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ANALYSIS OF HANDOFF TECHNIQUES USED FOR HYBRID NETWORKS: CELLULAR / WLAN

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Abstract: *Most real life networks are hybrid networks. A hybrid network combines the best features of two or more networks. In networking terminology, a hybrid network according to "Information Technology control and Audit" are reliable and versatile. They provide large numbers of connections and data transmission paths to users. These hybrid networks may be treated as network nodes for analysis purpose. The two radio access technologies (RATs) are considered with cellular/WLAN depending on whether it is voice/ data, video. For observing practical result, some setups are required in laboratory which includes interface from personal computer to mobile terminal and vice-versa. The network simulator (Ns-2) is used for analysis purpose. The results shows the parameters like energy good put, Bandwidth utilization, packet delivery ratio, energy good put and energy consumed are improved after using hybrid networks.*

Keywords: *Radio Resource Management (RRM), Radio Access Technologies (RAT), Vertical Handoff, Heterogeneous Network.*

I. INTRODUCTION

The most real life networks are hybrid networks. Theese hybrid networks may be treated as network nodes for analysis purpose. The two Radio Access Technologies (RATs) are considered with cellular /WLAN. To design and develop algorithm for practical results needs interface between personal computer and mobile terminal. Social network-based systems usually suffer from two major limitations:

1. They tend to rely on a single data source (e.g. email traffic)
2. The form of network patterns is often privileged over their content.

To go beyond these limitations we describe a system we developed to visualize and navigate hybrid networks constructed from multiple data sources with a direct link between formal representations and the raw content. Motivated by ever increasing demand for wireless communication services, the past decade has witnessed rapid evolution and successful deployment of wireless networks. It is widely accepted that next generation wireless networks will be heterogeneous in nature with multiple wireless access technologies. While heterogeneity poses new challenges to achieve interpretability among different wireless networks, their complementary characteristics can be exploited with the interworking to enhance service provisioning.

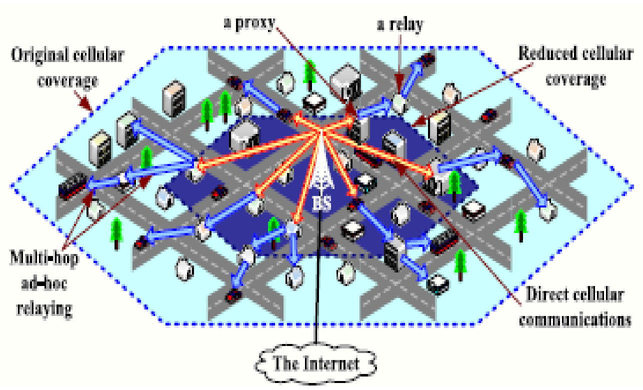

Figure 1: Scenario of heterogeneous wireless networks

The popular cellular networks and wireless Local Area Networks (WLANs) are two most promising technologies, and the cellular/WLAN interworking has attracted much research attention from both the industry and academia. Network protocol: AODV, Number of nodes: 20 Data transfer protocol: TCP MAC layer standard: IEEE 802.11 are used to design network.

Cellular networks are originally designed to provide high quality voice service with wide area coverage. The first generation (1G) cellular networks are upgraded to the second generation (2G) with digital technologies. The 2G systems e.g. the global system for mobile communication (GSM) are further extended with packet switching for more efficient data transmission. For example, the data transmission rate is increased from 9.6 kbps with GSM to around 100 kbps with the General Packet Radio Service (GPRS). Currently the third generation (3G) augmented with multimedia service support has been commercialized, such as the Universal Mobile Telecommunication System (UMTS) and cdma 2000 c1 [1]. The UMTS system supports a data rate up to 2 mbps with greater capacity and improved spectrum efficiency. However, the deployment cost remains high due to expensive radio spectrum and implementation complexity. On the other hand, WLANs have also achieved great success and provide higher data rates at a much higher data rates and much lower cost. However, designed as a wireless extension to the wired Ethernet, a WLAN can only cover a small geographic area. For instance, an 802.11b access point (AP) can communicate with mobile within up to 60 meter at 11 Mbps and upto 100 meter at 2Mbps with unidirectional antennas. The standardization for 3G/WLAN interworking is now in progress by the third generation partnerships project (3GPP) and the third generation partnership project 2 (3GPP2) from a cellular network operator's perspective [2]. Six interworking scenarios are defined in 3GPP TR 22.934 to implement the 3GPP/WLAN interworking step by step. The interworking requirements, architecture and procedures have been specified in 3 GPP TR 23.234. Nonetheless, the specification on quality of service (QoS) provisioning is still limited to very high level discussion, such as 3GPP TR 23.836. The remaining paper includes handoff algorithms for quality of service provisioning in section II. Section III follows methodology used, whereas section IV gives results. Section V and section VI are conclusion and references respectively.

II. PHANDOFF ALGORITHMS FOR QUALITY OF SERVICE PRO-VISIONING

It is known that mobile wireless network exhibit some features distinct from wired networks. First, a wireless channel becomes time-varying and location-dependent due to radio propagation characteristics. The achievable channel capacity may be substantially degraded by impairments such as large-scale path loss and small-scale fading resulting from multipath time delay spread and Doppler frequency dispersion. To improve channel capacity, frequency reuse is enabled in cellular networks. In cellular networks is further complicated by co-channel interference and user mobility. Resource allocation plays a key role in effectively provisioning QoS guarantee and efficiently utilizing the scare radio resources. There has been extensive research on resource allocation for heterogeneous wireless networks: which involves various aspects from the packet level to call level, such as packet scheduling and medium access control (MAC), flow and congestion control, QoS routing, and call admission control (CAC). In the cellular/WLAN integrated network, resource allocation becomes much more challenging due to network heterogeneity. The resource allocation techniques need to be adapted to this heterogeneous networking environment and address many emerging new problems. To achieve a high utilization efficiency, the resources in the integrated systems should be jointly considered in the allocation. Also, the unique characteristics of the integrated network should be taken in to account.

III. METHDOLOGY

Our objective is to evaluate if this approach can yield capacity benefits over that of the original cellular network. While the use of the relays to form a hybrid network provides shorter higher rate communication links, multichip forwarding contributes to a reduction in capacity [3]. We determine under what conditions and by how much is the downlink capacity of a hybrid cellular ad-hoc network higher or lower than that of the original pure cellular network. The capacity of a cellular data networks can be improved by creating a larger number of smaller cells, each of which houses an expensive base-station (BS). The benefit of such an approach is the increased spatial reuse of the spectrum. Alternatively, in order to increase spatial reuse, cellular networks may be augmented with ad-hoc wireless connectivity; this is attractive as compared to the former approach in terms of the incurred cost. Mobility management consists of two aspects i e location management and handoff management. Location management continuously tracks the mobile's location, while handoff management maintains ongoing connections when switching attachment points. Generally, the handoff process is divided into three stages i.e. initiation, decision, execution [4].

Depending on the decision entities, there are mobile-controlled handoff, mobile-assisted handoff and network-controlled handoff. Horizontal handoff within a homogeneous wireless network is inherently supported as a functionality of the mobility management. In the 3G cellular network UMTS; there is GPRS Mobility Management (GMM) for the link layer and network layer mobility [5]. Tunneling protocols are used in the cellular core to support roaming. In CDMA 2000 system, mobile IP is introduced to provide network layer transparency to IP-based applications (IP mobility) under the same packet serving node (PDSN) and between different PDSNs. In contrast, current UMTS specifications only support IP mobility under the same GGSN node. In three state evolution specified, mobile IP is being considered for inter UMTS or inter-technology IP mobility. The mobility management in WLANs is much simplex since they are designed for local areas. In 802.11 a distribution system (e.g.an 802.3- type Ethernet) connects multiple basic service sets (BSSs) into an extended service set (ESS). On the other hand, vertical handoff in heterogeneous wireless networks need to address many new challenges posed by network heterogeneity. In a loosely coupled cellular/WLAN network, the vertical handoff can be mobile-assisted or mobile-controlled, while tight coupling offers mobile-assisted or network-controlled

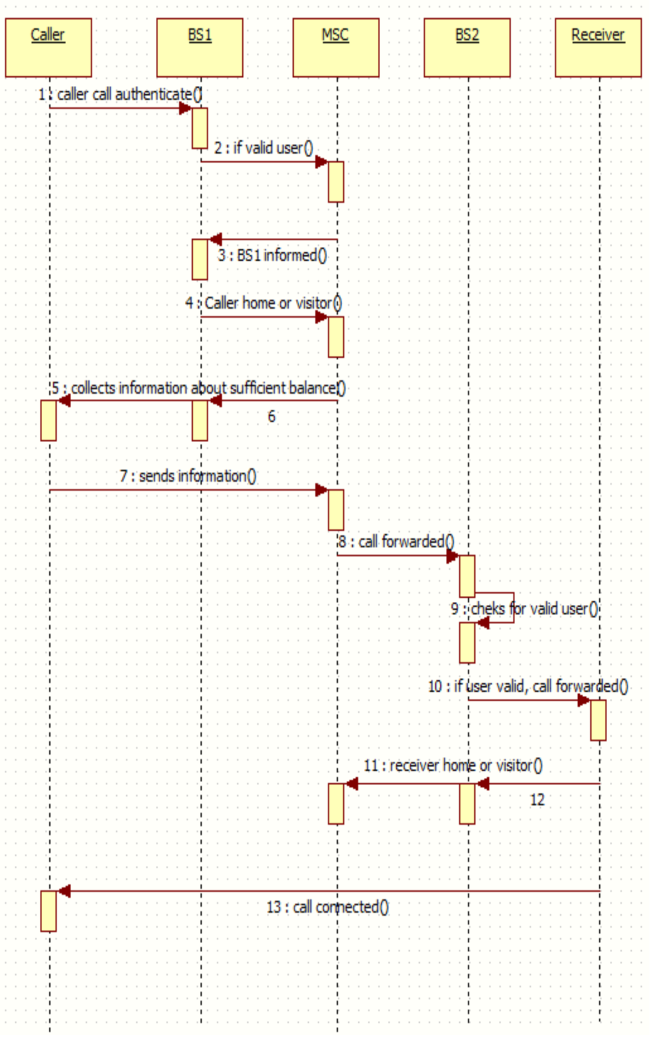

Figure 2: Sequence diagram of Handoff

vertical handoff with enhanced performance but high complexity. In order to make an intelligent handoff decision, timely information must be retrieved from candidate networks. Traditionally metrics measured include received signal strength (RSS), signal –to-noise ratio(SNR) or bit error rate (BER), Packet loss rate etc [6]. In the heterogeneous cellular/WLAN interworking environment the information collection becomes much more challenging. Especially, the loose coupling may result in a large overhead and long latency for the information exchange between the two networks. The networks information is collected from mobiles via power control and link adaptation signaling and is managed with local databases. The data can be retrieved from the database upon request and transferred to the mobile through extended cell broadcast or in-band signaling in a piggy back fashion. The mobiles dual network interfaces are always enabled active for control messages. In this way, the mobile keeps receiving periodic advertisements from both networks indicating network conditions such as link performance, channel utilization and traffic load. Handoff decision algorithms while the cellular network provides ubiquitous connectivity with wide area coverage, WLAN s are only deployed disjoint in hotspot areas. The cellular/WLAN interworking then results in an overlay structure, which offers both cellular access and WLAN access to dual mode mobiles in WLAN covered areas. In hierarchical cellular networks small-sized microcells are overlaid with large macrocells. However, the cellular network and WLANs differ intrinsically in the physical layer, medium access and link control layers. It is necessary to differentiate the downward vertical handoff from a cell to a WLAN and upward vertical handoff from a WLAN to a cell. Further vertical handoff may originate from quality of service (QoS) enhancement or load balancing considerations other than maintaining connectivity [7]. Hence, not only can vertical handoff proceed when a mobile moves out of the cell/WLAN border but also back-and-forth vertical handoff can take place when mobile moves within the cell/WLAN. Vertical handoff algorithms need to decide whether and when to perform a handoff to minimize the unnecessary handoff and the impact of ping-pong effect and where to direct the handoff in case of multiple access interfaces. Many works on the vertical handoff decision are based on metrics such as RSS, SNR and user moving speed. Due to network heterogeneity, such traditional metrics in the two networks are rather disparate and should be used in a way different from that for horizontal handoff. The transport layer scheme proposed to supports UMTS and WLAN vertical handoff via stream control transmission protocol (SCTP).

IV. RESULTS

Agent used AODV with following specifications:

Packet size:1000 #in octets
Capacity: 5e6 # 4.7e6
Reserved Bandwidth: 0.1e6
Grad step: 0.05
Rate Control:1
Queue is Drop Tail with length 50
Antenna unidirectional
Number of nodes: 21

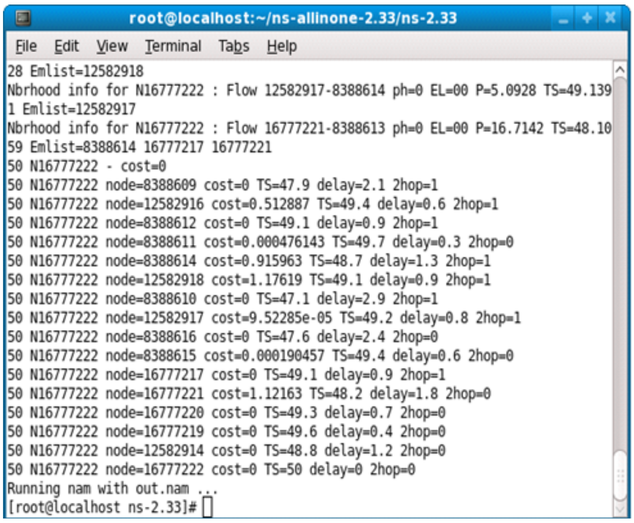

Figure 3: The terminal window

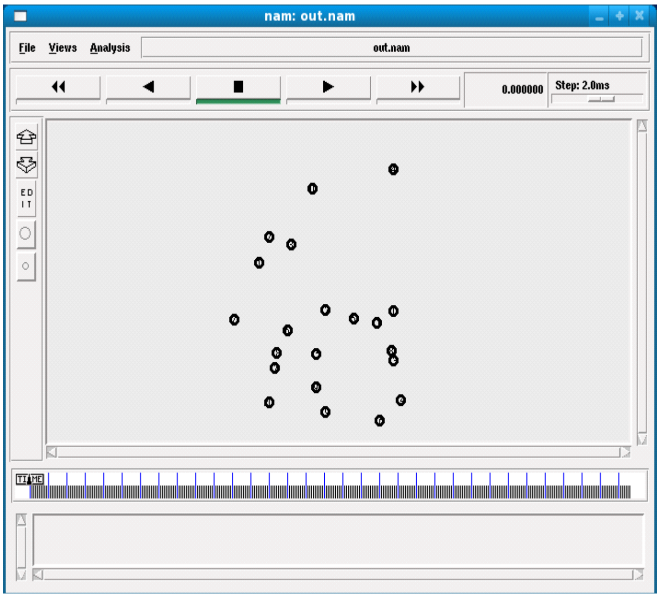

Figure 4: Animator window

Figure 5: Final output

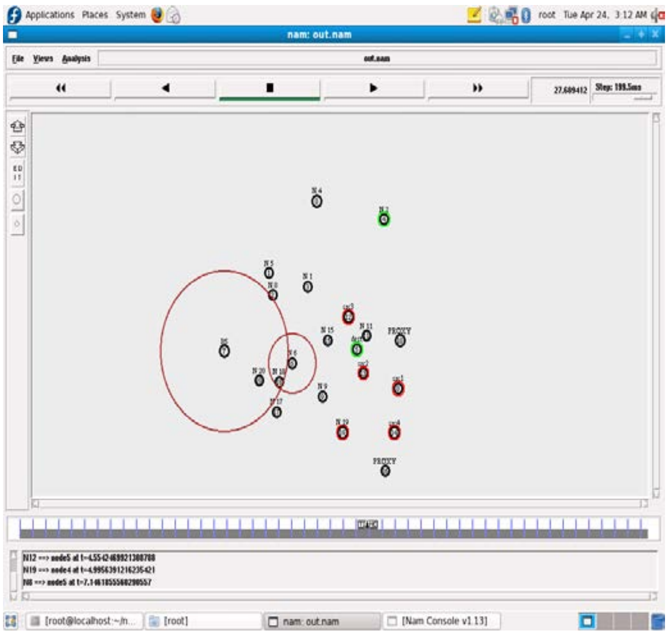

Figure 6: Intermediate execution state

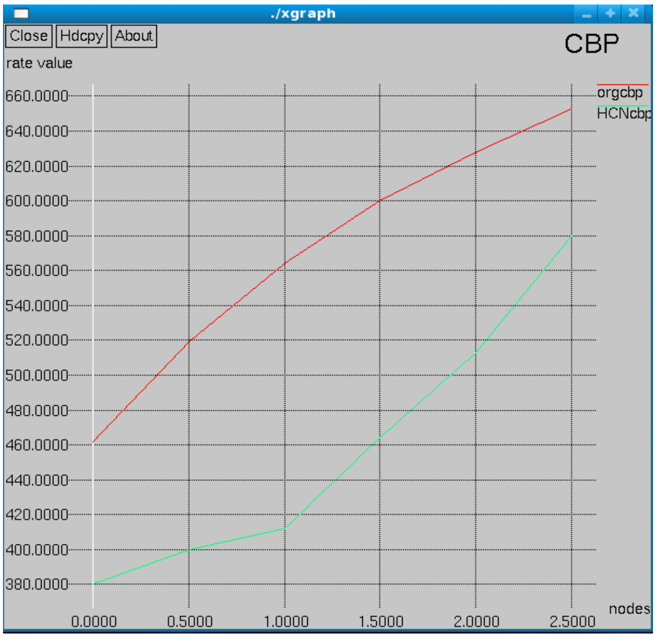

Figure 7: CBP

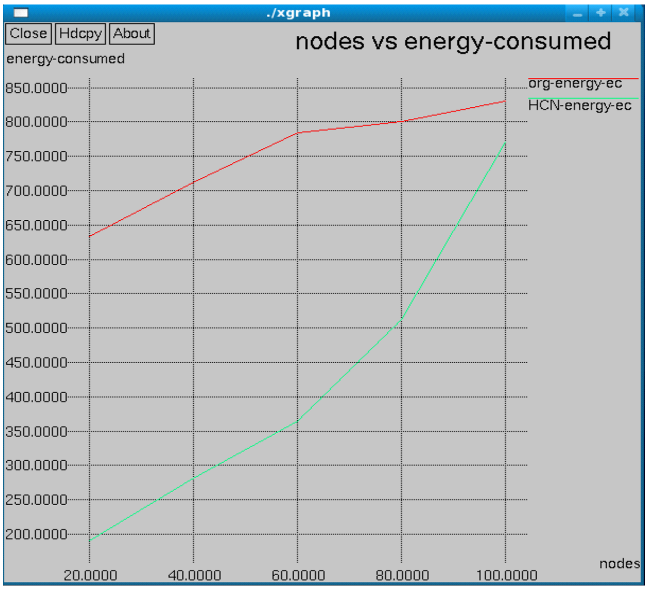

Figure 8: Nodes vs energy consumed

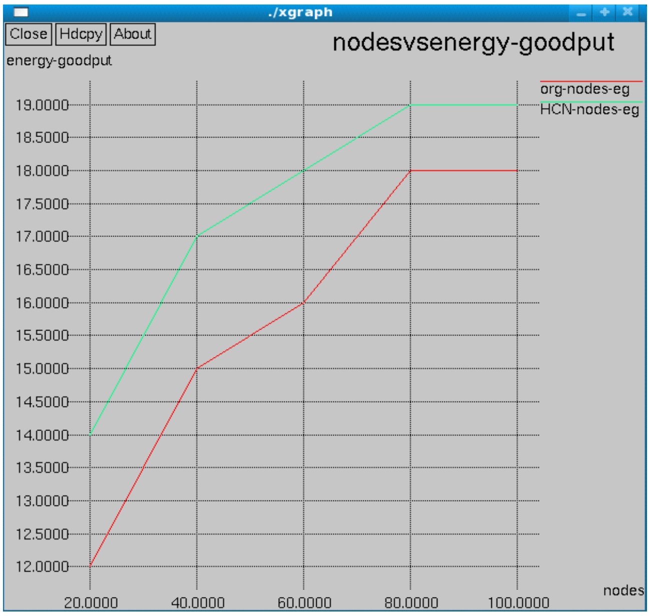

Figure 9: Nodes vs. energy-Good put

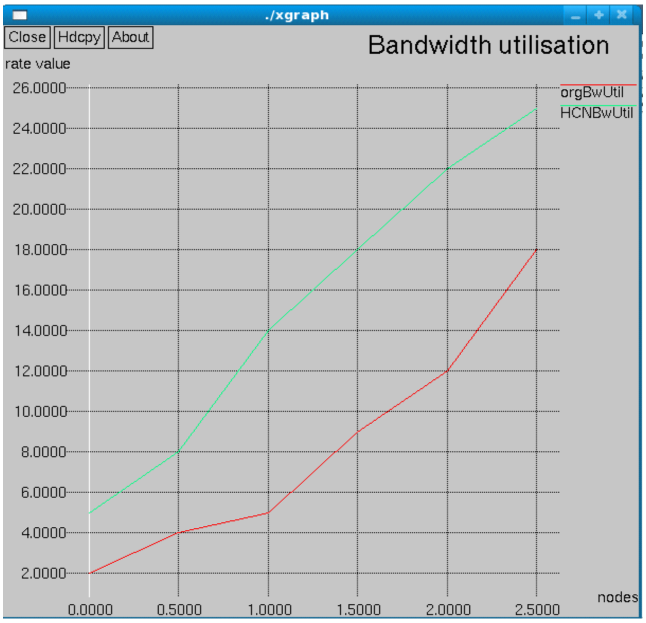

Figure 10: Bandwidth utilization

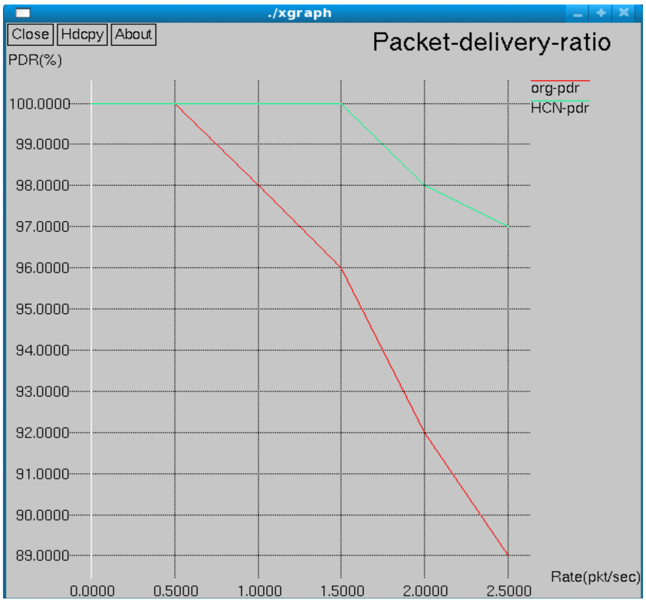

Figure 11: Packet Delivery Ratio

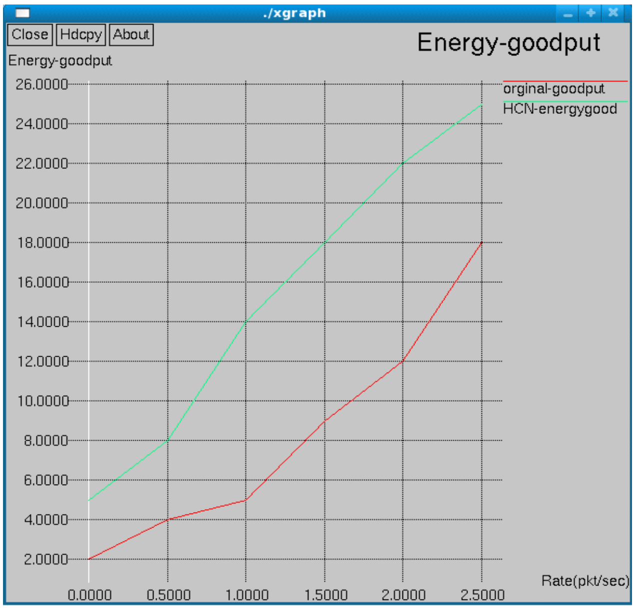

Figure 12: Energy-good put

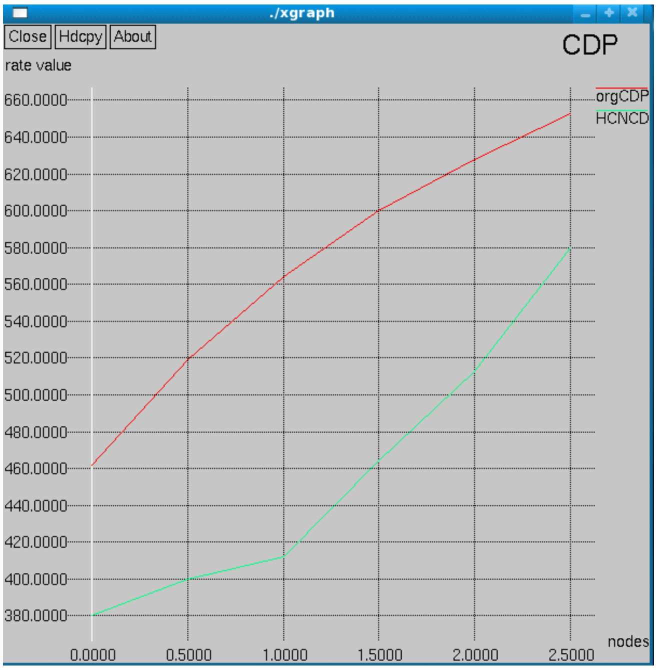

Figure 13: CDP

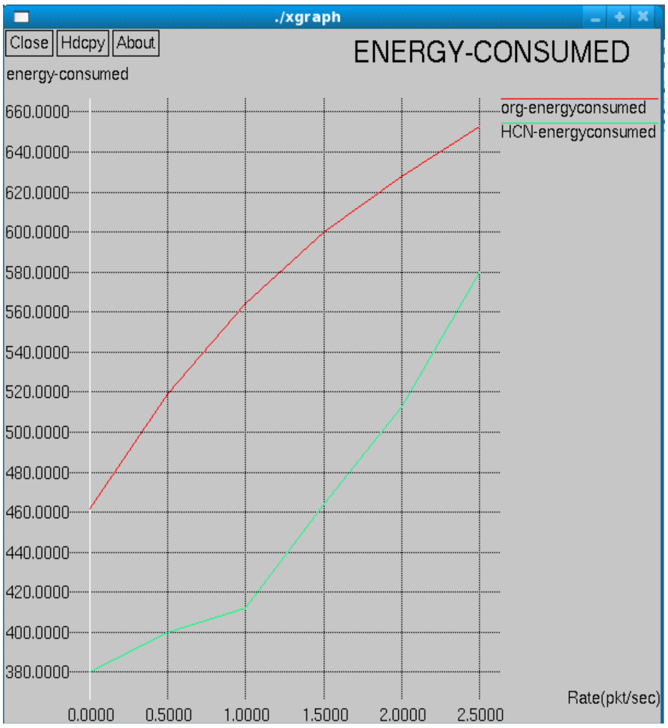

Figure 14: Energy consumed

V. CONCLUSION

From the graphs, it is clear that the performance features like, CDP, CBP, Bandwidth utilization, energy good put, energy consumed, Packet delivery ratio is better for the hybrid network. Hence it can be concluded that as compared to the original system of network, the developed hybrid network which uses AODV for handoff is better. Handoff algorithm is an important aspect for the integrated system of cellular networks and WLANs. So we can apply a handoff algorithm scheme for the cellular/WLAN integrated network to support multiple service classes.

VI. FUTURE WORK

The method implemented above for vertical handoff in heterogeneous network shows all above mentioned parameters are improved. But this is only implementation of handoff by Core Network (CN). The remaining condition initiated by Mobile Terminal (MT) due to new call indication or due to new Radio Access Technology (RATs) or due to low battery or due to low Radio Signal Strength (RSS) is future work. The same analysis can be done for all above condition by using Network Simulator (Ns-2) as future part.

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