IEEE P802.11
Wireless LANs

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| Link Costs |
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Abstract

This document proposes text for a parameterized method of computing a GLK link cost and supplementary informative material to resolve CID 9 from CC17.

# Introduction

This document proposes text for a parameterized method of computing a GLK link cost and supplementary informative material to resolve CID 9 from CC17.

**Resolution:** Revised. As specified in submission 11-14/1482r2.

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***Change the name of clause 10.45 as follows:***

## 10.45 GLK ~~BSS~~ operation

***Add a subclause heading immediately after the clause 10.45 heading as follows:***

### 10.45.1 General

***Add the following subclause under clause 10.45:***

### 10.45.2 GLK link cost determination

For each GLK association, direct link, or peering at a STA there is an array of sample window data rates. Each such array consists of rate sample windows R[0] to R[N] in units of 500 kbit/s, where N is the value of dot11GLKLinkCostSamples. Each sample window covers a time period of dot11GLKLinkCostWindowSize TUs. When the association or peering is created, R[0] through R[N] are initialized to the lowest data bit rate the STA is configured to use.

Every dot11GLKLinkCostWindowSize TUs the following steps occur in the order given:

(1) The data rate sample array is shifted with the value of R[N] being discarded, each R[K] is set to the value of R[K-1] for K from N to 1, and R[0] is set as follows:

* Zero if all attempts to transmit data that ended during the window failed;
* The average data rate in units of 500 kbit/s of successful transmissions ending in the window if there were any successful transmissions; and,
* The data rate that would have been attempted if there were no attempts to transmit data during the window.

(2) The minimum, average, and geometric mean of the data rates in the sample array entries are calculated as follows:

* The minimum rate $R\_{min}$ is the array entry with the smallest magnitude.
* The average is Ravg = Floor($ {\sum\_{i=0}^{i=N}R[i]}/{(N+1})$ )
* The geometric mean is Rgeo = Floor( $\sqrt[N+1]{\prod\_{i=0}^{i=N}(R\left[i\right]+1)}$ )

(3) A composite data rate is then computed using non-negative weights W as follows:

 Rcomposite = Floor($\frac{W\_{min}×R\_{min} + W\_{avg}×R\_{avg} + W\_{geo}×R\_{geo} }{1 + W\_{min} + W\_{avg} + W\_{geo}}$)

where

 Wmin = dot11GLKLinkCostWmin

 Wavg = dot11GLKLinkCostWavg

and Wgeo = dot11GLKLinkCostWgeo

(4) A cost is then computed by dividing a large integer by Rcomposite.

 Costraw = Floor(dot11GLKLinkCostScaling×40,000,000 / (Rcomposite×16) )

(5) The first Costreported for a GLK link is Costraw as determined in step 4. Subsequent values of Costreported are subject to hysteresis based on dot11GLKLinkCostHysteresis. In particular, if the previous Costreported is greater than the new Costraw×dot11GLKLinkCostHysteresis/256 and less than the new Costraw×256/dot11GLKLinkCostHysteresis then the new Costreported is unchanged from the previous Costreported. In all other cases, the new Costreported is the new Costraw. Costreported is available in the per association, direct link, or peering dot11GLKLinkCostReported MIB variable.

# Annex C: ASN.1 encoding of the MAC and PHY MIB

***Add the following at the end of the Dot11StationConfigEntry sequence:***

dot11GLKLinkCostSamples Unsigned32,

dot11GLKLinkCostWindowSize Unsigned32,

dot11GLKLinkCostWmin Unsigned32,

dot11GLKLinkCostWavg Unsigned32,

dot11GLKLinkCostWgeo Unsigned32,

dot11GLKLinkCostScaling Unsigned32,

dot11GLKLinkCostHysteresis Unsigned32

***Add the following to the end of the specifications for the members of the Dot11StationConfigEntry sequence:***

dot11GLKLinkCostSamples OBJECT-TYPE

SYNTAX Unsigned32 (2..257)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is the number of data bit rate sample windows

in the array of such values used in the determination

of the cost for GLK links.”

 DEFVAL { 32 }

::= { dot11StationConfigEntry tbd }

dot11GLKLinkCostWindowSize OBJECT-TYPE

SYNTAX Unsigned32 (1..256)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The size of the data bit rate sample window duration

in TUs.”

 DEFVAL { 8 }

::= { dot11StationConfigEntry tbd }

dot11GLKLinkCostWmin OBJECT-TYPE

SYNTAX Unsigned32 (0..255)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This value is the relative weight given to the

minimum bit rate observed in the data rate sample

windows on a GLK link or peering. A larger value

means more weight or influence for the minimum

observed bit rate.

It is used in the determination of the cost for GLK links.”

 DEFVAL { 50 }

::= { dot11StationConfigEntry tbd }

dot11GLKLinkCostWavg OBJECT-TYPE

SYNTAX Unsigned32 (0..255)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This value is the relative weight given to the

average bit rate observed in the data rate sample

windows on a GLK link or peering. A larger value means

more weight or influence for the average observed bit

bit rate.

It is used in the determination of the cost for GLK links.”

 DEFVAL { 50 }

::= { dot11StationConfigEntry tbd }

dot11GLKLinkCostWgeo OBJECT-TYPE

SYNTAX Unsigned32 (0..255)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This value is the relative weight given to the

geometric mean of the bit rates observed in the data

rate sample windows on a GLK link or peering. A larger

value means more weight or influence for the geometric

mean of the observed bit rates.

It is used in the determination of the cost for GLK links.”

 DEFVAL { 50 }

::= { dot11StationConfigEntry tbd }

dot11GLKLinkCostScaling OBJECT-TYPE

SYNTAX Unsigned32 (1..256)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This value is used to scale the cost reported

appropriately depending on the use of that cost and how

pessimisticly costs are being determined. A scaling of

16 would produce a cost suitable for use in IEEE 802.1Q

protocols with no pessimism.”

 DEFVAL { 10 }

::= { dot11StationConfigEntry tbd }

dot11GLKLinkCostHysteresis OBJECT-TYPE

SYNTAX Unsigned32 (1..256)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This value is used to apply hysteresis to the cost

reported for a GLK link. If it is set to 256, then any

change in cost is immediately reported. The smaller its

value, the larger the change that must occur before

that change is report.”

 DEFVAL { 200 }

::= { dot11StationConfigEntry tbd }

***Add the following new informative Annex:***

# Annex AA: Link Cost Considerations

Default values for the link cost determination MIB variables whose names start with “dot11GLKLinkCost” are provided in Annex C. In adjusting the value of these variables, the following considerations should be taken into account:

* For applications such as bulk data transfer where the long-term bandwidth is of primary concern, dot11GLKLinkCostWavg should be set near the top of its range while dot11GLKLinkCostWgeo and dot11GLKLinkCostWmin should be set low, perhaps to zero. It may also be reasonable to increase some combination of dot11GLKLinkCostSamples and dot11GLKLinkCostWindowSize and decrease dot11GLKLinkCostHysteresis from their default values.
* For time critical applications requiring good performance on short bursts of transmissions, the dot11GLKLinkCostWmin should be set near the top of its range while dot11GLKLinkCostWavg and dot11GLKLinkCostWgeo should be set low, perhaps to zero. It may also be reasonable to decrease dot11GLKLinkCostWindowSize and/or increase dot11GLKLinkCostHysteresis from their default values to make the cost more responsive. dot11GLKLinkCostSamples × dot11GLKLinkCostWindowSize will determine how quickly Rcomposite can spring back from one or more samples of low or zero effective data bandwidth.
* For general applications that are not time critical but require reasonable performance for messages related to human interaction or the like, the dot11GLKLinkCostWgeo weight should dominate and dot11GLKLinkCostWmin and dot11GLKLinkCostWavg should be set low, perhaps to zero. dot11GLKLinkCostSamples × dot11GLKLinkCostWindowSize should not exceed typical human response expectations, perhaps 1 or 2 seconds.