IEEE P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| MU-MIMO BF Selection | | | | |
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Abstract

This submission proposes the format of MIMO BF Selection frame as well as the modications on the texts related to MU-MIMO BF selection subphase.

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**9.6.22.1 Unprotected DMG Action field**

***#1: Change Table 9-415(Unprotected DMG Action field values) as follows:***

|  |  |
| --- | --- |
| Table 9-415—Unprotected DMG Action field values(11ad) | |
| Unprotected DMG Action field value | Meaning |
| 0 | Announce |
| 1 | BRP |
| x | MIMO BF Selection |

**---------------------------------------------------------------------------------------------------------------------**

***#2: insert the following clause:***

9.6.22.xx MIMO BF Selection frame format

The MIMO BF Selection frame is an Action No Ack frame. The format of a MIMO BF Selection frame Action field is shown in Table 9-xx (MIMO BF Selection frame Action field format).

|  |  |
| --- | --- |
| Table 9-xx−MIMO BF Selection frame Action field format(11ad) | |
| Order | Information |
| 1 | Category |
| 2 | Unprotected DMG Action |
| 3 | Dialog Token |
| 4 | MIMO Selection Control element |

The Category field is defined in 9.4.1.11 (Action field).(#3403)

The Unprotected DMG Action field is defined in 9.6.22.1 (Unprotected DMG Action field).(#3403)

The Dialog Token field is set to a value chosen by the STA sending the frame to uniquely identify the transaction.

The MIMO Selection Control element is defined in 9.4.2.x.

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***#3: insert the following clause:***

9.4.2.x MIMO Selection Control element

The MIMO Selection Control element is shown in Table 9-xxx (MIMO Selection Control element format).

|  |  |  |  |
| --- | --- | --- | --- |
| Table 9-xxx MIMO Selection Control element format  (11ad) | | | |
| Field | | Size | Meaning |
| Element ID | | 8 bits |  |
| Length | | 8 bits |  |
| Element ID Extension | | 8 bits |  |
| EDMG Group ID | | 8 bits | Indicates the EDMG group ID of target MU group. |
| Number of MU-MIMO Transmission Configurations | | 3 bits | Indicates the number of MU-MIMO transmission configurations, *N*conf. |
| MU-MIMO Transmission Configuration Type | | 1 bit | Sets to 1 to indicate the MU-MIMO transmission configurations obtained from the MU-MIMO BF training of downlink type; and Sets to 0 to indicate the MU-MIMO transmission configurations obtained from MU-MIMO BF training of uplink type. |
| Downlink Type MU-MIMO Transmission Configuration | Configuration 1 Group User Mask for Antenna 1 | 32 bits | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 SISO ID Subset Index for Antenna 1 | 12 bits | Indicates the RX AWV of the first STA associated with the first TX DMG antennain the first MU-MIMO transmission configuration. |
| … |  |  |
| Configuration 1 User SISO ID Subset Index for Antenna 1 | 12 bits | Indicates the RX AWV of the STA associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| … |  |  |
| Configuration 1 Group User Mask for Antenna *N*TX | 32 bits | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 SISO ID Subset Index for Antenna *N*TX | 12 bits | Indicates the RX AWV of the first STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| … |  |  |
| Configuration 1 User SISO ID Subset Index for Antenna *N*TX | 12 bits | Indicates the RX AWV of the STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
| … |  |  |
|  | Configuration *N*conf Group User Mask for Antenna 1 | 32 bits | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | Configuration *N*conf User 1 SISO ID Subset Index for Antenna 1 | 12 bits | Indicates the RX AWV of the first STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | … |  |  |
|  | Configuration *N*conf User SISO ID Subset Index for Antenna *N*TX | 12 bits | Indicates the RX AWV of the STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | … |  |  |
|  | Configuration *N*conf Group User Mask for Antenna *N*TX | 32 bits | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Configuration *N*conf User 1 SISO ID Subset Index for Antenna *N*TX | 12 bits | Indicates the RX AWV of the first STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| … |  |  |
| Configuration *N*conf User SISO ID Subset Index for Antenna *N*TX | 12 bits | Indicates the RX AWV of the STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
| Uplink Type MU-MIMO Transmission Configuration | Configuration 1 Group User Mask for Antenna 1 | 32 bits | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
| Configuration 1 User 1 AWV feedback ID for Antenna 1 | 11 bits | Indicates the RX AWV of the first STA associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
|  | Configuration 1 User 1 BRP CDOWN for Antenna 1 | 6 bits |
|  | Configuration 1 User 1 RX Antenna ID for Antenna 1 | 3 bits |
|  | … |  |  |
|  | Configuration 1 User AWV feedback ID for Antenna 1 | 11 bits | Indicates the RX AWV of the STA associated with the first TX DMG antenna in the first MU-MIMO transmission configuration. |
|  | Configuration 1 User BRP CDOWN for Antenna 1 | 6 bits |
|  | Configuration 1 User RX Antenna ID for Antenna 1 | 3 bits |
|  | … |  |  |
|  | Configuration 1 Group User Mask for Antenna *N*TX | 32 bits | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
|  | Configuration 1 User 1 AWV feedback ID for Antenna *N*TX | 11 bits | Indicates the RX AWV of the first STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
|  | Configuration 1 User 1 BRP CDOWN for Antenna *N*TX | 6 bits |
|  | Configuration 1 User 1 RX Antenna ID for Antenna *N*TX | 3 bits |
|  | … |  |  |
|  | Configuration 1 User AWV feedback ID for Antenna *N*TX | 11 bits | Indicates the RX AWV of the STA associated with the *N*TX TX DMG antenna in the first MU-MIMO transmission configuration. |
|  | Configuration 1 User BRP CDOWN for Antenna *N*TX | 6 bits |
|  | Configuration 1 User RX Antenna ID for Antenna *N*TX | 3 bits |
|  | … |  |  |
|  | Configuration *N*conf Group User Mask for Antenna 1 | 32 bits | Indicates the STA(s) in the target MU group associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | Configuration *N*conf User 1 AWV feedback ID for Antenna 1 | 11 bits | Indicates the RX AWV of the first STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | Configuration *N*conf User 1 BRP CDOWN for Antenna 1 | 6 bits |
|  | Configuration *N*conf User 1 RX Antenna ID for Antenna 1 | 3 bits |
|  | … |  |  |
|  | Configuration *N*conf User AWV feedback ID for Antenna 1 | 11 bits | Indicates the RX AWV of the STA associated with the first TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | Configuration *N*conf User BRP CDOWN for Antenna 1 | 6 bits |
|  | Configuration *N*conf User RX Antenna ID for Antenna 1 | 3 bits |
|  | … |  |  |
|  | Configuration *N*conf Group User Mask for Antenna *N*TX | 32 bits | Indicates the STA(s) in the target MU group associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | Configuration *N*conf User 1 AWV feedback ID for Antenna *N*TX | 11 bits | Indicates the RX AWV of the first STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | Configuration *N*conf User 1 BRP CDOWN for Antenna *N*TX | 6 bits |
|  | Configuration *N*conf User 1 RX Antenna ID for Antenna *N*TX | 3 bits |
|  | … |  |  |
|  | Configuration *N*conf User AWV feedback ID for Antenna *N*TX | 11 bits | Indicates the RX AWV of the STA associated with the *N*TX TX DMG antenna in the *N*conf MU-MIMO transmission configuration. |
|  | Configuration *N*conf User BRP CDOWN for Antenna *N*TX | 6 bits |
|  | Configuration *N*conf User RX Antenna ID for Antenna *N*TX | 3 bits |  |

The Element ID, Length and Element ID Extension fields are defined in 9.4.2.1 (General).

The Configuration *i* Group User Mask for Antenna *j* field (*i* = 1, 2, …, *Nconf* and *j* = 1, 2, …, *N*TX) is a bitmap that indicates whether each of EDMG STAs in the target MU group is associated with the *j-*th TX DMG antenna in the *i*-th MU-MIMO transmission configuration. A MU-MIMO transmission configuration defines a specific subset of STAs in the target MU group and their respective RX AWVs to be used for receiving DL MU-MIMO data transmission. The order of EDMG STAs in the Configuration *i* Group User Mask for Antenna *j* field follows the order in which they appear in the corresponding EDMG Group field of EDMG Group ID Set element containing the target MU group. The first bit (i.e., the least significant bit) corresponds to the first EDMG STA, and the second bit corresponds to the second EDMG STA, and so on. A bit is set to 1 to indicate the corresponding STA is associated with the *j* TX DMG antenna in the *i* MU-MIMO transmission configuration; otherwise the bit is set to 0. If the number of EDMG STAs in the target MU group is smaller than 32, the corresponding bits in the Configuration *i* Group User Mask for Antenna *j* field (*i* = 1, 2, …, *Nconf* and *j* = 1, 2, …, *N*TX) shall be set to 0.

The Uplink Type MU-MIMO Transmission Configuration field shall not be present in the MIMO BF Selection frame when the MU-MIMO Transmission Configuration Type field is set to 1; and the Downlink Type MU-MIMO Transmission Configuration field shall not be present in the MIMO BF Selection frame when the MU-MIMO Transmission Configuration Type field is set to 0.

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10.38.9.2.4.3.2 Downlink MIMO phase

***#4: Change the last paragraph in this clause as follows:***

The initiator shall initiate the MU-MIMO BF selection subphase an MBIFS following reception of the MIMO BF Feedback frame from the last remaining responder. In the MU-MIMO BF selection subphase, the initiator shall transmit one or more MIMO BF Selection frames with the MU-MIMO Transmission Configuration Type set to 1 to each responder in the MU group. The initiator should transmit the minimum number of MIMO BF Selection frames to reach all responders in the MU group. The MIMO BF Selection frames should be sent using the DMG control mode. The TA field of the MIMO BF Selection frame shall be set to the BSSID of the initiator and the RA field shall be set to the broadcast address. Each MIMO BF Selection frame contains the dialog token in the Dialog Token field for identifying the MU-MIMO BF training, the EDMG group ID for the MU group in the EDMG Group ID field and the number of MU-MIMO transmission configurations, *N*conf, in the Number of MU-MIMO Transmission Configurations field. Each MIMO BF Selection frame shall indicate which responder(s) in the MU group is associated with each of *N*TX TX DMGantennas for each of *N*conf MU-MIMO transmission configurations in the Configuration *i* Group User Mask for Antenna *j* subfield (*i* = 1, 2, …, *Nconf* and *j* = 1, 2, …, *N*TX). Each MIMO BF Selection frame shall also indicate the TX sector of each of *N*TX TX DMGantennas and the corresponding RX AWVs of all associated responders used in each of *N*conf MU-MIMO transmission configurations in the Configuration *i* User *k* SISO ID Subset Index for Antenna *j* subfield (*k* = 1,2, …, , *i* = 1, 2, …, *Nconf* and *j* = 1, 2, …, *N*TX).

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10.38.9.2.3.3 Uplink MIMO phase

***#5: Change the last paragraph in this clause as follows:***

The initiator shall initiate the MU-MIMO BF selection subphase an MBIFS following reception of the EDMG BRP RX/TX packet with the BRP CDOWN field set to 0 from the last responder in the MU group. In the MU-MIMO BFselection subphase, the initiator shall transmit one or more MIMO BF Selection frame with the MU-MIMO Transmission Configuration Type set to 0 to each responder in the MU group. The initiator should transmit the minimum number of MIMO BF Selection frames to reach all responders in the MU group. The MIMO BF Selection frames should be sent using the DMG control mode. The TA field of the MIMO BF Selection frame shall be set to the BSSID of the initiator and the RA field shall be set to the broadcast address. Each MIMO BF Selection frame contains the dialog token in the Dialog Token field for identifying the MU-MIMO training, the EDMG group ID for the MU group in the EDMG Group ID field and the number of MU-MIMO transmission configurations, *N*conf, in the Number of MU-MIMO Transmission Configurations field. Each MIMO BF Selection frame shall indicate which responder(s) in the MU group is associated with each of *N*TX TX DMGantennas for each of *N*conf MU-MIMO transmission configurations in the Configuration *i* Group User Mask for Antenna *j* subfield (*i* = 1, 2, …, *Nconf* and *j* = 1, 2, …, *N*TX). Each MIMO BF Selection frame shall also indicate the RX AWVs of all responders associated with each of *N*TX TX DMGantennas used in each of *N*conf MU-MIMO transmission configurations in the Configuration *i* User *k* AWV feedback ID for Antenna *j* subfield, the Configuration *i* User *k* BRP CDOWN for Antenna *j* subfield and the Configuration *i* User *k* RX Antenna ID for Antenna *j* subfield (*k* = 1,2, …, , *i* = 1, 2, …, *Nconf* and *j* = 1, 2, …, *N*TX).

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***#6: Change 9.4.2.254 as follows:***

* + - 1. EDMG Group ID Set element

The EDMG Group ID Set element allows an AP or PCP to define groups of MU capable EDMG STAs to perform DL MU-MIMO beamforming training and transmissions. The EDMG Group ID Set element is transmitted in DMG Beacon or Announce frames.

The format of the EDMG Group ID Set element is shown in Figure 43.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | Length | Element ID Extension | Number of EDMG Groups | EDMG Group 1 | … | EDMG Group NG |
| Octets: | 1 | 1 | 1 | 1 | Variable | … | Variable |

Figure 43—EDMG Group ID Set element format

The Element ID, Length and Element ID Extension fields are defined in 9.4.2.1.

The Number of EDMG Groups field indicates the number of EDMG Group fields.

The EDMG Group field defines a group and is formatted as shown in Figure 44.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | EDMG Group ID | Group Size (Nu) | AID 0 | AID 1 | … | AID Nu | Reserved |
| Bits: | 8 | 5 | 8 | 8 | … | 8 | 3 |

Figure 44—EDMG Group field format

The EDMG Group ID subfield is a unique, nonzero value that identifies the group.

The Group Size subfield indicates the number of EDMG STAs that belongs to the group.Each AID subfield contains the AID of an EDMG STA that belongs to the group.

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***#7: Change Table 31 as follows:***

Table 31—Control trailer definition when CT\_TYPE is GRANT\_RTS\_CTS2self

|  |  |  |  |
| --- | --- | --- | --- |
| Field | Number of bits | Start bit | Description |
| Channel Aggregation | 1 | 0 | See Table 17 |
| BW | 8 | 1 | See Table 17 |
| Primary Channel Number | 3 | 9 | See Table 17 |
| SISO/MIMO | 1 | 12 | Set to 0 to indicate that the following transmission from this STA is performed in SISO. Set to 1 to indicate that the following transmission from this STA is performed in MIMO. |
| SU/MU MIMO | 1 | 13 | Set to 0 to indicate SU-MIMO, and set to 1 to indicate MU-MIMO. Reserved when the SISO/MIMO field is set to 0. |
| TX Sector Combination Index | 6 | 14 | Indicates the TX sector combination (as defined in 9.4.2.253) and the corresponding RX AWVs to be used in the following SU-MIMO transmission. Reserved if the SISO/MIMO field is set to 0 or the SU/MU MIMO field is set to 1. |
| EDMG Group ID | 8 | 20 | Indicates the EDMG Group ID of target MU group. Reserved if the SISO/MIMO field is set to 0 or the SU/MU MIMO field is set to 0. |
| MU-MIMO Transmission Configuration Type | 1 | 28 | Sets to 1 to indicate the MU-MIMO transmission configurations obtained from the MU-MIMO BF training of downlink type; and Sets to 0 to indicate the MU-MIMO transmission configurations obtained from MU-MIMO BF training of uplink type. Reserved if the SISO/MIMO field is set to 0 or the SU/MU MIMO field is set to 0. |
| MU-MIMO Transmission Configuration Index | 3 | 29 | Indicates the MU-MIMO transmission configuration (as defined in 9.4.2.x MIMO Selection Control element) to be used in the following MU-MIMO transmission. Reserved if the SISO/MIMO field is set to 0 or the SU/MU MIMO field is set to 0. |
| ~~Number of SS~~ | ~~3~~ | ~~14~~ | ~~The value of this field plus one indicates the number of SSs transmitted to the EDMG STA that is the recipient of the control trailer. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS1~~ | ~~6~~ | ~~17~~ | ~~This field indicates the sector that the transmitter of this control trailer uses for SS1. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS1~~ | ~~2~~ | ~~23~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS1. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS1~~ | ~~2~~ | ~~25~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS1. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS2~~ | ~~6~~ | ~~27~~ | ~~This field indicates the sector that the transmitter of this control trailer uses for SS2. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS2~~ | ~~2~~ | ~~33~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS2. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS2~~ | ~~2~~ | ~~35~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS2. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS3~~ | ~~6~~ | ~~37~~ | ~~This field indicates the sector that the transmitter of this control trailer uses for SS3. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS3~~ | ~~2~~ | ~~43~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS3. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS3~~ | ~~2~~ | ~~45~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS3. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS4~~ | ~~6~~ | ~~47~~ | ~~This field indicates the sector that the transmitter of this control trailer uses for SS4. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS4~~ | ~~2~~ | ~~53~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS4. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS4~~ | ~~2~~ | ~~55~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS4. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS5~~ | ~~6~~ | ~~57~~ | ~~This field indicates the sector that the transmitter of this control trailer uses for SS5. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS5~~ | ~~2~~ | ~~63~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS5. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS5~~ | ~~2~~ | ~~65~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS5. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS6~~ | ~~6~~ | ~~67~~ | ~~This field indicates the sector that the recipient of this control trailer uses for SS6. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS6~~ | ~~2~~ | ~~73~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS6. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS6~~ | ~~2~~ | ~~75~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS6. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS7~~ | ~~6~~ | ~~77~~ | ~~This field indicates the sector that the transmitter of this control trailer uses for SS7. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS7~~ | ~~2~~ | ~~83~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS7. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS7~~ | ~~2~~ | ~~85~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS7. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX Sector ID for SS8~~ | ~~6~~ | ~~87~~ | ~~This field indicates the sector that the recipient of this control trailer uses for SS8. Reserved if SISO/MIMO is set to 0.~~ |
| ~~TX DMG antenna ID for SS8~~ | ~~2~~ | ~~93~~ | ~~This field indicates the DMG antenna that the transmitter of this control trailer uses for SS8. Reserved if SISO/MIMO is set to 0.~~ |
| ~~RX DMG antenna ID for SS8~~ | ~~2~~ | ~~95~~ | ~~This field indicates the DMG antenna that the recipient of this control trailer uses for SS8. Reserved if SISO/MIMO is set to 0.~~ |
| Reserved | 95 | 32 | Set to 0 by the transmitter and ignored by the receiver. |
| CTCS | 16 | 127 | Contains the CRC-16 computed over the content of the control trailer. This field is computed as defined in section 20.3.7 |

**Straw Poll:**

* **Do you agree to accept the proposed text modifications in doc 11-17/1184r2?**