

WiMax

*

WAN: Wide Area Network (Personal and Local Area Networks (PANs and LANs))
 QoS: (Quality of Service) (Area Networks)
 (backbone)

(Broadband)
 (IEEE 802.16e) (Worldwide Interoperability for Microwave Access) WiMax
 (Point-to-Point) (mobility)

(Hotspots) (Point-to-Multipoint)
 (Wi-Fi: Wireless Fidelity)

(Hotzone) WiMax
 (BSs : Base Stations) (data rate)
 .WiMax

()

(Handover procedure)

Wi-fi Wi Max :

*

:(Introduction) -1

(stations : ST As) ()

(SNR: Signal-to-Noise Ratio)

.[1]

()

(11 6 1)

(13 7 1)

((IEEE 802.11 b, g)

Infrastructure) (WLAN)

APs : Access) (mode

WiMax (Points

WiMax) (

WiMax .

(resource utilization) (ADSL : Asymmetric Digital Subscriber Line)

.WiMax

[2]

WiMax () :

LBA : Load Balancing)

(Algorithm

(MAC layer)

[3] :(Related work) -2

(IEEE 802.11e) (a, b, g) (IEEE 802.11)

(handover procedure))

: WiMax (

(BS) .(

()

()

:(Proposed system model) -3

(1) (BSs)

(re-use frequency) :

cluster)

(sectorisation

(DS: Distribution System))

(()

:

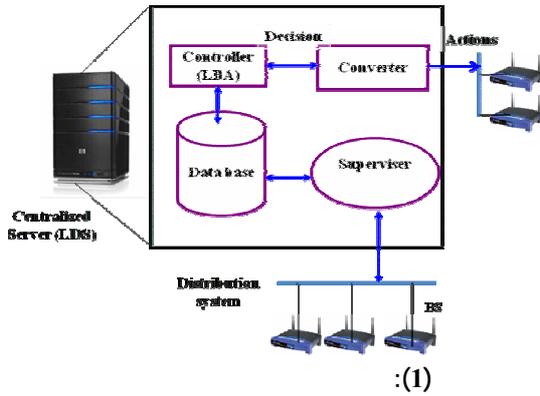
(supervisor) ○

) :

) (PHY layer)

.(... ((mesh mode) .(MAC layer)

(database) ○



(controller) ○

()

(converter) ○

(signaling)

(distributed system)

centralized)

(system

.(1)

)

(

Load Balancing)

-4

:(Algorithm : LBA

(error tolerance)

(T_i)

(traffic)

back-)

(T_{STA_j})

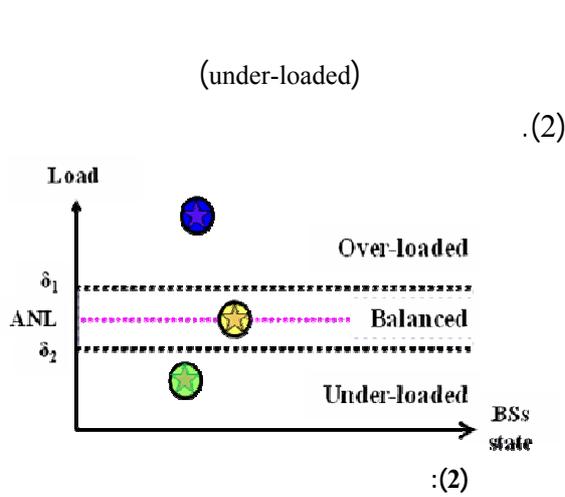
(standby)

(up server

$$T_i = \sum_{j=1}^m T_{STA_j} \quad (m)$$

(balance index)

: (β)



$$\beta = \frac{\left(\sum_{i=1}^n T_i \right)^2}{n \times \sum_{i=1}^n T_i^2}$$

(n) (i) (T_i)

()

.β

: β ∈ [1/n, 1]

T₁=T₂= ... T_n=T :

(n=3)

ANL : Average Network)

(Load

$$\beta = \frac{(T_1 + T_2 + T_3)^2}{n \times (T_1^2 + T_2^2 + T_3^2)} = \frac{(3T)^2}{3 \times 3T^2} = 1$$

(T₁>>T₂ and T₁>>T₃)

(i) ANL = (T₁ + T₂ + ...T_i)/i

(T₁) (T₃ T₂)

(α) δ₁ = ANL + α × ANL
(tolerance parameter)

$$\beta = \frac{(T_1 + T_2 + T_3)^2}{n \times (T_1^2 + T_2^2 + T_3^2)} = \frac{(T_1)^2}{n \times T_1^2} = \frac{1}{n} = \frac{1}{3}$$

β

(α) .(β=1)

(α)

(handover processes) (transfer policy)
(BS state (status))

((over-loaded) ()

(BC)

$$\delta_2 = ANL - \alpha \times ANL$$

distribution)

(policy

(new user)

(ping-pong phenomena)

)

(transferring station)

.(

(β_{new})

balanced)

(serving BS)

(BS

(target BS)

($\beta_{new} > \beta_{old}$)

.()

selection)

(policy

:(Results Analysis)

5

)

.(

(BC : Best Candidate)

WiMax

:

(3)

WiMax

$$\Delta = T_{BS} - ANL$$

$$BC_j = |T_{BC_j} - \Delta|$$

Z₁,)

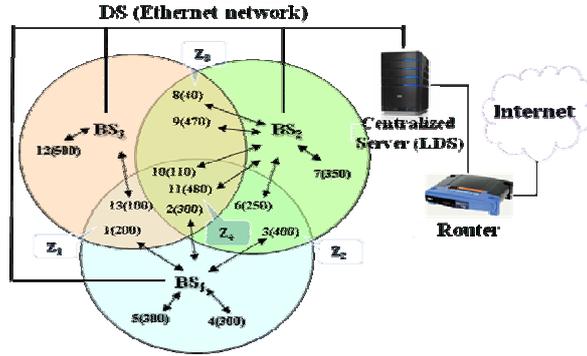
(Z₂, Z₃, Z₄

.(Kbps)

()

(j)

(worst zone approach)



:(3)

:(Enumerative approach) ()

.(β

)

)

.(

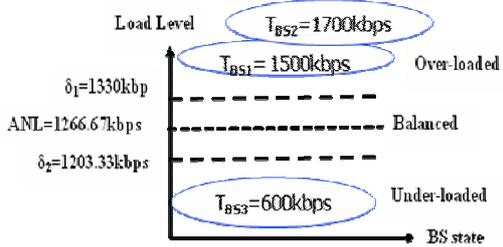
(α= 5%)

)

(

(4)

:(approach by zone)



:(4)

(common zone approach)

()

.(Z₄)

(BS₂) :
 (BS₁) ((β=β₄))
 (σ_T)
 (BS₁) :
 (STA2) (BS₃)
 ()

$$\sigma_T = \sqrt{\frac{(T_{BS1} - AN)^2 + (T_{BS2} - AN)^2 + \dots + (T_{BSn} - AN)^2}{n-1}}$$
 () (n)
 (β)
) (σ_T) ()
)
 : (2) ()
 : (2)

β	σ _T
0,981	213,85
0.9992 > 0.9959	41.63 < 98.65

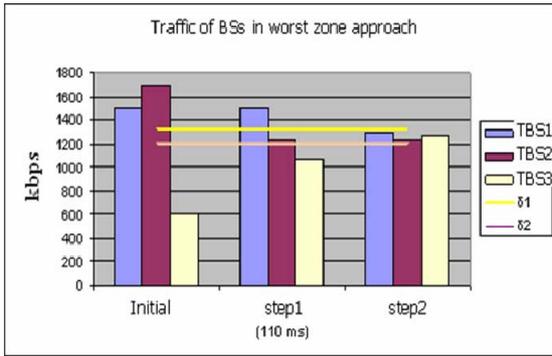
(STA₁₁)
 (BS₃) (BS₂)
 (BS₃) (BS₁) (STA₁)
 : (1)
 ((resource utilization))

(σ_T, β)

:(1)

T _{BS1}	T _{BS2}	T _{BS3}	β	σ _T
1500	1700	600	0.875	585.94
1500	1220	1080	0.981	213.85
1200	1220	1380	0.9959	98.65

(BS₁, BS₂)
 (BS₃) (BS₂)
 (β) (3)
) (Z₃)
 (STA8, STA9) ()
 (STA9) .(BS₃) (BS₂)
 .STA10, STA11 :
 (BS₃)
 (Z₁) β .(STA11)
 .(BS₃)



(5)

β (6)

(σ_T)

(7)

(8)

(σ_β) β

(BS₃) (STA1)

(σ_T, β)

β

()

β

β

β

β

β

β

β

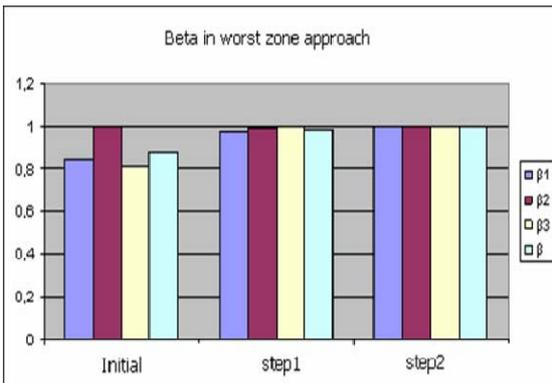
(3)

β	σ_T
0.981	217.33
0.99948 > 0.9959	35.11 (Minimum)

β

β

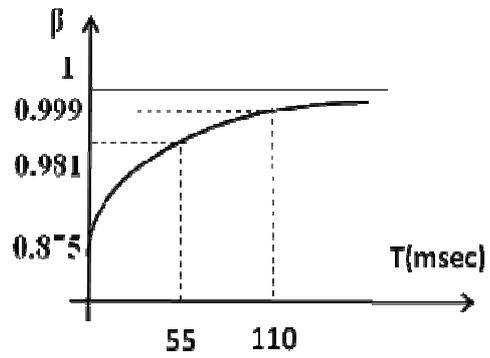
(5)



6

The effect of LBA on the real-time)
 :(applications

.(QoS constraints)



β :(6)

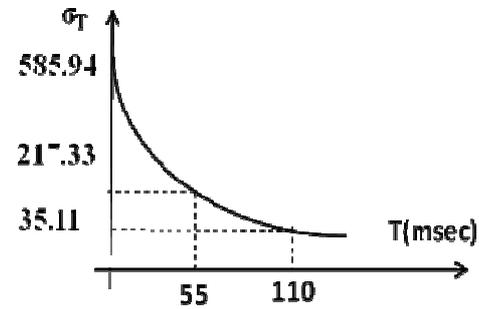
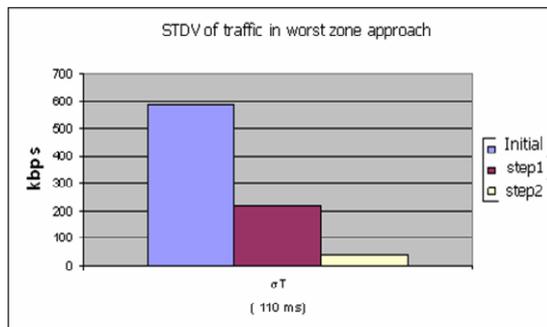
(VoIP: Voice over IP)
 .(Video streaming)

)

(

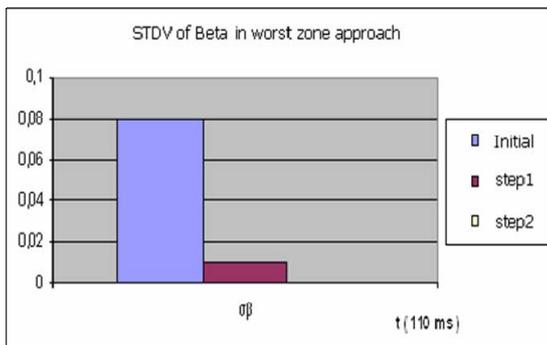
(VoIP)

()



:(7)

β



β :(8)

(α)

()

(α)

(δ_2 δ_1)

[14] [13] [12]

(VoIP)

[60kbps, 120kbps]

(.25ms)

(α)

(120kbps)

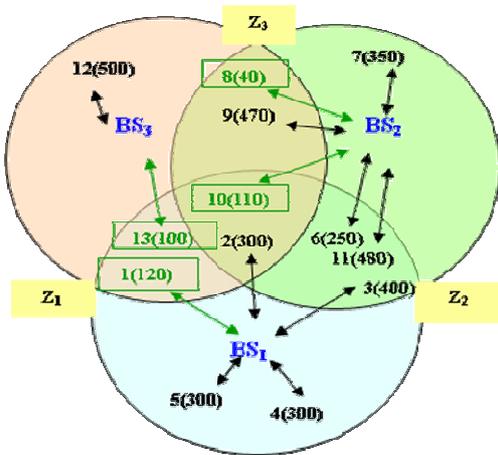
(VoIP)

(α)

(13, 10, 8, 1)

[5%-15%]

(.9)



(congestion)

VoIP

: (9)

(α)

(4)

(STA9)

(BS3)

(STA2)

(BS3)

$$TBS_{(overloaded)} = \alpha_{critical} ANL + ANL;$$

$$\alpha_{critical} = (TBS_{(overloaded)} - ANL) / ANL$$

:(5)

T_{BS1}	T_{BS2}	T_{BS3}	β	σ_T
1420	1700	600	0.875	571.66
1420	1660	640	0.890	533.29

(Z₃)

(STA9)

.(3))

.(STA₈))
(

(Z₁)

adaptable)

(STA₁)

(applications

(Z₄)

(STA₂)

(Z₂)

(1, 2, 9, 10)

.(α=10%)

Conclusion and)

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:(future work

ANL=1240kbps, δ₁ = 1364kbps, δ₂ = 1116 kbps

(5)

: -8

AP	Access Point
ADSL	Asymmetric Digital Subscriber Line
BS	Base Station
DSM	Design Structure Matrix
DS	Distribution System
LBA	Load Balancing Algorithm
LDS	Load Distribution System
QoS	Quality of Service
SNR	Signal-to-Noise Ratio
Wi-fi	Wireless Fidelity
WiMax	Worldwide Interoperability for Microwave Access

new)

(users

()

.(transferring users)

)

.(

WiMax

(mesh mode)

WiMax

(relay/bridge)

(best routing)

(switches)

(DSM : Design Structure Matrix)

WiMax

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