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Vertical Handoff Algorithm Based On the Improved Joint Vertical Handover

Liu Guanqun[1], Tan Ping[2] and Lin Zi[3]

[1]*HuNan Radio&TV University, Changsha, 410004, China*
[2]*Central South University, Changsha , 410083, China*
[3]*HuNan Radio&TV University, Changsha, 410004, China*

Abstract

Vertical handoff is the mutual fused result of heterogeneous wireless network.In the process of vertical handoff, switching decision is a very important link which determines handoff function directly. For the increasing sensor network characteristics,in this paper, it will quote heterogeneous networks which consist of WSN and WLAN as samples to analyze present vertical handoff relative algorithms, by analyzing node moving speed to propose relative vertical handoff algorithms. During the selection procedure of target networks, it analyzed the relative factors in detail which affected network selection. As the residence time of mobile terminals is different in various covered area,it brought in concept of speed thresholds and made improvements for selection algorithm of combined vertical handoff network. The simulation result shows that improved selection algorithm of combined vertical handoff network can choose the best network to access according to mobile terminals moving speed.

Keywords: *Index Terms-wireless LAN, vertical handoff, network selection, mobile communication system;*

1. Introduction

With the increasing of large construction facilities in our country, people has become pay more attention to internal safety emergency management for large public constructions. By means of advantages of low cost and power consumption, flexible networking, strong system invulnerability, low dependence for environment etc., WSN has wide application prospect in searching and rescuing, personnel and equipment orientation, on-site environment monitoring, crisis gaining etc., it has become the important component in monitoring warning and emergency commanding system[1].And for Hot-spot accessing WLAN, because of advantages of high-band width, high-capacity etc., it has widely existed in buildings and constructions, WLAN has incomparable advantages in transmitting video information and continuous voice information, but its coverage can't as wide as WSN, signals decaying in edge areas has much more serious influence for communication than WSN[2].Meanwhile, one accessing point of wireless WLAN is invalid, it will lead to WLAN paralysis in certain area, therefore, and it appears the serious problem which some areas can't use WLAN in emergency communication. Interconnection among networks has become one communication way which use resources effectively and inevitable trend, it formed heterogeneous network of mobile communication.

WLAN is another fast developed communication technology. WLAN is based on the agreement of IEEE 802.11 series which is quite convenient data transmission system[3].WLAN is able to provide limit coverage in the coverage area which from dozen meters to few hundred meters. WLAN allows to use non-authorized radio frequency range to carry on wireless connection in local environment. IEEE formulated relative technology criterion for that in 1997,that is IEEE 802.11 norm, this standard is able to

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supply 2Mbps data speed rate. IEEE 802.11b and 802.11a criterion proposed in 1999 made use of 2.4GHz and 5GHz band which provided 11Mbps and 54Mbps data transmission speed rate. IEEE 802.119 criterion can supply 54Mbps data transmission rate in band 2.4 GHz which proposed in 2003.Vertical handoff is the key of heterogeneous wireless network mutual fusion. At present, vertical handoff algorithm mainly aims at WLAN and cellular network, such as WLAN and GPRS,WLAN and CDMA[4-5]etc...As wireless sensor network has large difference with traditional cellular network in signal coverage and strength, working way, function and external disturbance influence etc.,so it is difficult to use present handoff algorithm. It has great value to design a handoff algorithm for future emergency rescue which not only suits wireless sensor network,but also suits WLAN. Based on this, here proposes a vertical handover algorithm on the basis of relative moving speed, this algorithm adopts thought which cost function makes estimation for network, according characteristics of wireless sensor network to choose parameters of priority access, signal quality etc., then to decide if executes handoff to come true switching decision for mobile node self-adaption.

As a new wireless accessing way, WLAN is widely used in some hot areas, such as airport, office building, coffee, hotel and school etc...Although WLAN is able to provide high-speed data transmission service in local areas, it can't apply for special environment like sensor network, such as low power consumption. Meanwhile, wireless communication facilities change rapidly, mobile users have more and more diversified demands for service, people are expecting to use one kind wireless terminal to do many kinds services[6].At this time, to use any kind single wireless communication network can't satisfy users all demands.

Heterogeneous wireless network is a wireless communication system which adopts two or more than two different accessing technologies, to utilize present multiple wireless communication technologies, pass through system mutual fusion way to let multiple systems to learn each other strength, comprehensively develop its own advantages to satisfy demand of future mobile communication service. As all present wireless accessing systems are all overlapped coverage in many areas, so to combine these mutual overlapped and different types wireless accessing systems smartly, utilize multiple-mode terminal intelligent accessing ways to let multiple networks to supply wireless accessing together for mobile users at any time and in anywhere.

In[7]Song proposed vertical handoff concept at the first, and described the hierarchical construction of heterogeneous wireless network. Lower wireless network has the characteristics of high bandwidth and low coverage, such as WLAN network; upper wireless network has the characteristics of low bandwidth and high coverage, such as satellite network and cellular network etc...Lower and upper network fuse, work cooperatively to provide service for mobile terminal in common, that's the important characteristics for next generation heterogeneous wireless network.

As handoff procedure of heterogeneous wireless network happens in networks which adopt different accessing technologies, so vertical handoff only could be a hard handover procedure. Vertical handoff should consider more factors than horizontal handover, the Ping-Pong handoff which occurs in horizontal handover procedure will be more outstanding in the influence of vertical handoff procedure[8-9].

Even though vertical handover has something in common with horizontal handoff, heterogeneous wireless network fuses many wireless networks, it can't adopt horizontal handoff mode and way while switching, need a brand-new vertical handoff way. Presently, the research emphasis of vertical handoff is in framework and agreement design. Present vertical handoff solution is trying to adopt different tier TCP/IP protocol to support mobility. These vertical handoff solutions are divided into different types according proposed TC/IP layer protocol, such as mobile IP protocol of network layer, TCP

movement protocol of transmission layer and SIP protocol of application layer.MIP and SIP protocols are two handoff agreements which are standardized by IETF[10].

Most research proposed vertical handover plans from link layer angle. By using link layer information, it can be obviously reduced handoff delay and failure probability, such as terminal acceptance signal strength and mobile terminal speed etc...

Before target network selection of vertical handoff, it should be got that which factors are related with accessing target network selection. In traditional handover algorithm, it only considers signal intensity and available accessing channels[11].In next generation of heterogeneous wireless network, many new judgment indexes are used with signal intensity to carry on selection for accessing target network.

To compare with homogeneous network handoff, switching between heterogeneous wireless networks not only has differences in accessing technologies, but also in handover reason, accessing network selection, switching control etc...At this time, traditional handoff decision method which adopts to compare signal intensity can't suit vertical handover demand of heterogeneous wireless network.

Theory of multiple attribute decision making developed rapidly in the last century, it originates from simple weighting method[18].Method of multiple attribute decision making is to use each attribute value of each alternative plan to carry on calculation with its relative weight value, and then to compare advantages of each alternative plan to get the best plan. Classic MADM has simple additive weighting, technique for order preference by similarity to ideal solution, multiplicative exponent weighting. In vertical handover making procedure, some judgment indexes can't express by some accurate pictures, but to use characters to express this index weakness and goodness, it's hard to make accurate handoff decision at present; therefore, it should transform inaccurate information to exact figures of fuzzy theory to widely use in vertical handover judgment procedure. In[12]they expresses vertical handoff judgment decision as a fuzzy and multiple attribute judgment procedure according to traditional MADM,to use fuzzy logic thought to handle inaccurate attribute value and users preference of each accessing network.[13]divides fuzzy multiple-attributed judgment decision into two procedures: the first step is to transform fuzzy data into real number; the second step is to use traditional MADM to carry on judgment order for candidate network.[14-15]uses fuzzy theory to handle inaccurate index during the process of vertical handoff making. In[16],the author proposed a flexible, multiple-attributed vertical handoff making algorithm by combining fuzzy theory and Airman neural network forecasts.

In this paper,it will use heterogeneous network framework which consist of WLAN and WSN as research object.Considering the influence of terminal movement speed in heterogeneous wireless network and to make research for handoff trigger and network selection problem.Taking heterogeneous network consists of WSN and WLAN as samples,to study and support vertical handoff program from link layer angle[17].

The main achievements of this paper is analyzed present vertical handoff algorithm,and proposed relative vertical handover algorithm.By mobile terminal to receive original network signal intensity to estimate terminal movement direction and to apply terminal movement direction for vertical handoff triggered process.To consider the residence time of mobile terminal is different in diversified covered accessing network,it makes improvement for selection algorithm of joint vertical handoff network and introduces speed thresholds.It was showed by simulation result;improved selection algorithm of joint vertical handoff network is able to choose the best network to access by terminal movement speed.

2. Vertical Handoff Algorithm of Heterogeneous Wireless Network

The usual selection algorithm of vertical handoff network is the method of constructed cost function,to utilize all kinds of indexes and its weighting constructed cost function,compare each value of accessing network cost function and get the best to access network.Some researchers gave each candidate network cost function,this function considers all kinds of business types demands and all parameters of each candidate network.Other researchers proposed policy-enabled vertical handoff model,which considered the balance between users preference and network different characteristics.Other usual vertical handoff making algorithm,such as using analytic hierarchy process and gray relational analysis to construct model for handoff decision procedure.

AHP divides vertical handoff procedure into many small procedures,and designs relative weighting for each small procedure.GRA makes permutation for each candidate network and chooses the candidate network in highest rank while switching.Based on the optimal resource purpose which gets from each connection,Switching decision according factors of network cost function,stable period etc.to judge if does switching for accessing network.In indoor environment,to consider all aspects,wireless sensor is widely implanted,the constituted wireless sensor network is able to achieve full coverage for certain area basically,and signal of wireless sensor still exists.WLAN coverage is about 30-45m in indoor semi-open space,it could be thought that invalid communication range of WLAN hot spots are all covered in wireless sensor network,and application scene is as figure 1 indicates.

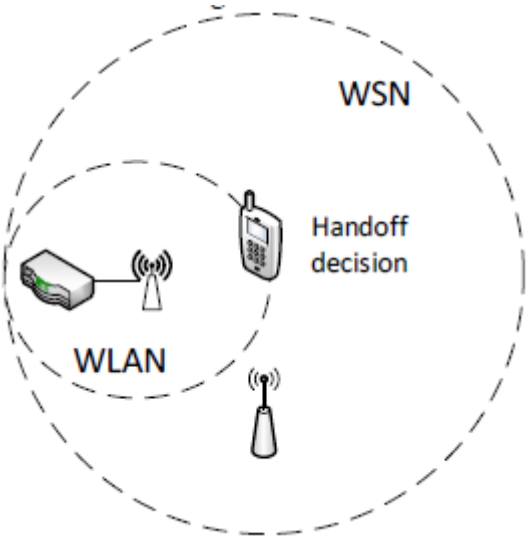

Figure 1. Switching Application Scene

As switching among heterogeneous wireless network happens in the handoff process of different kinds of accessing technology,it makes the obvious difference with traditional homogeneous network.To compare with switching in homogeneous network,switching among heterogeneous wireless network not only has difference in accessing technology,but also in handover reason,accessing network selection,switching control etc..Vertical handoff of WSN should satisfy below three demands:1)A little bit of handover time,to reduce ongoing business interruption probability as far as possible;2)In the procedure of switching,to provide user expected service quality,hope it can achieve zero packet loss;3)The handover failure probability should be quite low.

To satisfy above three demands,to design a reasonable vertical handoff algorithm is a big challenge.This algorithm can improve communication network fitness degree for live

scene change;satisfy the demand of heterogeneous network communication in indoor environment.

In figure 2,it describes the vertical handoff network selection procedure;it is also the research emphasis of this chapter.

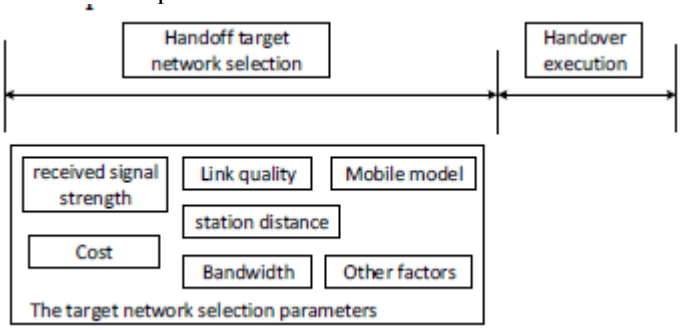

Figure 2. Network Selection Procedure of Vertical Handover

3.Network Parameter Model

As wireless sensor network has characteristics of low power consumption,low speed rate etc.,its node has limit in data collection capacity and transmission capacity,so it is very important to choose suitable network parameter as basis to calculate cost function.Suitable network parameter should not only saves wireless sensor network consumption,extends network overall using time,but also fully reflects network condition,to supply necessary support for handoff making.

In the scene of indoor emergency communication,WLAN mainly to achieve high speed rate,high bandwidth wireless accessing in certain hot spot areas,when power outage or circuit damage occurs,it may cause certain AP coverage that could not access to WLAN,weak invulnerability.As wireless sensor network is widely distributed,basically it can come true all area coverage,even though power outage,several node damage occurs,it will not influence too much for the whole network communication,strong invulnerability,it only supplies wireless communication service of low speed rate,less data volume.On the basis of above analysis,it chose below parameters as network selection basis between WLAN and wireless sensor network.

3.1 Receiving Signal Quality and Communication Time Delay

In WLAN and WSN,receiving signal strength is parameter to detect communication quality;it has feasibility and universality to choose it to express signal quality.To consider the signal collection characteristics and operational capacity of sensor network,this algorithm is mainly according present collected signal strength for signal quality evaluation.

When moving node position does not exist WLAN valid coverage,or it has WLAN wireless coverage,but this LAN AP is not able to connect with wired backbone network,it communication time delay will increase sharply.In addition,emergency reason will also cause communication time delay increasing of WLAN or wireless sensor network.Communication time delay parameter could guarantee emergency communication data to send without delay.

3.2 Network Selection Priority

Data throughput rate;it is important basis to judge transmission speed rate.When it needs to send video and other large volume data,its weighting value should increase respectively.Besides above three normal parameters,this algorithm according different

application scene to set a special parameter which is network selection priority for vertical handoff between WLAN and wireless sensor network in different condition.For example,when emergency rescue needs to know live situation or contacts with first rescue workers,it asks WLAN to provide high transmission speed rate,high communication bandwidth,low time delay service,at the moment,WLAN will get higher priority than WSN;When it requires to provide all area coverage,reliable transmission service,WSN priority will be higher.The priority change is as figure 3 shows.

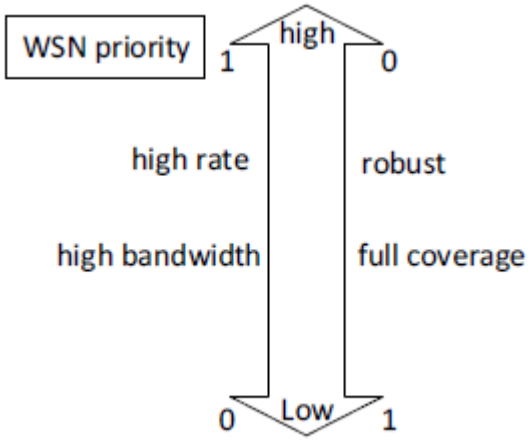

Figure 3. Heterogeneous Network Priority

4. The Proposed Improved Algorithm for Joint Vertical Handoff Network Selection

In the heterogeneous network environment which consists of WLAN and WSN network,as figure 4 shows.As these two coverage square is different,it leads to residence time of mobile terminal is different in each network.

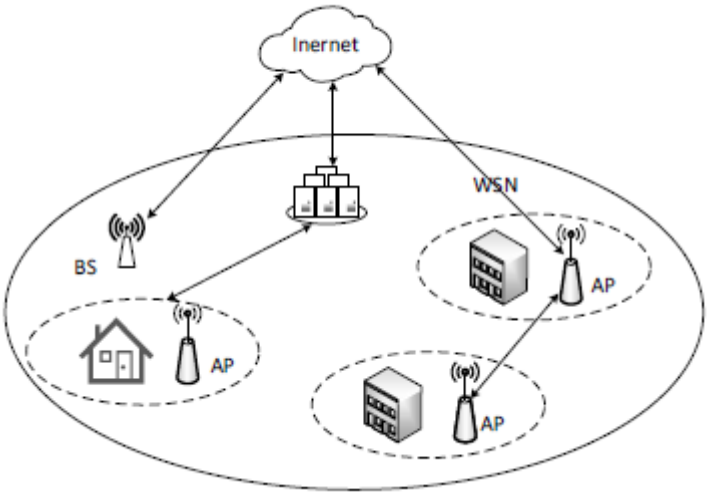

Figure 4. The Heterogeneous Network Environment of WLAN and WSN Networks

The influence in detail is analyzed which terminal movement speed for selection performance of vertical handoff network.We consider the mobile terminal movement speed influence for vertical handoff and proposed respectively vertical handoff algorithm.By analysis for receiving signal in this algorithm and utilizing STFT to get

evaluation value of mobile terminal speed and average receiving power rate,and applying the evaluation value in this algorithm.It utilizes the proposed method in 3Gpp to estimate terminal moving position,and to put terminal movement position into this algorithm.Considering users position and terminal movement speed,we utilizes terminal position information to design a new vertical handover algorithm on the basis of dynamical information,it has improved users satisfaction.

But as residence time of mobile terminal is different in different coverage network,terminal with low movement speed rate which accesses to less coverage network,on the contrary,terminal with high movement speed rate accesses to large coverage network.Although it uses terminal movement speed,it does not define well for high and low speed mobile terminal,will cause unnecessary handoff for mobile terminal,and increase terminal handoff frequency and system burden.

According to WSN and WLAN network combine constructed,to design handoff decision function entity,its main function is to pass through controlling network condition and other parameters to produce network vertical handoff decision,and choose correct handoff target.HDF is the control unit which carries on cost calculation of vertical handoff in appointed time,for different network condition,it has different cost function.The cost function of candidate network is less,then the network condition is better,that means the candidate network in low cost function value is the primary accessing network.

To assume WpS is network 1,WLAN is network 2,to constitute cost function:

$$\rho_n = w_b \ln\left(\frac{1}{B_n}\right) + w_r \ln\left(\frac{1}{R_n}\right) + w_a \ln\left(\frac{1}{T_n}\right) \tag{1}$$

In above formula, $w_b + w_r + w_a = 1$; n Represents available network numbers; B_n R_n is bandwidth factor to evaluate network signal bandwidth; R_n is terminal receiving signal strength factor; T_{l_n} are users application satisfied factor,to decrease speed rate according to present receiving signal strength and average signal strength,to satisfy user required time of duration which apply for QoS:

$$\frac{1}{T_{l_n}} = \frac{R_n - \phi}{D_{R_n}} \tag{2}$$

In above formula,represents signal strength decreasing average speed rate of available accessing network n ; ϕ represents certain application QoS requirement,it deals with channel bit error rate and application error recovery,and needs satisfaction estimation which receiving signal strength level to satisfy this requirement.To choose the least value of cost function as candidate network,that is $\rho = \min\{\rho_1, \rho_2\}$, as the most optimal handoff target.Where, ρ_1 represents cost function of WSN; ρ_2 represents cost function of WLAN;It constituted cost function to carry on vertical handoff network selection,but it did not consider the terminal movement speed influence for network selection,and in the vertical handoff process of heterogeneous wireless network,people all expect users of static or low speed mobile terminal handoff to access to low coverage communication network in normal service and with certain users satisfaction,and high speed mobile terminal handoff to access to high coverage communication network in regular service and with certain users satisfaction,in this case,it not only can guarantee terminal get satisfied service,but also effectively reduce terminal handoff times,and then to decrease mobile terminal power consumption,system burden.

In the process of joint vertical handoff decision,to use negative log function to normalize factors which are relatively beneficial for mobile terminal communication,to use positive log function to normalize factors which are relatively beneficial for mobile terminal communication.To consider the influence which terminal movement speed for

vertical performance,to carry on improvement for selection algorithm of joint vertical handoff network,it was introduced a speed threshold K in the procedure of vertical handoff decision.

For WLAN network,speed of mobile terminal is relative a less benefit factor.So in the process of vertical handoff,performance decision function of WLAN network(HDF)is:

$$p_{WLAN} = w_b \ln\left(\frac{1}{B_{wLAN}}\right) + w_r \ln\left(\frac{1}{R_{wLAN}}\right) + w_a \ln\left(\frac{1}{T_{L_{WLAN}}}\right) + \alpha \ln\left(\frac{\bar{k}_i}{K}\right) \quad (3)$$

For WSN network,mobile terminal speed is relative beneficial factor.As considering terminal movement speed,average decreasing speed rate of available network signal strength D_{R_n} has different value according to different movement speed of terminal K:

$$D_{R_n} = \left|\frac{(p_t - p_{t+\Delta t})k}{d_t - d_{i+\Delta t}}\right| \quad (4)$$

So in the vertical handoff procedure,performance decision function of WSN network is:

$$\rho_{WLAN} = w_b \ln\left(\frac{1}{B_{WSN}}\right) + w_r \ln\left(\frac{1}{R_{WSN}}\right) + w_a \ln\left(\frac{1}{T_{L_{\mathrm{var}}N}}\right) + \alpha \ln\left(\frac{K}{\bar{k}_i}\right) \quad (5)$$

Where, $w_b + w_r + w_a = 1, k_i$ is the average speed of mobile terminal which in the end of last decision and at the beginning of next decision,a is speed weighting factor which greater than 1,RWLAN is the signal strength which mobile terminal got from WLAN.

$$R_{WLAN} = P_{T-AP} \ln\left(\frac{1}{2\pi d_A / \lambda}\right)^2 + P(\mu, \sigma) dbm \quad (6)$$

R_{WSN} is the signal strength which WSN sent to mobile terminal,it can adopt path damage model in the same way,and consider shadow fading influence for signal strength,represents the function which distance between mobile terminal and node point AP of WSN:

$$R_{WSN} = P_{T-B} \ln\left(\frac{1}{2\pi d_B / \lambda}\right)^2 + \rho(\mu, \sigma) dBm \quad (7)$$

In above two formulas, p_{T-AP} is transmitted power of accessing point AP of WLAN, p_{B-AP} is transmitted power of node point B of WSN, λ is the wave length of radio wave, $\rho(\mu, \sigma)$ is zero average value,represents shadow fading.

To solve Ping-Pong problem in vertical handoff,it adopts that to assume a stable period to postpone moving node to execute handoff time.Stable period can be calculated by below formula:

$$T_s = \zeta_{Handoff} + \zeta_{Handoff} / (\varepsilon^{C_{hCNCr}} - 1) \quad (8)$$

In formula, $\zeta_{Handoff}$ is the link delay of present optimal accessing network; C_{hCNCr} is the cost function value of optimal accessing network.It is present network cost function value.Figure 4 is a flow chart of vertical handoff algorithm.On the basis of above analysis,when moving node finds the optimal handoff network by passing calculated cost function,handoff decision model saves present cost function value at the first,and according formula(8)to calculate stable period TS;And then start calculation of interior model,when model period finishes,node calculates cost function value of present optimal handoff network,and to compare with beginning cost function value,if deviation value is

beyond C_r ,then it was thought target network has weak stability and did not execute handoff,or carry on handoff.

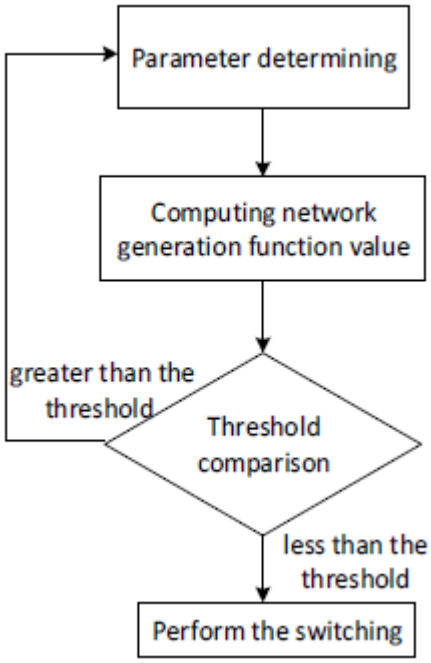

Figure 5. The Procedure of Vertical Handoff Algorithm

5. Simulation Result

The experiment carried on in indoor area with WLAN coverage,set 30 sensor nodes in the site before test,the distance was 15m for each double bounce,evaluated scene model as figure 6 indicates.

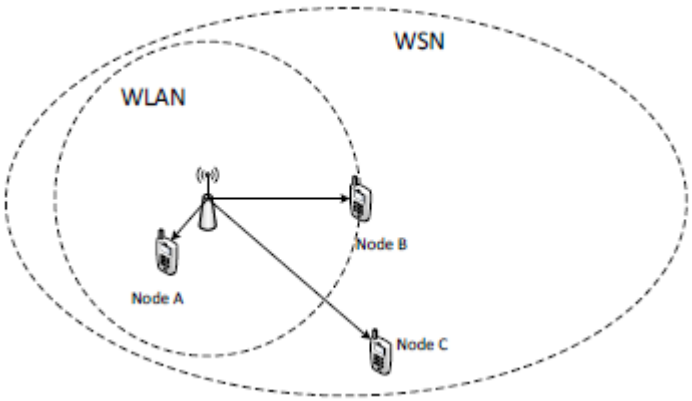

Figure 6. Test Evaluated Environment

In the constructed performance estimation model,to assume that mobile terminal is averagely attributed in WLAN and WSN,and when vertical handoff network carries on selecting,mobile terminal can get the signal both WSN and WLAN send respectively.In vertical handoff process of heterogeneous network,according to changes of mobile terminal movement speed,it evaluated the probability which mobile terminal choose to access WSN after handoff decision;simulation parameter is as Table 1.

Table 1. The Simulation Network Model Parameters

Parameter	Value
WSN transmit power	5mW
WLAN transmit power	150mW
WSN bandwidth factor	0.5 Mbps
WLAN bandwidth factor	5 Mbps
Bandwidth of weight factor	3
Signal strength weighting factor	0.3
The signal wavelength	0.8m
Velocity weighting factor a	3
The velocity threshold K	100m/s
User satisfaction weighted factor	0.25
The number of nodes	16
The communication rate	500 Kb/s
Transmit power	4 dBm

Moving node shuttlecocks in speed 1 m/s in the scene,to access and departure valid WLAN coverage continuously.In the simulation,it takes communication signal quality,communication delay,priority as referential index of vertical handoff,to set WSN sensor numbers in 20,node time delay of single bounce is 0.2,signal strength parameter is 0.1,throughput rate parameter is 0.1;To set a AP of WLAN,coverage is 30m,communication time delay parameter is 0.2,signal strength parameter is $0.02 \times 20/(20-d_A)$,throughput rate parameter is 0.002;to set signal strength threshold value is 0.5,threshold value of communication time delay is 0.5,throughput rate threshold value is 0.2;the other two priorities set as 1,the algorithm chooses the least cost function network as target,then it adopts proposed algorithm in this chapter to carry on simulation.

As WLAN network coverage for short distance and hot spot areas,these areas normally are in complicated environment,receiving signal strength are influenced too much by shadow fading.Shadow fading obeys logarithm Gaussian distribution.Therefore,to add shadow fading which average value is 0,variance is 8 in simulation procedure.

In figure 7,it gives terminal triggered handoff probability which adopts different handoff triggered mechanism.We can see that from the figure,the probability is about 0.4-0.8 which adopts selection algorithm of traditional joint vertical handoff network.And after adopting proposed improved selection algorithm of vertical handoff,the probability value fluctuates from 0.3-0.5 with the alternation of movement speed,when terminal movement speed is greater than 30 m/s,terminal triggered handoff probability is less 0.5 basically,it has an obvious advantage than selection algorithm of traditional joint vertical handoff network.

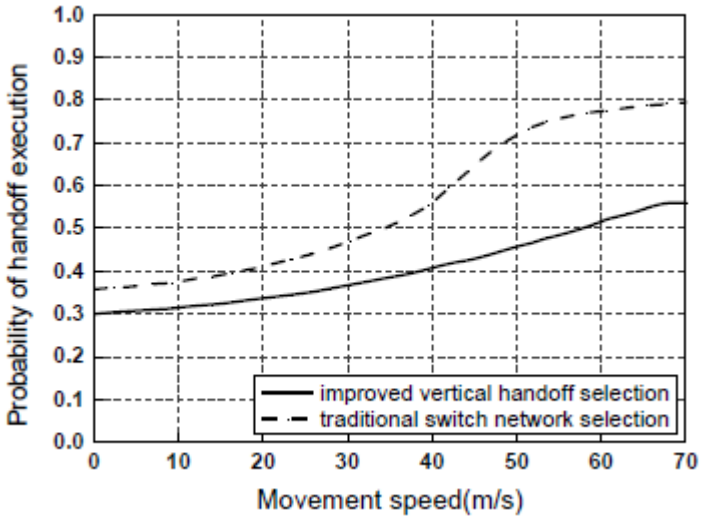

Figure 7. Terminal Handover Probability using Different Handoff Trigger Mechanism

In figure 8,it gives terminal packet loss probability which adopts different handoff triggered mechanism,it can be seen that packet loss probability traditional joint vertical handoff network selection algorithm is zero when terminal movement speed is less 10m/s,with the increasing of terminal movement speed,the packet loss probability raises sharply.The packet loss probability of QoS handoff triggered mechanism is zero when terminal movement speed is less than 20 m/s,it raises with the increasing of terminal movement speed,when terminal movement speed is 60m/s,the largest packet loss probability is 0.4.When it adopts self-adapted incremental quantity handoff triggered mechanism,terminal movement speed is less than 30 m/s,the terminal packet loss probability is zero,when terminal movement speed is greater than 30 m/s,with the increasing of terminal movement speed,then the packet loss probability increases,while terminal movement speed is up to 70 m/s,packet loss probability is 0.4 while handoff.It can be seen from the simulation result,in the aspects to reduce terminal triggered handoff probability and decrease packet loss probability in handoff process;the proposed improved selection algorithm is obvious better than selection algorithm of traditional joint vertical handoff network and vertical handoff network in this chapter.

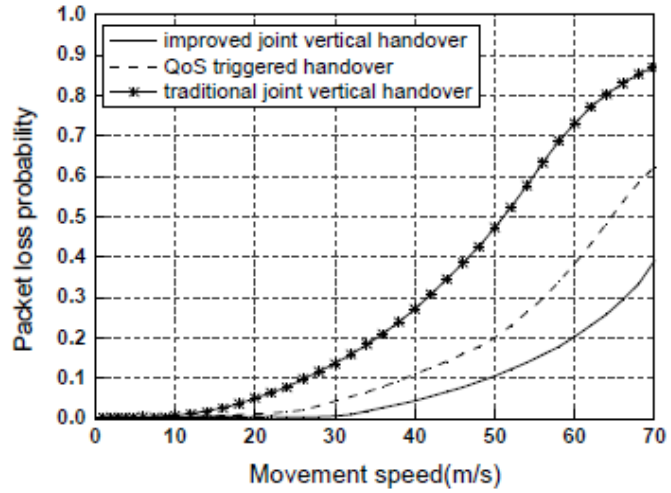

Figure 8. Terminal Packet Loss Probability using Different Handoff Trigger Mechanism

As figure 9 shows,the probability is about 0.2 which original vertical handoff algorithm switches to WSN in the different movement speed of mobile terminal,the probability is more large which heterogeneous handoff switches to WLAN network,It will lead to mobile terminal in high speed movement switch frequently in heterogeneous network.It can be seen in figure 9 that the probability is obvious greater that vertical handoff decision algorithm which considering movement speed in the condition of low speed movement,and with the increasing of terminal movement,the probability gradually increase while switching to WSN.To compare with original vertical handoff decision algorithm,the vertical handoff decision algorithm which considers terminal movement speed can effectively reduce the network burden which terminal causes in high speed movement.

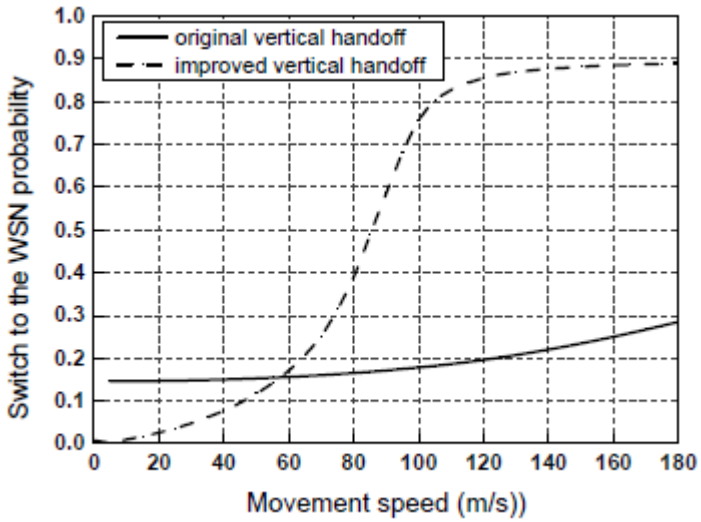

Figure 9. The Comparison Result to the Original Algorithm

In figure 10,it can be seen that if speed handoff thresholds great,the WSN probability alteration is slow in the heterogeneous handoff decision process,to make mobile terminal can carry on seamlessly switching and the heterogeneous network burden is low,speed threshold K should get a suitable value.

The simulation in figure 9,speed weighting factor value is 3,speed threshold value is 100 m/s,it is not the optimal selection for vertical handoff,but whatever value of speed weighting factor and speed threshold are,it don't influence too much for figure 9.About the optimal value problem of speed weighting factor and speed threshold K,it needs to carry on reasonable evaluating according to terminal different business.

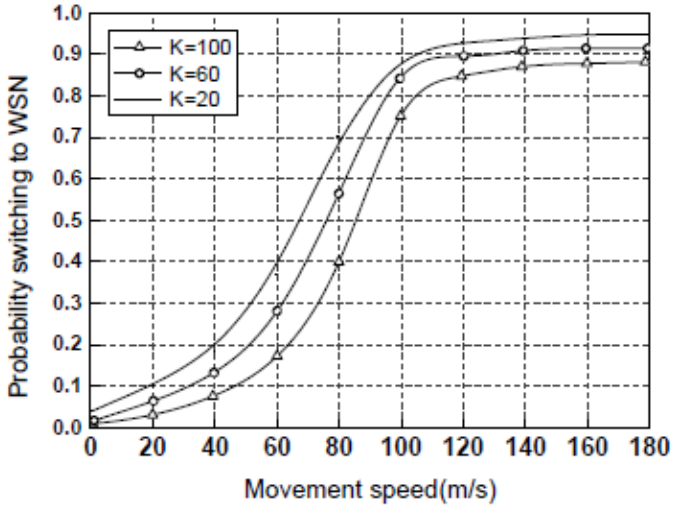

Figure 10. Comparison Results with Different Threshold

6. Conclusion

First of all,it analyzed several necessary factors in vertical handoff network selection process,and got that network selection procedure of vertical handoff is a multiple-attributed decision procedure,simply introduced several normal multiple-attributed decision methods.Next,it introduces network selection algorithm of joint vertical handoff,practical requirement for emergency communication in heterogeneous network environment.And then it considered that if terminal movement speed was different,the residence time in different type accessing network is diversified,to reduce unnecessary switching,it quoted the concept of speed threshold value,and made improvement for present joint vertical handoff network selection algorithm,proposed a self-adapted vertical handoff algorithm which on the basis of WSN and WLAN.The simulation result showed that this algorithm can effectively satisfy wireless communication QoS requirements while rescuing emergently in indoor environment,strengthen the adaption which heterogeneous wireless communication network for environment change.Improved algorithm is able to reasonably choose the optimal candidate network to access according to terminal movement speed.

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References

[1] A. Bletsas, A. Khisti, D. R. Reed and A. Lippman,“A simple cooperative diversity method based on network path selection”, IEEE Sel. Areas Commun.,vol.24, no.3, **(2006)**, pp.659-672.
[2] E. C. van der Meulen, “A survey of multi—way channels in information theory:1961-1976”, IEEE Trans.Inf.Theory, vol.23, no.1, **(1977)**, pp.1-37.
[3] H. Guo and J. H. Ge, “Outage probability of two way opportunistic amplify and forward relaying”, Electron.Lett., vol.46, no.13, **(2010)**, pp.918-919.
[4] J. Li, X. Cai, J. Yang and L. Zhu, “Scalable Cluster-based Routing in Large Wireless Sensor Networks”, Journal of Networks, vol.7, no.12, **(2012)**, pp.1990-1995.
[5] C. Xu, “Application of Multi-information Fusion Positioning Technology in Robot Positioning System”, Journal of Multimedia, vol.9, no.3, **(2014)**, pp.271-280.

[6] L. Song, G. Hong, B. Jiao and M. Debbah, “Joint relay selection and analog network coding using differential modulation in two-way relay channels”, IEEE Trans.Veh.Technol., vol.59, no.6, **(2010)**, pp.2932-2939.
[7] M. G. Adian and H. Aghaeinia, "Optimal resource allocation for opportunistic spectrum access in multiple-input multiple-output-orthogonal frequency division multiplexing based cooperative cognitive radio networks", Iet Signal Processing, vol.7, no.7, **(2013)**, pp.549-557.
[8] H. Ding, J. Ge and D. B. da Costa, "Opportunistic role selection for two-user amplify-and-forward relaying systems", Ieee Transactions on Vehicular Technology, vol.62, no.7, **(2013)**, pp.3039-3061.
[9] M.S.Gokturk,O.Gurbuz and E.Erkip,"A cross-layer multi-hop cooperative network architecture for wireless ad hoc networks,"Computer Networks,vol.57,no.18,pp.4010-4029,Dec.2013.
[10] Y. Gu, S. S. Ikki and S. Aissa, "Opportunistic cooperative communication in the presence of co-channel interferences and outdated channel information", IEEE Communications Letters, vol.17, no.10,**(2013)**, pp.1948-1951.
[11] S. Al-Ahmadi, "Asymptotic capacity of opportunistic scheduling over gamma-gamma(generalised-k)composite fading channels", Iet Communications, vol.6, no.18, **(2012)**, pp.3231-3237.
[12] B. Hagelstein, M. Abolhasan, D. Franklin and F. Safaei, "Improving fairness in IEEE 802.11 networks using mac layer opportunistic retransmission", Computer Networks, vol.57, no.17, **(2013)**, pp.3410-3427.
[13] T. T. Duy and H. Y. Kong, "Exact outage probability of cognitive two-way relaying scheme with opportunistic relay selection under interference constraint", let Communications, vol.6, no.16, **(2012)**, pp.2750-2759.
[14] H. jung and M. A. Weitnauer, "Multi-packet interference in opportunistic large array broadcasts over disk networks", IEEE Transactions on Wireless Communications, vol.12, no.11, **(2013)**, pp.5631-5645.
[15] K. Stamatiou, D. Chiarotto, F. Librino and M. Zorzi, "performance analysis of an opportunistic relay selection protocol for multi-hop networks", Ieee Communications Letters, vol.16, no.11, **(2012)**, pp.1752-1755.
[16] M. F. Kader, Asaduzzaman and M. M. Hoque, "Hybrid spectrum sharing with cooperative secondary user selection in cognitive radio networks", Ksii Transactions on Internet And Information Systems, vol.7, no.9, **(2013)**, pp.2081-2100.
[17] E. S. Hassan, “Energy-efficient hybrid opportunistic cooperative protocol for single-carrier frequency division multiple access-based networks”, let Communications, vol.6, no.16, **(2012)**, pp.2602-2612.
[18] Y. Geng, J. Chen, K. Pahlavan, “Motion detection using RF signals for the first responder in emergency operations:A PHASER project”, 2013 IEEE 24nd International Symposium on personal Indoor and Mobile Radio Communications(PIMRC), **(2013)**; London, Britain.

Authors

LIU Guanqun, she was born in Changsha, Hunan province china ,in 1981. She holds the Master’ degree in Software Engineering from University of Electronic Science and Technology . She mainly studies in the fields of software technology and communication technology. She is on the faculty at the Department of Information Engineering of the Hunan Radio&TV University which is located in Changsha, Hunan province, where she served as a lecturer and an engineer.

