Protection and Guarantee for voice and video traffic in IEEE 802.11e wireless LANs

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Outline

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- The second–level protection and guarantee
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Introduction

- The IEEE 802.11e standard provides QoS feature support to the existing 802.11b
- Hybrid Coordination Function (HCF)
  - Referred to as Enhanced Distribution Coordination Function (EDCF)
  - EDCF provides a priority scheme for difference service
- Without a good control mechanism and a good protection mechanism for QoS requirements

Introduction

- In this paper , we propose a two-level protection and guarantee mechanism for QoS traffic
- First level
  - Tried and known
  - Early protection
- Second level
  - Dynamic control EDCF channel parameter

Related work

- The contention based channel access is referred to Enhanced Distributed Coordination Function (EDCF)
  - Channel utilization calculated during each beacon
  - Available/residual budgets are calculated
  - The EDCF works with four Access Categories (AC)
  - EDCF supports eight different priorities

Related work

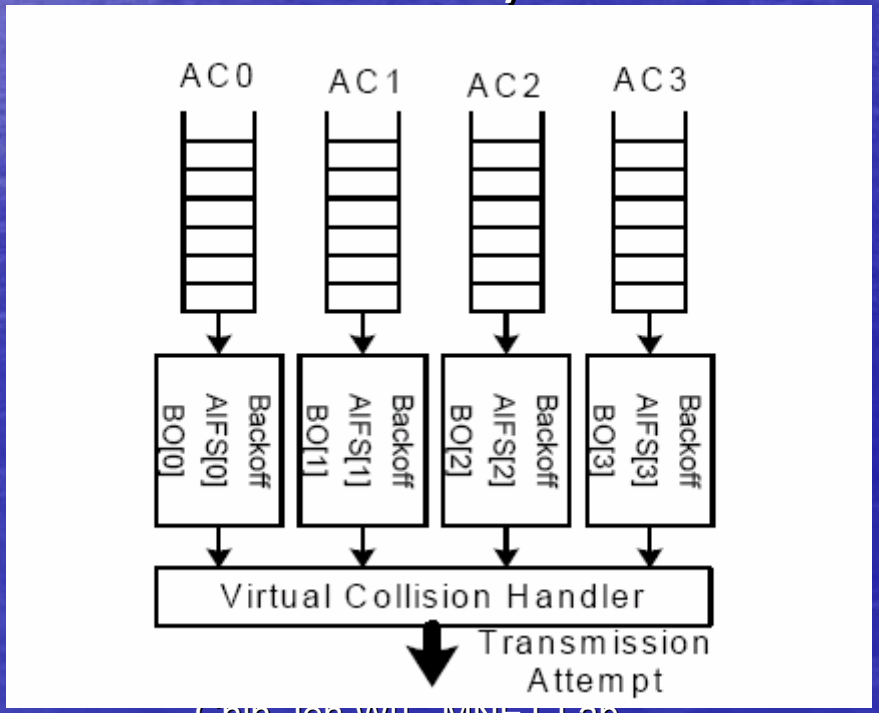
- EDCF priority table
  - The payload from a higher layer is labeled with a priority value

TABLE 1
PRIORITY TO ACCESS CATEGORY MAPPING

PRIORITY	AC	DESIGNATION
1	0	BEST EFFORT
2	0	BEST EFFORT
0	0	BEST EFFORT
3	1	VIDEO PROBE
4	2	VIDEO
5	2	VIDEO
6	3	VOICE
7	3	VOICE

Related work

- Each queue has its own back-off counter BO[i] (i=1..3)
- Each AC has its own AIFS , Contention window



Related work

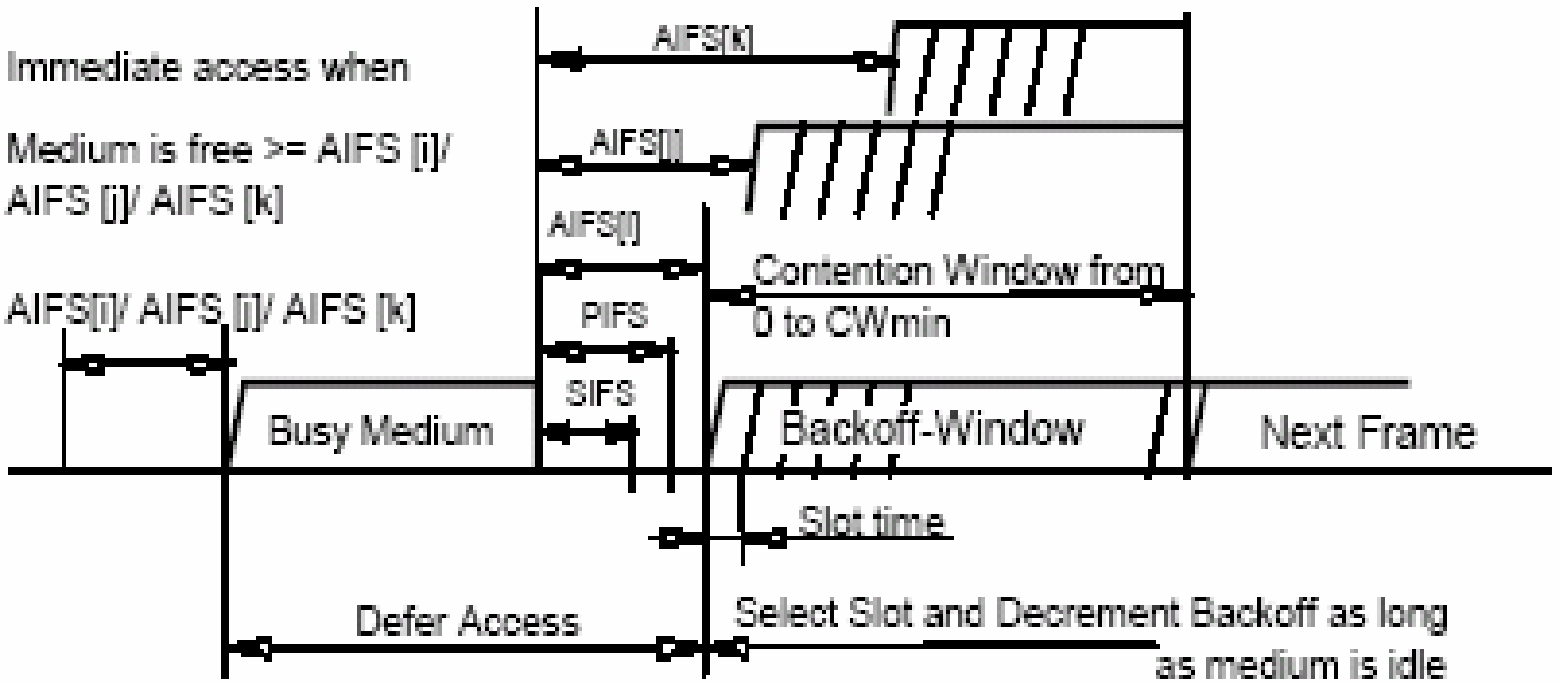


Fig. 2 EDCF timing diagram

$$CW[i] \geq CW[j] \quad AIFS[i] \geq AIFS[j] \quad 0 \leq i < j \leq 3$$

The first-level protection and guarantee

- CW
- AIFS
- TXOPBudget
- SurplusFactor
- TxTime

TxUsed
TxSuccess
TxLimit
TxRemainde
TxMemory

The first-level protection and guarantee

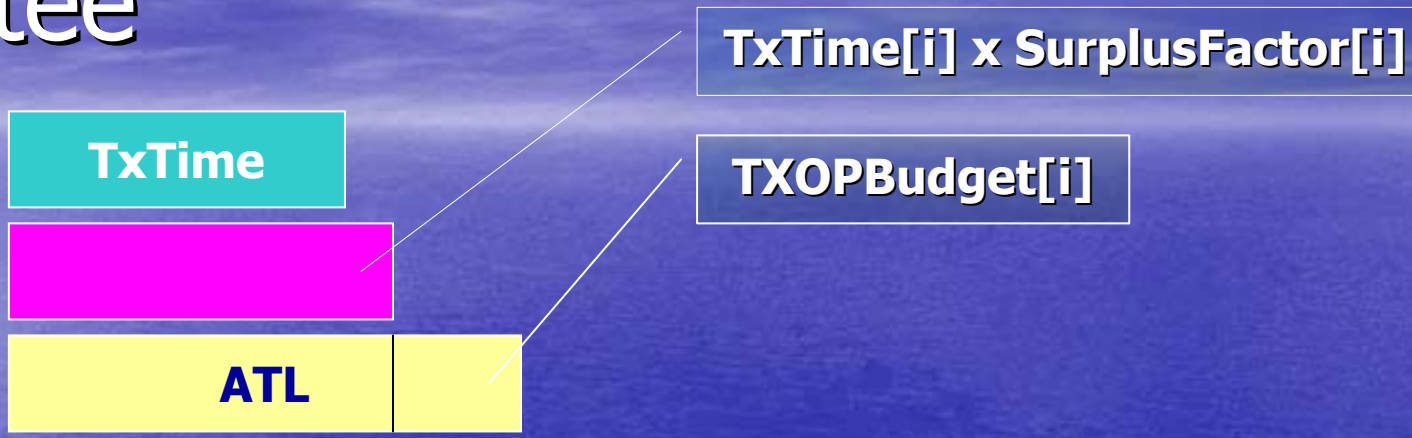
Procedure at QoS AP ：

- The QoS Parameter set element provides information needed by station
- Include CW , AIFS
  - TXOPBudget
  - SurplusFactor
  - TxTime
- TXOPBudget[i]=

  Max(ATL[i]-TxTime[i] x SurplusFactor[i] , 0)

  (ATL[i] is for the maximum time used for transmission)

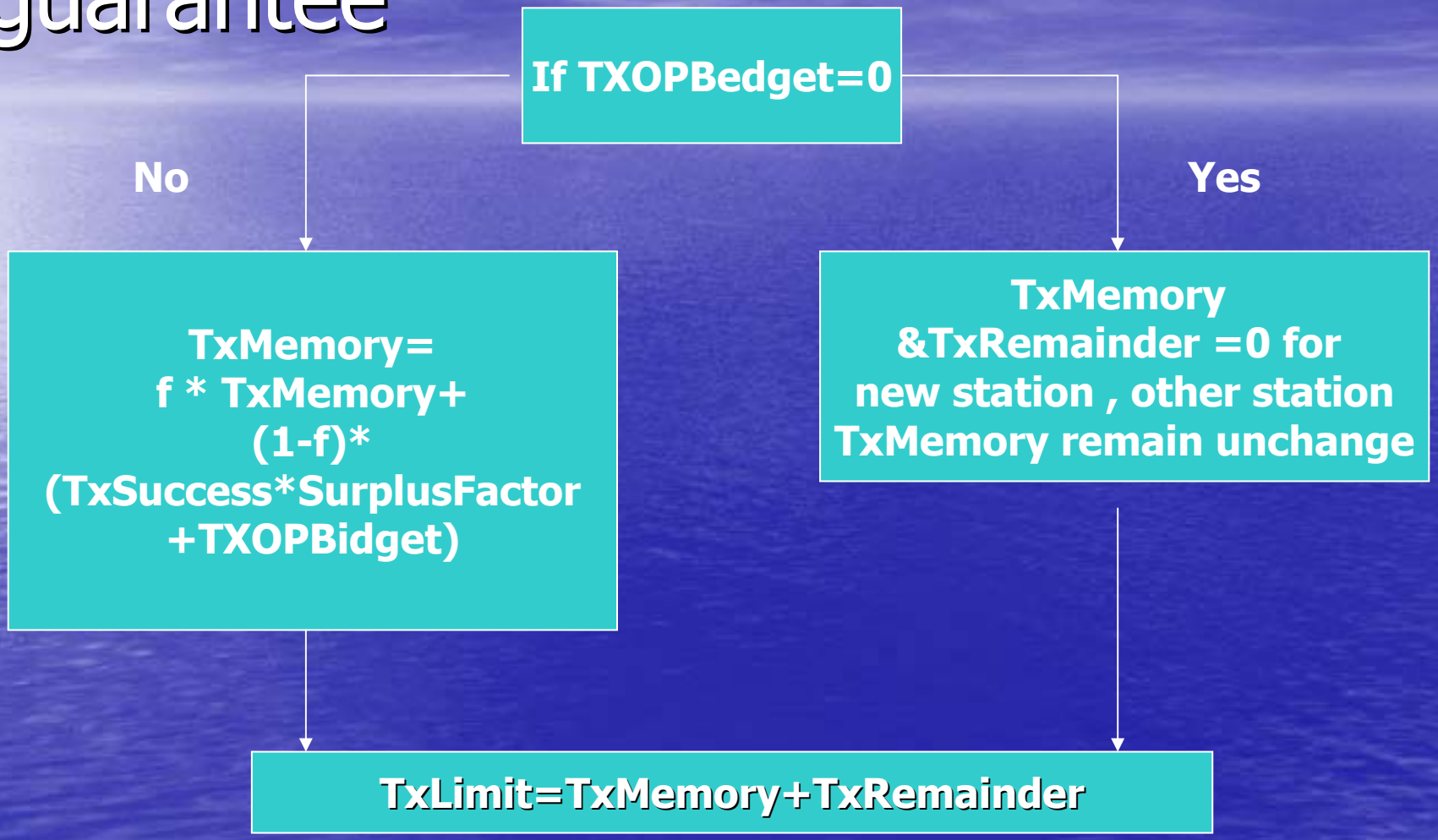
The first-level protection and guarantee



Procedure at Station

- Maintain local variable for each AC
  - TxUsed
  - TxSuccess
  - TxLimit
  - TxRemainder (TxLimit-TxUsed)
  - TxMemory

The first-level protection and guarantee



The first-level protection and guarantee

- As long as the transmission budget is larger than zero , TxMemory and TxLimit need be adjusted periodically
- Tried and known :

$$\text{If } \frac{\sum_{j=1}^{k} Throughout[j]}{k} \le \alpha T_{\min} \quad \text{and/or} \quad \frac{\sum_{j=1}^{k} Delay[j]}{k} \ge \beta D_{\max}$$

$0 < \alpha < 1$ and $\beta > 1$ then this flow rejects itself

The first-level protection and guarantee

- Early Protection
  - If TOXPBudget < Request_Budget * Φ
    => new flow can't allowed enter
  - If TOXPBudget > Request_Budget * Φ
    => TxMemory is set
    0~ TXOPBedget/Surplusfactor

- When the budget is below some threshold, new flows can't enter

The Second-level protection and guarantee

- The traffic control with TxLimit will cause unfairness among stations

  =>New stations can't transmit, then suffering from starvation if all the budget for data traffic

- Our approach is to dynamically control data traffic parameter

The Second-level protection and guarantee

- Dynamically adjusting parameter when fail

$$CW\min = \theta * CW\min(\theta > 1)$$

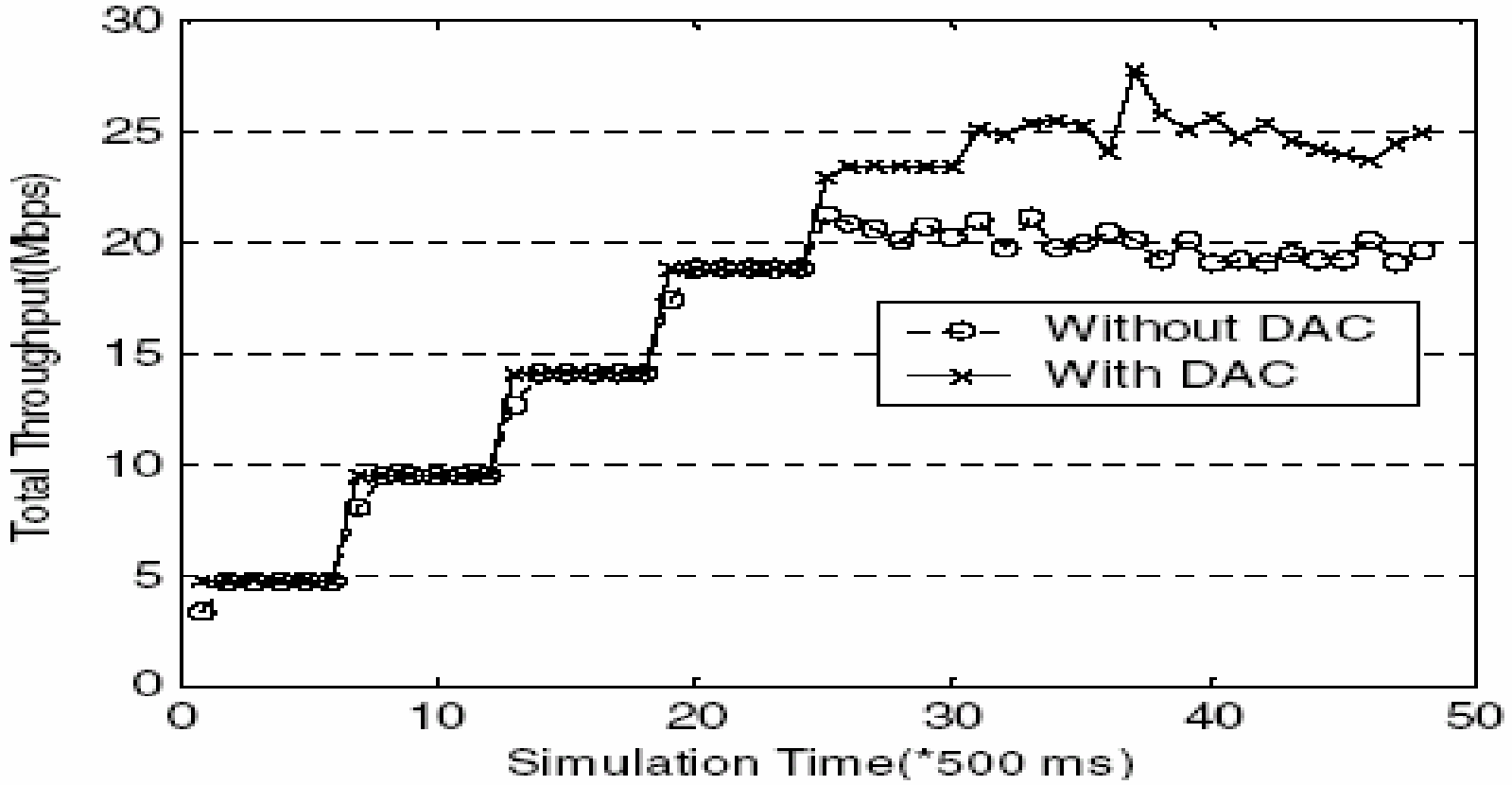
$$AIFS = \lambda * AIFS(\lambda > 1)$$

- Dynamically adjusting parameter when consecutive successful

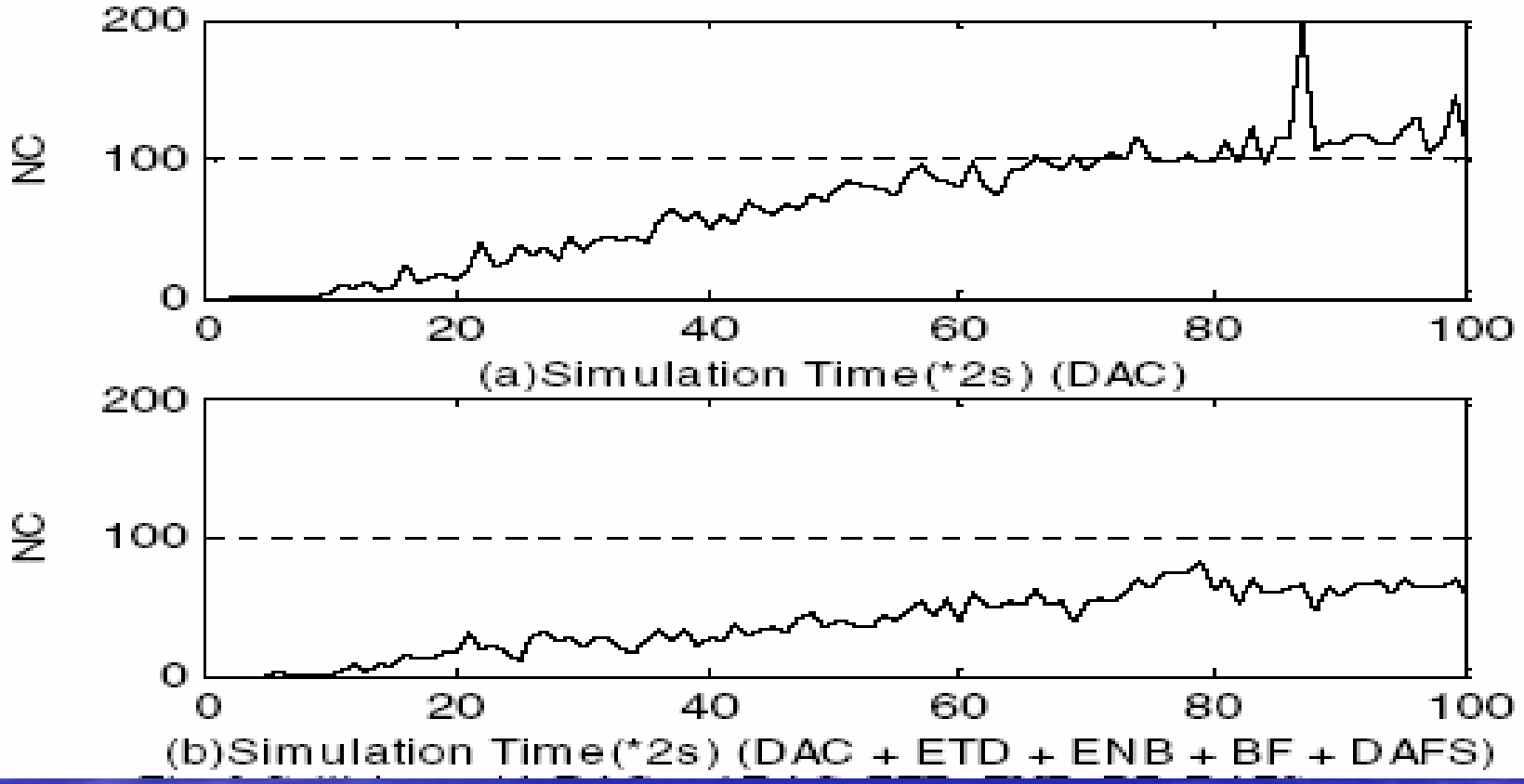
$$CW\min = CW\min/\theta(\theta > 1)$$

$$AIFS = AIFS/\lambda(\lambda > 1)$$

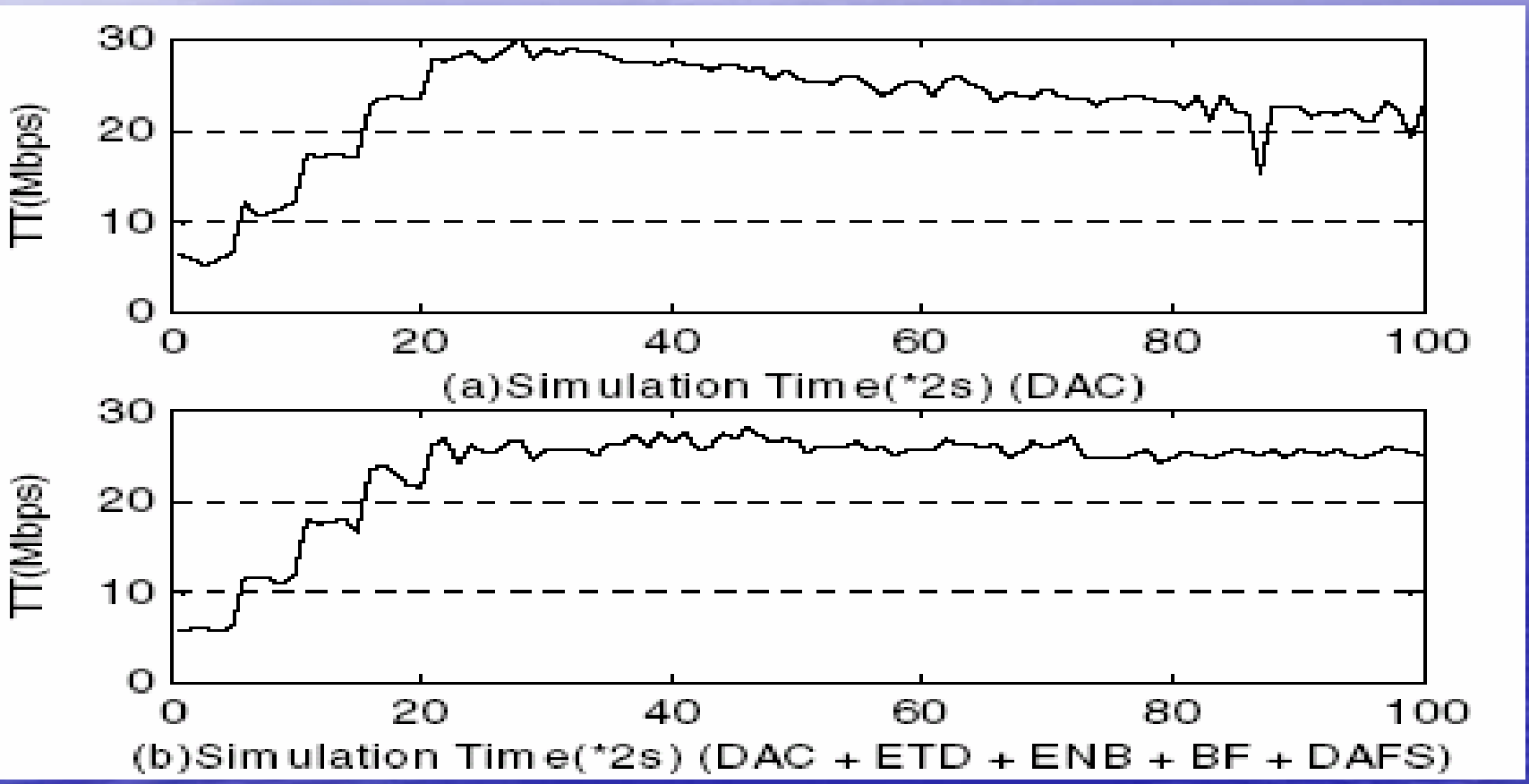
Performance evaluation



Performance evaluation



Performance evaluation



Conclusion

- In this paper , a two-level protection and guarantee mechanism be proposed for QoS requirement in wireless LANs