IEEE P802.11  
Wireless LANs

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| Proposed Resolution to CID 2 on TGaj D0.6 in CC22 | | | | |
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Abstract

This document proposes resolution to CID 2 on TGaj D0.6 in CC22.

**Editorial Comments**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| CID | Clause | Page | Line | Type | Comment | Proposed Change | Remark |
| 2 | 3.2 | 1 | 12 | T | It seems that a QMG STA may use the channel access mechanism specified in subclause "9.33 DMG channel access", because a "CBAP" appears here. What is the relationship of DMG and QMG channel access mechanisms? | If some DMG mechanisms are applicable for a QMG STA, then clarify them. |  |

Proposed resolution: **Revised**

We have revised the DMG MAC mechanisms to adapt the IEEE 802.11aj (45GHz).

***Change the title of 9.36 as follows***

## DMG and QMG channel access

### General

***Change the first paragraph of 9.36.1 as follows:***

Channel access by a DMG or QMG STA occurs during beacon intervals and is coordinated using a schedule. A DMG or QMG STA operating as a PCP or AP generates the schedule and communicates it to STAs using DMG Beacon and Announce frames. A non-PCP STA that is a non-AP STA and that receives scheduling information accesses the medium during the scheduled periods using the access rules specific to that period. Medium access rules to establish a BSS are defined in 9.36 and 10.1.4.

QMG STAs follow the same rules of DMG channel access except the specific modification for QMG STAs as described in 9.36 (DMG channel access)

### Access periods within a beacon interval

***Change the first paragraph of 9.36.2 as follows:***

Medium time within a DMG or QMG BSS is divided into beacon intervals. Subdivisions within the beacon interval are called access periods. Different access periods within a beacon interval have different access rules. The access periods are described in a schedule that is communicated by the PCP or AP to the non-PCP and non-AP STAs within the BSS. The schedule communicated by the PCP or AP can include the following access periods:

* **BTI:** For DMG STAs, it is an access period during which one or more DMG Beacon frames is transmitted. Not all DMG Beacon frames are detectable by all non-PCP and non-AP STAs. For QMG STAs, it is an access period during which one or more DMG Beacon frames is transmitted at least in the primary 540MHz channel. Not all DMG Beacon frames are detectable by all non-PCP and non-AP STAs. Not all beacon intervals contain a BTI. A non-PCP STA that is a non-AP STA shall not transmit during the BTI of the BSS of which it is a member.

***Insert the new paragraph and figure9-56a after the second paragraph of 9.36.2***

The DTI, for QMG BSS, also comprises contention-based access periods (CBAPs) and scheduled service periods (SPs), and the bandwidth of the allocation in DTI can be 540MHz and 1080MHz. Figure 9-46a illustrates an example of access periods within a beacon interval for a 1080MHz QMG BSS, comprising a BHI, that may contains BTI, A-BFT, and ATI, and two 540MHz CBAPs and SPs within the DTI and one 1080MHz CBAPs and SPs within the DTI. Any combination in the number and order of SPs and CBAPs can be present in the DTI. For QMG, the BHI shall be sent in primary 540MHz channel, and can be sent in 1080MHz channel.



**Figure 9-56a—Example of access periods within a BI for QMG**

### ATI transmission rules

***Change the fourth paragraph of 9.36.3 as follows:***

For DMG STAs, during each ATI the PCP/AP shall schedule transmissions to a non-PCP/non-AP STA if the non-PCP/non-AP STA Heartbeat field in the STA’s DMG Capabilities element within the Association Request frame of the last successful association attempt is 1 and the non-PCP/non-AP STA is in the Awake state. If the non-PCP/non-AP STA does not respond to the frame transmitted by the PCP/AP, the PCP/AP shall use the DMG Control modulation class (9.7.7.1) at its next transmission attempt to the non-PCP/non-AP STA. The PCP/AP shall use the DMG Control modulation class for all subsequent transmissions to the non-PCP/non-AP STA until it receives a valid frame from the non-PCP/non-AP STA.

***Insert the new paragraph after the fourth paragraph of 9.36.3***

For QMG STAs, during each ATI the PCP/AP shall schedule transmissions to a non-PCP/non-AP STA if the non-PCP/non-AP STA Heartbeat field in the STA’s QMG Capabilities element within the Association Request frame of the last successful association attempt is 1 and the non-PCP/non-AP STA is in the Awake state. If the non-PCP/non-AP STA does not respond to the frame transmitted by the PCP/AP, the PCP/AP shall use the QMG Control modulation class (9.7.7a.1) at its next transmission attempt to the non-PCP/non-AP STA. The PCP/AP shall use the QMG Control modulation class for all subsequent transmissions to the non-PCP/non-AP STA until it receives a valid frame from the non-PCP/non-AP STA.

***Insert the new paragraph after the 13th paragraph of 9.36.3***

For QMG STAs, the bandwidth of a response frame transmitted during the ATI shall be set to the same as the previously received request frame.

### DTI transmission rules

***Change 9.36.4 as follows:***

During the DTI, a STA may transmit frames (following the DMG channel access rules for DMG STAs and following the QMG channel access rules for QMG STAs ) if any of the following conditions are met:

1. During a CBAP for which the STA is identified or included as source or destination (9.36.6.3, 9.36.7, and 9.36.8)
2. During an SP for which the STA is identified as source or destination (9.36.6.2 and 9.36.7) and shall not transmit if none of these conditions are met. A STA initiating data transfer shall check that the transaction, including acknowledgments, completes before the end of the CBAP or SP in which it was initiated. And for QMG STAs initiating data transfer shall use the bandwidth that not larger than the allocated channel bandwidth of the CBAP or SP in which it was initiated

When the entire DTI is allocated to CBAP (that is, the CBAP Only field is 1 in the DMG Parameters field for DMG STAs, or the CBAP Only field is 1 in the QMG Parameters field for QMG STAs), for DMG STAs, the ATI Present field within the DMG Beacon containing the DMG Parameters field shall be set to 0, and for QMG STAs, the ATI Present field within the DMG Beacon containing the QMG Parameters field shall be set to 0.

Non-PCP/non-AP DMG and QMG STAs shall be capable of processing the Poll and Grant frames and the Extended Schedule element. A PCP/AP shall be capable of processing the SPR frame transmitted by a non-PCP/nonAP STA and responding to a SPR frame with a Grant frame. The DMG low-power SC PHY (21.7) may be used only within SPs that have the LP SC Used subfield within the Extended Schedule element equal to 1 and shall not be used otherwise.

A STA supports the DMG low-power SC PHY if the Low-Power SC PHY Supported subfield within its DMG Capabilities element is 1. A STA that supports the DMG low-power SC PHY shall not transmit a PPDU using the DMG low-power SC PHY unless the STAs identified in the RA field of all MPDUs contained within the PPDU support the DMG low-power SC PHY. A STA can use the procedure described in 10.29.1 to discover the capabilities of another STA.

### Contention-based access period (CBAP) transmission rules

***Change the seventh paragraph of 9.36.5 as follows***

At the beginning of a TXOP with a TXOP responder that has the Heartbeat field in the TXOP responder’s DMG Capabilities element equal to 1 for DMG STAs, or has the Heartbeat field in the TXOP responder’s QMG Capabilities element equal to 1 for QMG STAs, the following rules apply:

* For DMG STAs, the TXOP holder shall transmit a frame to the TXOP responder using the DMG Control modulation class before it uses any other modulation class for transmission if the time elapsed since the last frame received from the TXOP responder is larger than or equal to the Heartbeat Elapsed Time value computed using the Heartbeat Elapsed Indication field within the TXOP responder’s DMG Capabilities element.
* For DMG STAs, the TXOP holder may transmit a frame using a modulation class other than the DMG Control modulation class at the start of the TXOP if the time elapsed since the last frame received from the TXOP responder is shorter than the Heartbeat Elapsed Time value computed using the Heartbeat Elapsed Indication field within the TXOP responder’s DMG Capabilities element.
* For QMG STAs, the TXOP holder shall transmit a frame to the TXOP responder using the QMG Control modulation class before it uses any other modulation class for transmission if the time elapsed since the last frame received from the TXOP responder is larger than or equal to the Heartbeat Elapsed Time value computed using the Heartbeat Elapsed Indication field within the TXOP responder’s QMG Capabilities element.
* For QMG STAs, the TXOP holder may transmit a frame using a modulation class other than the QMG Control modulation class at the start of the TXOP if the time elapsed since the last frame received from the TXOP responder is shorter than the Heartbeat Elapsed Time value computed using the Heartbeat Elapsed Indication field within the TXOP responder’s QMG Capabilities element.

### Channel access in scheduled DTI

#### General

***Insert the new paragraph after the seventh paragraph of 9.36.6.1***

For QMG STAs, an SP or CBAP allocation within an Extended Schedule element may be a 540MHz allocation or a 1080MHz allocation, the channel and bandwidth of the SP or CBAP allocation is indicated in the Extended Schedule element.

***Change the title of 9.36.6.2 as:***

#### Service period (SP) allocation

***Insert the new paragraph after the second paragraph of 9.36.6.2***

An SP is assigned to the source QMG STA identified in the Source AID subfield in an Allocation field within the Extended Schedule element. The source QMG STA shall initiate the frame exchange sequence that takes place during the SP at the start of the SP, except when the source QMG STA intends to establish a QMG Protected Period in which case the rules described in 9.36.6.6 shall be followed before the source QMG STA initiates the frame exchange in the SP. The SP allocation identifies the TC or TS for which the allocation is made; however, the type of traffic transmitted is not restricted to the specified TC or TS (10.4.1).

***Insert the new paragraph after the fifth paragraph of 9.36.6.2***

At the beginning of an SP in QMG band, except when the source QMG STA intends to establish a QMG Protected Period in which case the rules described in 9.36.6.6 shall be followed before the source QMG STA initiates the frame exchange in the SP, a source QMG STA shall transmit a frame to the destination QMG STA using the QMG Control modulation class before it uses any other modulation class for transmission if the Heartbeat field in the destination QMG STA’s QMG Capabilities element is 1. The frame sent by the STA may be an RTS or a DMG CTS-To-Self. The frame sent by the STA may be a SSW frame or a BRP packet if the STA is performing beamforming (9.7.7a.5 Rate selection for BRP packets).

***Insert the new paragraph after the sixth paragraph of 9.36.6.2***

At the beginning of an SP, a destination QMG STA shall transmit a frame to the source QMG STA using the QMG Control modulation class before it uses any other modulation for transmission if the Heartbeat field in the source QMG STA’s QMG Capabilities element is 1 and the frame sent by the destination QMG STA is the unsolicited DMG DTS as first frame in the SP of the STA performing QMG Protected Period ( **9.36.6.6**).

***Change the title of 9.36.6.6 as follows:***

#### DMG and QMG Protected Period

##### Introduction

***Insert the new paragraph after the first paragraph of 9.36.6.6.1***

In QMG band, the SP can have different bandwidth, 540MH or 1080MHz, so another intent of QMG Protected Period is to use dynamic bandwidth operation to negotiate a bandwidth can be use in this SP.

***Insert the new paragraph after the third paragraph of 9.36.6.6.1***

A QMG Protected Period can use the dynamic bandwidth operation during an SP if the bandwidth of the SP that indicated in the Extended Schedule element is 1080MHz.

***Insert the new paragraph after the fourth paragraph of 9.36.6.6.1***

A QMG STA that creates a QMG Protected Period during an SP in which it is a source QMG STA or a destination QMG STA moves to and stays in Listening Mode during time interval that starts before the start of the SP and remains in the Listening mode until it is allowed to use the SP. The actual duration of the time the STA stays in the Listening Mode is limited by the aQMGPPMinListeningTime parameter. The intent of the Listening Mode is that the QMG STA listens to other QMG STAs that may have an SP that overlaps with the SP where the QMG STA is a source QMG STA or a destination QMG STA. The NAV mechanism is used to indicate the time and frequency occupancy and the QMG STA in the Listening Mode updates NAV timers. If the NAV timers are not equal to 0 for the corresponding channel bandwidth, the QMG STA does not use the time and the band of the SP in which it is a source QMG TA or a destination QMG STA. If none of the NAV timers has a nonzero value at the start of the SP, the DMG STA is allowed to leave the Listening Mode and use the SP. If at least one of the NAV timers has a nonzero value at the start of the SP, the DMG STA is allowed to leave the Listening Mode and to use the time remaining in the SP after all NAV timers become or already have value zero.

***Change the last paragraph of 9.36.6.6.1 as follows:***

A DMG protected period is established through an RTS/DMG CTS handshake. The DMG CTS can be sent in a QMG PHY format, and can be sent in 540MHz or 540MHz duplicated mode. To create a DMG protected period, the source DMG STA of an SP sends an RTS, and the recipient STA responds with a DMG CTS. If the recipient STA responds with a DMG CTS, then a DMG protected period is established; otherwise, no DMG protected period has been established. In all cases of DMG protected period establishment, the same antenna configurations that are used by the STAs that establish the DMG protected period are used for the exchange of frames during the DMG protected period.

***Change the title of 9.36.6.6.2 as follows***

##### DMG and QMG Protected Period establishment and maintenance

***Insert the new paragraph after the first paragraph of 9.36.6.6.2***

A QMG STA that attempts to create a QMG Protected Period shall transition to Listening Mode on a channel that the bandwidth is indicated in the Extended Schedule element for this SP.

***Change the second paragraph of 9.36.6.6.2 as follows:***

A DMG STA shall not issue an RTS frame to establish a DMG protected period if any of its NAV timers is not equal to 0(MDR).

***Insert the new paragraph after the second paragraph of 9.36.6.6.2***

A QMG STA shall not issue an RTS frame to establish a QMG Protected Period on a channel if any of its NAV timers that corresponding to this channel is not equal to zero. A QMG STA can issue an RTS frame to establish a QMG Protected Period on a channel that the bandwidth of the channel is less than the SP allocated channel bandwidth and all of its NAV timers that corresponding to this channel is 0.

***Insert the new paragraph after the third paragraph of 9.36.6.6.2***

A QMG STA that transmits an RTS to establish a QMG Protected Period during an SP in which it is a source QMG STA shall not transmit the RTS outside of the SP and the value of the Duration field of the RTS shall not exceed the duration of the portion of the SP that remains following the RTS transmission. And a QMG STA that transmits an RTS to establish a QMG Protected Period during an SP in which it is a source QMG STA shall not transmit the RTS has a bandwidth that larger than the allocated bandwidth.

***Insert the new paragraph after the eighth paragraph of 9.36.6.6.2***

During an SP in which it is the destination QMG STA, a QMG STA that receives a valid RTS with the RA equal to the recipient QMG STA MAC address and the TA corresponding to the source QMG STA of the SP shall not respond with a DMG CTS on the channel if at the start of the reception of the RTS the recipient QMG STA has a nonzero value in at least one of its NAV timers corresponding to this channel.

***Insert the following subclause 9.36.6.6.2a. after 9.36.6.6.2***

**9.36.6.6.2a Dynamic and static bandwidth operation During QMG protected period**

If the QMG STA that sending the RTS frame to establish a QMG Protected Period during an SP in which it is a source QMG STA is capable of dynamic bandwidth operation (see 9.3.2.7 (CTS and DMG CTS procedure)), the STA shall set the TXVECTOR parameter DYN\_BANDWIDTH to Dynamic. Otherwise, the STA shall set the TXVECTOR parameter DYN\_BANDWIDTH to Static.

During an SP in which it is the destination QMG STA, a QMG STA that is addressed by an RTS frame in a QMG PPDU that has the RXVECTOR parameter DYN\_BANDWIDTH equal to Static behaves as follows:

— If the NAVs indicates idle and CCA has been idle for all the channel width indicated by the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH, then the STA shall respond with a DMG CTS frame carried in a QMG PPDU after a SIFS period. The DMG CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and shall be set to the same value as the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH.

— Otherwise, the STA shall not respond with a CTS frame.

During an SP in which it is the destination QMG STA, a QMG STA that is addressed by an RTS frame in a QMG PPDU that has the RXVECTOR parameter DYN\_BANDWIDTH equal to Dynamic behaves as follows::

— If the NAVs indicates idle in the primary 540MHz channel, then the STA shall respond with a DMG CTS frame in a QMG PPDU after a SIFS period. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH

shall be set to 540MHz if the secondary 540MHz channel is been detected as busy and shall be set to 1080MHz if the CCA on the secondary 540MHz channel is been detected as idle and the channel width indicated in the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH is 1080MHz

— Otherwise, the STA shall not respond with a CTS frame.

***Change the title of 9.36.6.6.3 as follows:***

##### Interference report

***Insert the new paragraph after the seventh paragraph of 9.36.6.6.4***

For QMG STA, it shall also include the Interferer Channel Bandwidth in the report, and the Interferer Channel Bandwidth shall be set to the CHBAND of the NAV timer.

### Dynamic allocation of service period

#### Grant period (GP)

***Change the fourth paragraph of 9.36.7.3 as follows***

To commence the GP, the PCP/AP shall transmit Grant frames to notify the source DMG STA and destination DMG STA about a dynamically allocated service period, or the PCP/AP shall transmit Grant frames to notify the source QMG STA and destination QMG STA about a dynamically allocated service period. The PCP/AP should transmit the last Grant frame within a GP to the source of the dynamically allocated SP if the source of the dynamically allocated SP is not the PCP/AP. In each transmitted Grant frame, the PCP/AP shall set the Duration field within the Grant frame to a time that does not overlap in time with another SP that has either the source AID or destination AID different from the broadcast AID. In addition, the source AID and destination AID fields shall be set to the source and destination, respectively, of the dynamically allocated SP, the Allocation Type field set to indicate the channel access mechanism during the allocation, and the Allocation Duration field set to a value that is not greater than the result of the subtraction of the duration of all remaining Grant frame transmissions, if any, plus all appropriate IFSs (9.3.2.3), plus 2×SIFS from the value of the Duration field. An allocation that is indicated in this manner begins at the time that is equal to the PHY-TXEND. indication of the Grant frame plus the value from the Duration field of the Grant frame minus the value of the Allocation Duration field of the Grant frame, and continues for the time indicated in the Allocation Duration field of the Grant frame.

***Insert the new paragraph after the sixth paragraph of 9.36.7.3***

During an SP between a source QMG STA and a destination QMG STA, the source QMG STA may transmit a Grant frame to the destination QMG STA to relinquish the remainder of the SP to the destination QMG STA. In the Allocation Info field of the transmitted Grant frame, the source QMG STA shall set source AID field to the AID of the destination QMG STA, the destination AID field to the AID of the source QMG STA, the Allocation Type field set to indicate SP, and the Allocation Duration field set to the time remaining in the SP minus the time taken to transmit the Grant frame, the Allocation Channel Band field set to the channel and bandwidth the same as the original SP . The Duration field in the Grant frame shall be set to the value of the Allocation Duration field. Upon transmission of the Grant frame, for the remainder the SP the roles of source QMG STA and destination QMG STA are swapped between the STAs.

***Change the seventh paragraph of 9.36.7.3 as follows***

During a TXOP between a TXOP holder and a TXOP responder, the TXOP holder may transmit a Grant frame to the TXOP responder to relinquish the remainder of the TXOP to the TXOP responder. In the transmitted Grant frame, the TXOP holder shall set source AID field to the AID of the TXOP responder, the destination AID field to the AID of the TXOP holder, the AllocationType field set to indicate CBAP, and the Allocation Duration field set to a value of 32768 as defined in 8.5.2 (Dynamic Allocation Info field). For QMG STAs the Channel Band field set to the channel and bandwidth the same as the original TXOP. The Duration field in the Grant frame shall be set to the time remaining in the TXOP minus TXTIME (Grant frame) minus aSIFSTime. Upon transmission of the Grant frame with the Beamforming Training field equal to 0, for the remainder the TXOP the roles of TXOP holder and TXOP responder are swapped between the STAs.

### Dynamic truncation of service period

***Insert the new paragraph after the third paragraph of 9.36.8***

Only the source QMG STA of an SP may truncate the SP, except that the destination QMG STA may truncate the SP if it does not receive an expected transmission from the source QMG STA at the start of the SP as defined in 9.36.6.7.



### Updating multiple NAV timers

***Change the first paragraph of 9.36.10 as follows:***

If a DMG STA supports multiple NAV timers, the number of available NAV timers within the STA shall be not less than aMinNAVTimersNumber. Each NAV timer is identified by a pair of MAC addresses, NAVSRC and NAVDST, and has associated variables NAV\_RTSCANCELABLE, NAV\_DTSCANCELABLE and NAV\_CHANNEL which is only used by QMG STA, the variable NAV\_CHANNEL indicated the channel that the Duration field is received, and it is a channel index that contains channel bandwidth information. Each STA also maintains a variable UPDATE\_OPTIONAL. When a STA is enabled for operation, all NAV timers shall have NULL values for their NAVSRC and NAVDST identifiers, the value of NAV\_RTSCANCELABLE shall be false, the value of NAV\_DTSCANCELABLE shall be false, the value of NAV\_CHANNEL shall be NULL only for QMG STA, and each NAV timer shall have the value 0. NAV timer address pairs correspond to the NAV-SA and NAV-DA fields in DMG DTS frames and correspond to the RA and TA fields of all other received frames that are used to update the NAV timers. Receipt of any frame can cause an update to the NAV timer whose identifying address pair corresponds to the specified address fields of the received frame according to the rules in this subclause.

***Change the second paragraph of 9.36.10 as follows:***

DMG STAs receiving any valid frame shall perform the following NAV Timer update operation expressed using the following pseudocode:

***Insert the new paragraph after the second paragraph of 9.36.10 as follows:***

QMG STAs receiving any valid frame shall perform the following NAV Timer update operation expressed using the following pseudocode:

NAV\_TIMER\_UPDATE(received\_frame):

UPDATE\_OPTIONALfalse

If (received\_frame = DMG DTS) {

UPDATE\_OPTIONAL true

}

If (received\_frame(RA) ≠ This STA MAC address || UPDATE\_OPTIONAL = true) {

If (received\_frame = DMG DTS) {

R\_DST received\_frame(NAV-DA)

R\_SRC received\_frame(NAV-SA)

R\_CHANNELreceived\_frame(CHANNEL BANDWIDTH)

} else if (received\_frame = Ack) {

R\_DST received\_frame(RA)

R\_SRC 0

R\_CHANNELreceived\_frame(CHANNEL BANDWIDTH)

} else {

R\_DST received\_frame(RA)

R\_SRC received\_frame(TA) R\_CHANNELreceived\_frame(CHANNEL BANDWIDTH)

}

R\_DUR received\_frame(DUR)

N\_TIMER -1

// Searching for a matching NAV timer

For (x 0; x < aMinNAVTimersNumber; x++) {

If (received\_frame = Ack || NAVSRC(x)=R\_DST) {

If(NAVDST(x) = R\_DST) {

N\_TIMER x

Break

}

} else if (NAVSRC(x) = R\_SRC && (NAVDST(x) = R\_DST|| NAVDST(x) = 0) ||

(NAVSRC(x)=0 && NAVDST(x) = R\_DST) ||

(NAVDST(x)=R\_SRC && NAVSRC(x)=R\_DST)) {

N\_TIMER x

Break

}

}

// No NAV timer has been found that matches the addresses

If (N\_TIMER < 0) {

For (x 0; x < aMinNAVTimersNumber; x++) {

If (NAVSRC(x) = NULL && NAVDST(x) = NULL

|| NAV(x) = 0) {

NAVSRC(x) R\_SRC

NAVDST(x) R\_DST

NAV\_CHNNAL(x) R\_CHANNEL

N\_TIMER x

Break

}

}

}

// Existing NAV timer found

If (N\_TIMER <0) {

If (UPDATE\_OPTIONAL = false) {

NAV(N\_TIMER) R\_DUR

NAV\_CHNNAL(N\_TIMER) R\_CHANNEL

If (received\_frame = RTS) {

NAV\_RTSCANCELABLE(N\_TIMER) ←true

} else {

NAV\_RTSCANCELABLE(N\_TIMER) ←false

}

} else if (UPDATE\_OPTIONAL = true) {

If ((implementation decision to update = true) ||

(received\_frame(RA) = This STA MAC address &&

This STA MAC address = source DMG STA MAC address for current

SP))

) {

NAV\_DTSCANCELABLE(N\_TIMER) true

NAV(N\_TIMER) R\_DUR

NAV\_CHNNAL(N\_TIMER) R\_CHANNEL

}

}

}

} else {

No change to NAV timers

}

END OF NAVEND OF NAV\_TIMER\_UPDATE