Energy Efficient Routing using Gateway Based Routing

Arvind Pande[1],Er. Prateek Singh[2]

M.Tech Student[1], Assistant Professor[2]

#Deptt. Of CSE, SHIATS Allahabad

Abstract— **One of the most important approaches in wireless sensor networks has been the modeling and development of energy-efficient routing methods. Sensor nodes have limited hardware resources in a Wireless Sensor Network. The heterogeneity of cluster routing protocols have been demonstrated effective in topology control, energy use, information collection or fusion, or reliable and stable in a distributed sensor network, a typical feature of routing technology. A heterogeneous clustering approach based on distributed energy efficient clustering is proposed in this paper, which uses threshold criteria for selecting cluster heads. The work presented work assumes that the base station is beyond the area of the network. The sensors are altered and divided into six bits, depending on the threshold level. The sensor nodes below the threshold are closely connected to the door node, while those above the threshold are identical to those suggested in LEACH. The findings in terms of lifespan, throughput and residual energy are well compared with the current protocols.**

Keywords- **Wireless Sensor Networks, Energy Efficient Routing, LEACH, Network Lifetime.**

I. INTRODUCTION

Due to its theoretically extensive area of use, the Wireless Sensor Network has become a significant research field. The WSN is made up of thousands of smaller nodes, each with its limited capabilities, which together can create a useful network for a range of applications, including emergency response, fire detection, vehicle tracking and habitat monitoring. Any feasible communication way to the destination or sinks by hopping data from node to node is identified for the meshed network connectivity. This small sensor nodes consist of sensors, processing of data and communication elements. This sensor nodes have main characteristics of an infrastructure-free and self-ordering capabilities. Randomly spaced and unattended, the sensor nodes carry out their functions. Another key feature of the sensor network is communication between sensor nodes. Processors in sensor nodes are on-board. The partly processing information is transmitted by calculation rather than the transmission of raw data sensor nodes. The WSN typically runs unattended after installation in the network region for each sensor node with a minimum power. With consumed energy, the sensor nodes start losing their energy and the node nearest to death stops all WSN operation. Therefore, maintaining the strength of the knots is one of the key shortcomings of the sensor network design.

The power usage of the source of electricity is an important concept in the WSNs because of the limited power supply in the sensor nodes. When information is transmitted through sensor nodes to other nodes, maximum energy is exploited. A variety of investigations have been undertaken in order to establish routing algorithms to prolong the existence of the sensor network. The Wireless Sensor Networks have some distinct features relative to other kinds of wireless networks that impact network performance. Those functions such as node density are special in the algorithms and protocols of wireless sensor networks.

It is very difficult to link sensor networks since they are distinct in several different respects from typical ad hoc networks and wireless networks. The networks are quite difficult. First, it is not possible to create a global management system for the implementation of pure sensor node numbers. Modern IP

protocols for sensor network implementations cannot therefore be used. Secondly, in contrast to conventional communication networks, almost all sensor network architectures permit the flow of sensed data from various regions to a specific sink. Thirdly, data traffic is highly redundant since many sensors are capable of producing the same data almost like an anomaly. This redundancy is used by the routing protocols to maximize energy and bandwidth usage. Fourth, sensing nodes, which demand careful control of energy, are highly restricted in the field of transmission power, on-board power, bandwidth processing and storage. Notwithstanding these differences, a considerable number of new data routing algorithms have been proposed on sensor networks. The methods of routing have taken into account sensor nodes' properties, software and architectural requirements.

Almost all routing protocols can be classified as data center or hierarchical, even if the flow of a network or the level of service depend upon a few different protocols. A research on the effect of heterogeneity in node potential is carried out in this study. It is thought that part of the population of nodes in the same network has more resources than other nodes and is thus a heterogeneous sensor network. The rationale for this work is that certain processes would significantly benefit from an understanding of the consequences of these heterogeneities. The nodes are energized rather than the nodes in use, and produce energy heterogeneity.

II. LITERATURE REVIEW

There is much study in the literature on energy-efficient WSN protocol clustering. Researches opined that a routing algorithm for homogeneous WSNs with LEACH clustering adaptation, with sensor nodes randomly calculated to be CHs and the unit power load shared with the WSN[4]. A new LEACH routing protocol is proposed[5] for energy optimisation. This algorithm is known by selecting cluster heads similarly, which is more efficient than the LEACH algorithm. A updated LEACH from the LEACH algorithm is given in the paper[6]. In[7], an improved, energy-efficient, portable sink algorithm has been developed compared to mod-LEACH and PEGASIS[8]. The revised Leach edition, LEACH-C, selects the cluster heads at a random level at the base station. Community heads could be all nodes with a higher energy content than an average. The base station runs a virtual ring algorithm to find the best solution for reducing cluster head energy in better locations[9]. M. Tripathi et.al implements the LEACH-C Energetic Efficient Protocol (EELEACH-C), which sorts the lower value of the cluster candidates head nodes sorted with their residual energy into a base station. After determining the candidates' cluster head nodes, it chooses the candidates with the largest residual energy, then computes the quadratic sum of distances from their nodes in order to find the optimum solution. The protocol suggested has been shown to increase network durability[10]. Q-LEACH technique, the sensor nodes on the territories are used and grouped into four quadrants for improved clustering. The whole network can be best protected by such partitioning. In addition, the precise distribution of nodes in the industry is well known. The network distribution in quadrants means that the sensor nodes are used effectively by capital. This division describes the optimum positions of CHs. The size of the clusters is arbitrary in typical LEACH clusters, and some members are distant. As this cluster is dynamically formed, more nodes suffer from high energy drainage and thus network efficiency degradation. Although the clusters are more deterministic in their structure in the Q-LEACH network and thus are sub-sectorally separated. Thus, the nodes are well spread within a certain cluster and help to drain resources efficiently. Instead, the LEACH distance-based method (DB-LEACH) proposes to look at the distance component from the threshold equation and the developments in energy-conscious distance[11]. And, with a cross-layer architecture between Medium Access Control (MAC) and network layers, the Motive Nodes Cluster Centered Routing Protocol is proposed to minimize energy for mobility sensor knot[12]. This type of approach performs best in WSNs with mobile sensor nodes.

Simulation data demonstrate that the above algorithms increase the network energy efficiency at various levels. An enhanced LEACH variant called the Multi-hop-LEACH (LEACH-M)[12], in which cluster members can sail more easily from and connect multihop with their respective cluster heads. Thus are shown the situations in which M-LEACH exceeds LEACH. However, this proposal requires that each sensor should add data, raising the overhead on all sensors. This variant is also suggested. In[13], the authors focused on heterogeneous sensor networks that use two types of sensors: Super Sensors and basic sensors. The sensors possess high energy, communicate intensely and function as cluster heads, while others are single, limited-powered sensors, attached to the nearest cluster head in the neighbourhood and communicate directly or in multi-hops. In this case, cluster heads with a high number of members' odes dry their resources relative to cluster heads with less related members' nodes. In fact, round, unequal nodes connect to several cluster heads. Furthermore, the LEACH routing protocol suggested in [14][15] in order to alleviate these problems is another matter of support for mobility.

III. METHODOLOGY

The first order radio model is used in many researches on wireless sensors networks. Energy dissipation takes place, while transmitting and receiving the data and energy consumption for short distance communication is 'd^2' when propagation is done in line of sight and 'd^4' when transmission is done for the long distance due to multipath fading propagation. It works on the route measurements and sensing takes place constantly resulting in steady volume of data being transmitted to the sink. The following assumptions are considered in an analytical implementation:

1) Base station remains fixed: Wireless sensors are densely populated in the network area and are static. Number of clusters according to the network is predetermined for the network. The nodes will pass the data on the predefined paths, in which clusters and the cluster heads are numbered according to the distance based on received signal strength.
2) Some sensors are located farther away from the base station due to which, the cluster head will consume the 'd^4' energy for transmitting l bit data for direct transmission. Thus, data is transmitted through multiple hops and finally reach the base station by clusters very near to the base station
3) Links in the path are symmetric i.e. same power is required for the communication between any two nodes. No changes in the topologies and the loads are considered.

Thus, to transmit a message of length to a distance d, the transmitter energy is given as:

$$d_0 = \text{sqrt}(E_{mp}/E_{fs}) \quad (1)$$

if $d<d_0$,

$$Et_x(k,d)=E_{elec}*k+E_{mp}*k*d_4 \quad (2)$$

if $d \geq d_0$

$$E_{tx}(k,d)=E_{elec}*k+Emp*k*d_4 \quad (3)$$

Receiver Energy:

$$E_{rx}(k)=E_{ele}c*k \quad (4)$$

where Eelec is the energy dissipated in transmission and reception, Efs and Emp are free space and amplifier energy respectively.

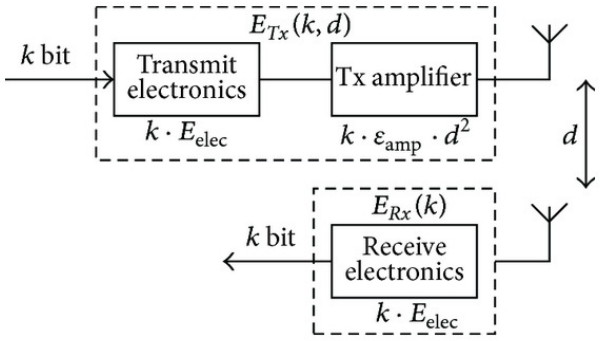

Figure 1: First Order Radio Model

The above diagram shown in Figure 1, shows a graphical representation of a first order radio model [16]. The transmitter and receiver use the same kind of electronic circuitry and thus their energies are accumulated as Eelec, for each data bit transmitted. The sensor nodes are thus symmetric to each other.

IV. RESULTS & DISCUSSIONS

In order to evaluate the performance of the proposed protocol, it has been implemented and simulated using MATLAB. A wireless sensor network with 100 nodes distributed randomly in 200m X 200m field. A gateway node is deployed at the center of the sensing field. The BS is located far away from the sensing field. Both gateway node and BS are stationary after deployment. The table 1 below shows the simulation parameters.

Table I: Simulation Parameters

Parameter	**Value**
Number of sensor nodes	200
Network size (m^2)	200*200
No of round	5000
Base station location	(50,50)
Efs (pJ/bit)	10*10^(-12)
Eamp (pJ/bit)	0.0013*10^(-12)
ETX (nJ/bit)	50*10^(-9)
ERX (nJ/bit)	50*10^(-9)

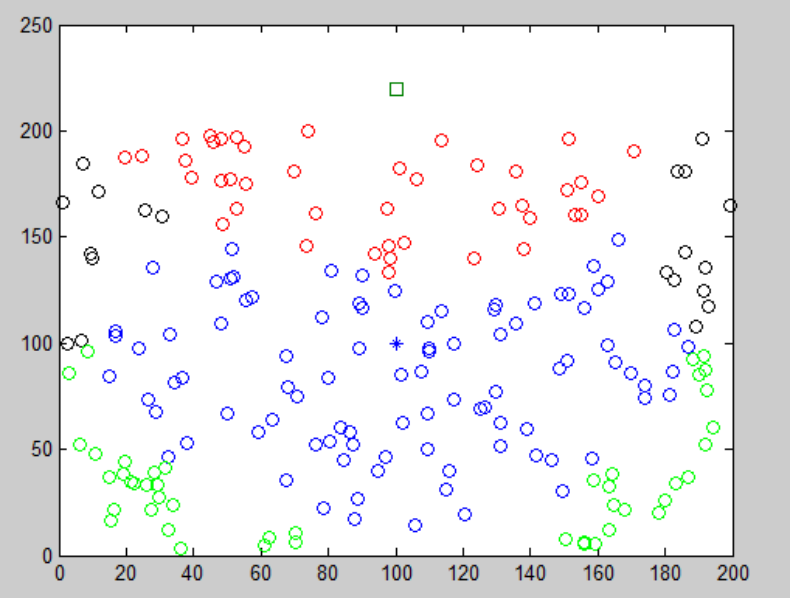

Figure 2: Node Deployment

The above figure 2 shows the different node types based on their location from the base station and gateway node. A total of six different types of cluster can be seen in the figure 3, indicating six regions of node communication with gateway and the base station.

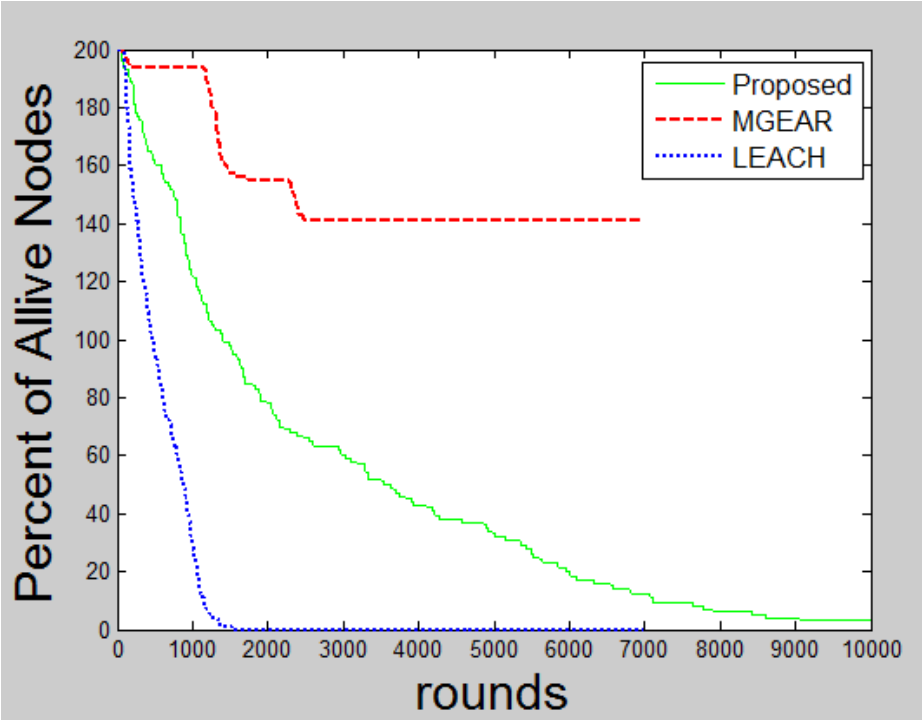

Figure 3: Alive Nodes vs Rounds

The number of alive nodes after each round has been plotted in figure 3. The comparison shows the proposed method compared with LEACH and M-GEAR protocols. The number of nodes alive is better than both LEACH and M-GEAR in simulation uptil 10000 rounds. The dead nodes vs rounds graph has been shown in figure 4.

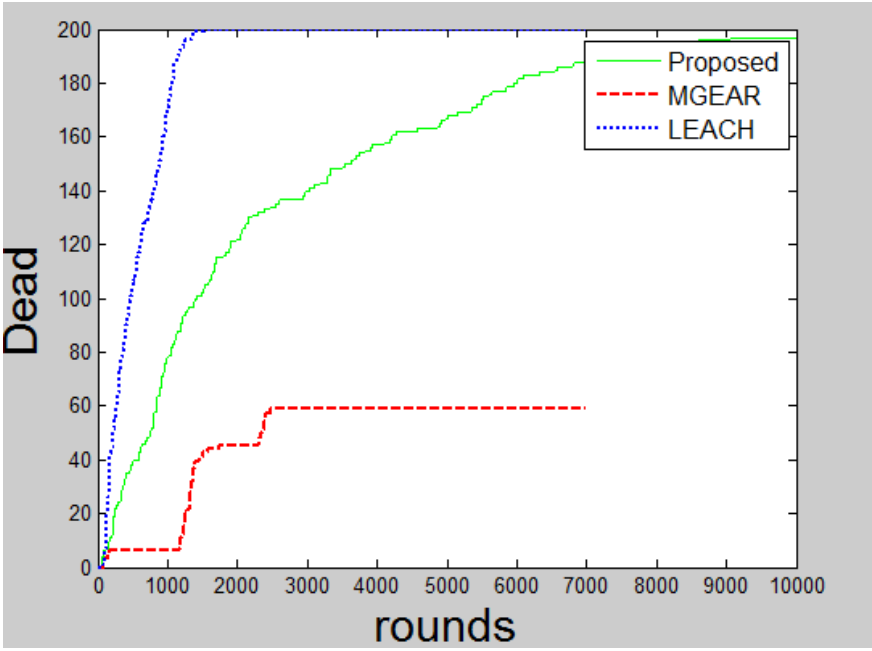

Figure 4: Dead Nodes vs Rounds

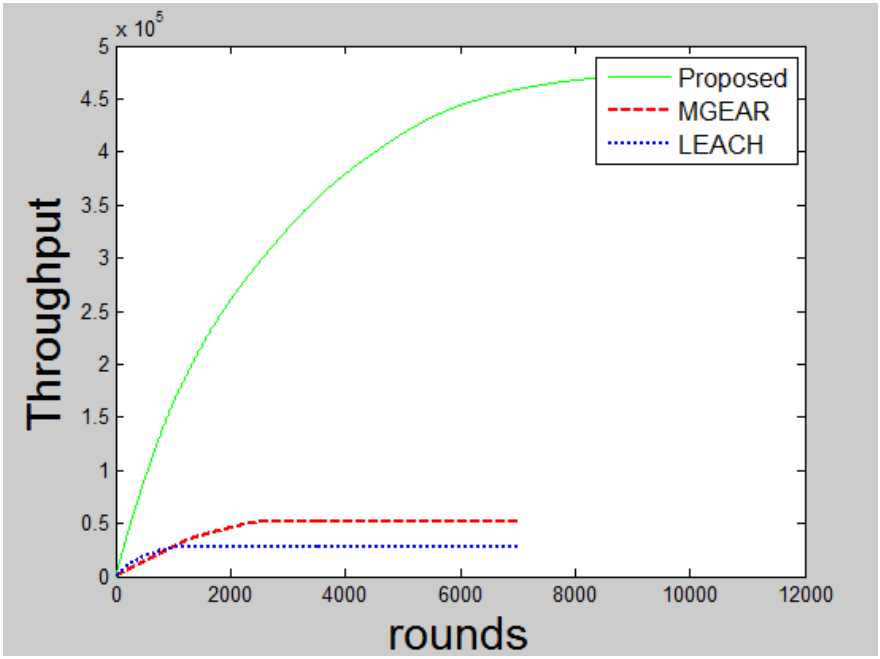

Figure 5: Throughput vs rounds

Figure 5 shows the throughput i.e. number of packets forwarded to the base station form the nodes. The proposed protocol shows better results as compared to other protocols.

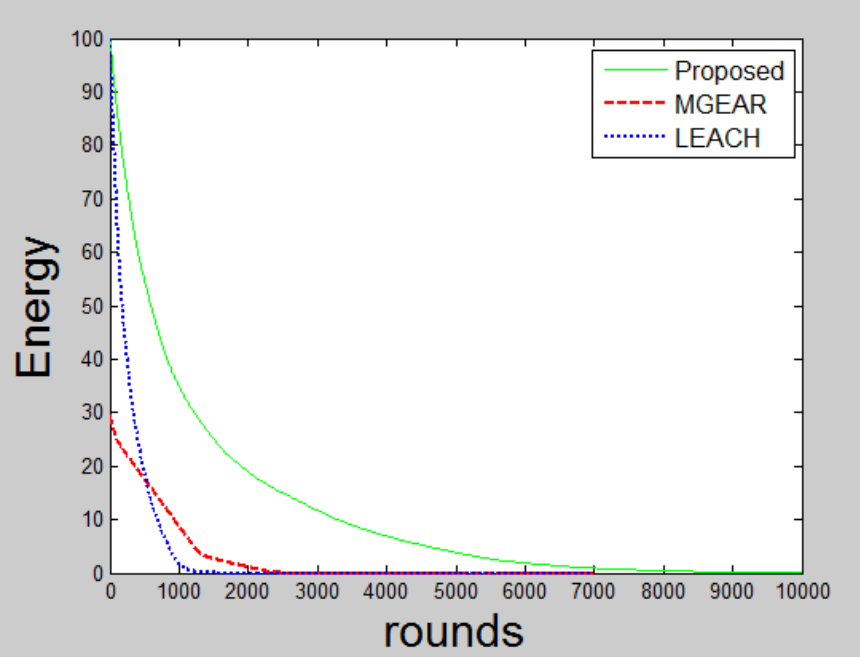

Figure 6: Residual Energy vs rounds

The residual energy graph giving a comparison between the proposed protocol, LEACH protocol and the M-GEAR protocol is shown in the figure 6. As shown in the graph the energy of the networks is increased in the proposed protocol and hence the network lifetime.

V. CONCLUSION

In this paper, a modified approach has been presented for routing problem in wireless sensor network domain. The proposed method is based on the gateway based protocol M-GEAR.

REFERENCES

[1] G. Vijayalakshmi, S. Hema and S. Geethapriya, "Secure Data Aggregation & Query Processing in Wireless Sensor Networks using Enhanced Leach Protocol", International Journal of Emerging Science and Engineering, Vol. 2, No. 1, pp. 51-56, 2013.

[2] M. Umashankar and C. Chandrasekar, "Energy Efficient Secured Data Fusion Assurance Mechanism for Wireless Sensor Networks", European Journal of Scientific Research, Vol. 49, No. 3, pp. 333-339, 2011.

[3] Kumar Padmanabh and Sunil Kumar Vuppala, "An Adaptive Data Aggregation Algorithm in Wireless Sensor Network with Bursty Source", Wireless Sensor Network, Vol. 1, No. 3, pp. 222-232, 2009.

[4] V. Bhoopathy and R. M. S. Parvathi, "Energy Efficient Secure Data Aggregation Protocol for Wireless Sensor Networks", European Journal of Scientific Research, Vol. 50, No. 1, pp. 48-58, 2011.

[5] Vaibhav Pandey, Amarjeet Kaur and Narottam Chand, "A review on data aggregation techniques in wireless sensor network", Journal of Electronic and Electrical Engineering, Vol. 1, No. 2, pp. 1-8, 2010.
[6] Nandini. S. Patil and P. R. Patil, "Data Aggregation in Wireless Sensor Network", IEEE International Conference on Computational Intelligence and Computing Research, 2010.
[7] Kiran Maraiya, Kamal Kant and Nitin Gupta, "Wireless Sensor Network: A Review on Data Aggregation", International Journal of Scientific & Engineering Research, Vol. 2, No. 4, pp. 1-6, 2011.
[8] Sung-Hwa Hong, Jeong-Min Park and Joon-Min Gil, "Performance Evaluation of a Simple Cluster-Based Aggregation and Routing in Wireless Sensor Networks", International Journal of Distributed Sensor Networks, Vol. 2013, Article ID: 501594, pp. 1-9, 2013.
[9] A. Manjeshwar and D. P. Agarwal, "TEEN: a routing protocol for enhanced efficiency in wireless sensor networks," In 1st International Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing, April 2001
[10] A. Manjeshwar and D. P. Agarwal, "APTEEN: A hybrid protocol for efficient routing and comprehensive information retrieval in wireless sensor networks," Parallel and Distributed Processing Symposium., Proceedings International, IPDPS 2002, pp. 195-202.
[11] U. Sajjanhar, P. Mitra, ―Distributive Energy Efficient Adaptive Clustering Protocol for Wireless Sensor Networks‖, Proceedings of the 2007 International Conference on Mobil Data Management, pp. 326 - 330, 2007.
[12] Elbhiri Brahim,Saadane Rachid,Alba-Pages Zamora, Dris Aboutajdine, ―Stochastic Distributed Energy-Efficient Clustering (SDEEC) for heterogeneous wireless sensor networks‖, ICGST-CNIR Journal, Volume 9, Issue 2, December 2009.
[13] Inbo Sim, KoungJin Choi, KoungJin Kwon and Jaiyong Lee,―Energy Efficient Cluster header Selection Algorithm in WIRELESS SENSOR NETWORK‖, International Conference on Complex, Intelligent and Software Intensive Systems , IEEE, 2009.
[14] Ma Chaw Mon Thein, Thandar Thein ―An Energy Efficient Cluster-Head Selection for Wireless Sensor Networks‖, International Conference on Intelligent Systems, Modeling and Simulation, IEEE 2009
[15] Dilip Kumar, Trilok C. Aseri, R.B. Patel, ―EEHC: Energy efficient heterogeneous clustered scheme for WIRELESS SENSOR NETWORKs‖, ELSEVIER, Computer Communications, 32 (2009) 662–667
[16] Yingchi Mao, Zhen Liu, Lili Zhang, Xiaofang Li, ―An Effective Data Gathering Scheme in Heterogeneous Energy WIRELESS SENSOR NETWORKs, International Conference on Computational Science and Engineering,2009.
[17] E.M. Petriu, N.D. Georganas, D.C. Petriu, D. Makrakis, and V.Z. Groza, "Sensor-based information appliances," IEEE Instrumentation and Measurement Magazine (December 2000) 31–35.
[18] G.D. Abowd, J.P.G. Sterbenz, "Final report on the interagency workshop on research issues for smart environments," IEEE Personal Communications (October 2000) 36–40.