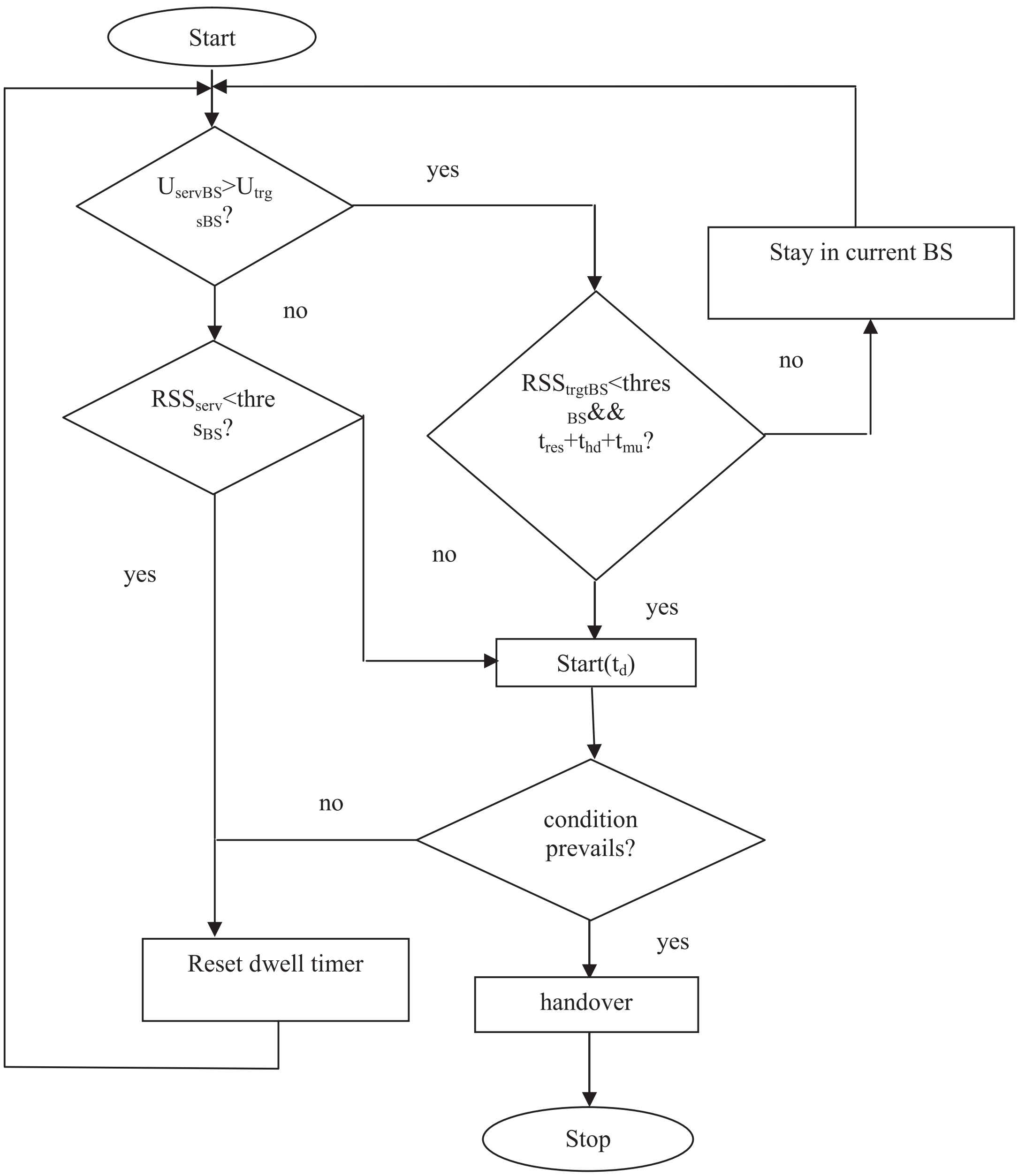

Fig 6 Dwell Timer Process

As with BPSK, there are phase ambiguity problems at the receiving end, and differentially encoded QPSK is often used in practice

Result and discussion

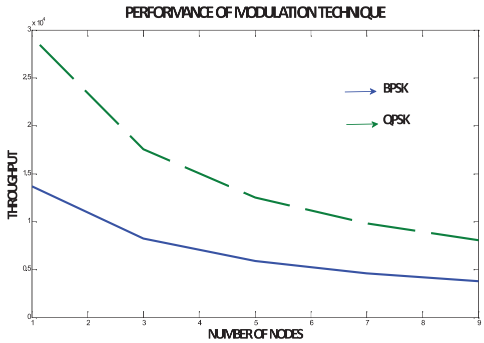

Fig 7.1 Performance of modulation technique - throughput

The above given graph in Fig 7.1 gives the relationship between the No of nodes and the through put for BPSK modulation and QPSK modulation. Obviously the dotted line which represents the QPSK modulation is very much above the BPSK line which is shown as a continuous line. This makes QPSK a better modulation technique which can be used to improve the channel performance. From the graph when the no of nodes is 1 the throughput for the BPSK modulation is nearer to 1.5 bits/second where as for the QPSK it is around 5 bits/second there is a significant improvement in the throughput of QPSK than BPSK and as the No of node increases the throughput decreases gradually. An improvement in throughput of around 35% is achieved while using QPSK.

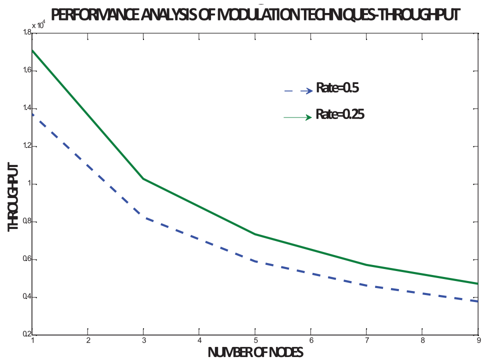

Fig 7.2 Performance analysis of throughput with respect to data rate

The above graph in Fig 7.2 shows the relationship between the No of nodes and throughput when the data rate is fixed the values are obtained from simulation results of the algorithm using Network Simulator software version 3.2.The data rate is fixed to 0.5 and the simulation results for QPSK modulation are obtained. The dotted line represents the performance of the channel at a data rate of 0.5.When the No of node is 3 the throughput is around 0.8 bits/sec where the continuous line which represents the performance of the channel when the data rate is 0.25 the throughput is around 1.5 bits/sec which shows that when the data rate is reduced better performance of the channel is achieved .

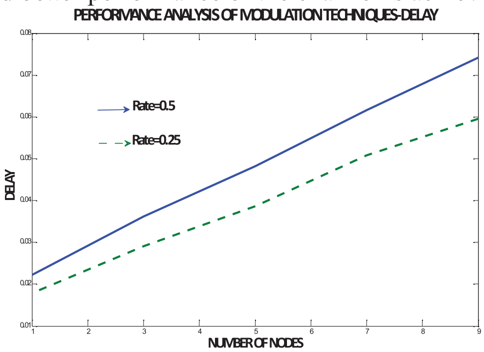

Fig 7.3 Performance analysis of delay with respect to data rate

This graph in Fig 7.3 shows the relationship between the delay and the No of nodes there should be a minimum of delay for the better performance of the channel. The data rate here is fixed at first to 0.5 bits/sec and the delay analysis is done. The continuous line showing the delay performance against the No of nodes when the rate is 0.5 bits/sec when the No of node is 5 the delay 0.05 sec and the delay progresses as the No of nodes increases. On the contrary the dotted line which shows the delay performance against No of nodes when the data rate is 0.25 bits/sec has a minimum amount of delay compared to the delay obtained when the data rate is 0.5 bits/sec when the No of node is 5 the delay is around 0.025 sec and it gradually increases when the No of nodes increases. There is a reduction in delay when the data rate is reduced it decreases to about 25%.

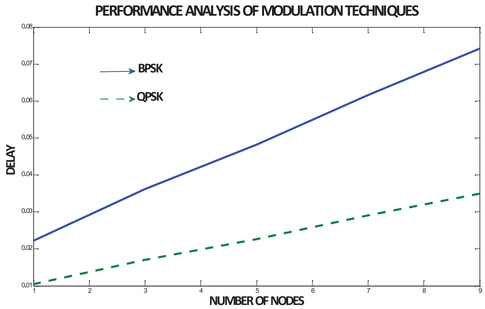

Fig 7.4 Performance analysis of modulation techniques - delay

The graph in Fig 7.4 shows the analysis of modulation techniques based on delay performance against the No of nodes the continuous line represents the delay performance when the modulation used is BPSK. When the No of node is 7 the delay is around 0.06 sec and the delay increases gradually as the No of node increases whereas the dotted line represents the delay performance of the channel when the modulation technique used is QPSK. When the No of node is 7 the delay is around 0.025 sec and it increases gradually when the No of node increases. Hence there is a decrease in delay when the modulation technique used is QPSK. An decrease in delay of around 45% is achieved which makes QPSK a better modulation technique than BPSK.

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