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Title	**Allowing more than one stream with DL MIMO Mode 2 in NLRU subchannelization (Section 15.3.7.2.4)**
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Re:	Category: P802.16m/D2 comments for LB30a Area: Section 15.3.7.2.4 (DL-MIMO)
Abstract	Table 827 currently limits MIMO Mode 2 (CL-SU-MIMO) to only one stream in NLRU subchannelization. This contribution presents simulation results that show gains from allowing MIMO Mode 2 to use both 1 and 2-streams in NLRUs.
Purpose	Discuss and adopt
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Allowing more than one stream with DL MIMO Mode 2 in NLRU subchannelization (Section 15.3.7.2.4)

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1. Introduction

In the DL MIMO section of the D2 draft, Table 827 forbids the use of more than one stream with MIMO Mode 2 transmission in mini-band LRUs (NLRUs). This restriction is unnecessary. We present system level simulation results showing that adaptively switching between one and two streams with MIMO mode 2 in NLRU can provide gains over the case where only one stream is used. These gains are quite significant in reuse 3 scenarios. This contribution proposes removing the rate-one-only restriction from DL MIMO Mode 2 with NLRU in Table 827.

2. Simulation Results

The parameters of the system simulation are shown in Table 1.

Table 1 System level simulation parameters

Parameter	**Values**
Bandwidth	10 MHz
Carrier frequency	2.0 GHz
Sectorization and frequency reuse plan	3 sectors/cell, reuse 3
Deployment scenario	Urban Macro (IMT-A 'UMa' configuration), user speed=30Km/hr
N_{FFT}	1024
Cyclic Prefix (CP) length	1/16
Frame length	5 msec
Number of OFDM symbols/Frame (excluding gaps)	48
Duplexing scheme	TDD; 5 DL sub-frames each with 6 OFDM symbols and 3 UL sub-frames with 6 OFDM symbols
Sub-channelization for data allocations	Mini-band CRUs with frequency without FFR

Multi-antenna Transmission Format for data	4x2 SU-MIMO with Codebook-based closed-loop beam-forming; 4x2 MU-MIMO with long-term beamforming based on channel correlation feedback
Scheduler	Proportional Fair
Modulation and Coding Schemes (MCS)	Choice of 64 possible MCS schemes inclusive of rate matching, repetition factor, and coding rate
CQI feedback delay	Periodic CQI feedback with period of 1 frame interval; the CQI delay is between 5 sub-frame and 9 sub-frame interval
Link to System Mapping	EESM
HARQ	Incremental Redundancy, maximum 3 HARQ retransmissions
Control channel overheads	Fixed overhead of 11.22%
Control signaling error	1%

Using the above simulator configuration, sector and cell-edge spectral efficiencies were estimated by simulation for the following three MIMO transmission schemes:

- **Scheme 1**: Single-User MIMO transmission with one streams
- **Scheme 2**: Single-User MIMO transmission with adaptively switching between one and two MIMO streams.
- **Scheme 3**: Adaptive switching between single stream Single-User MIMO transmission and MU-MIMO transmission with one stream per user

In **Table 2**, the sector and cell-edge spectral efficiencies normalized by the corresponding spectral efficiencies of the Scheme 1 are shown:

Table 2 Simulation results (spectral efficiencies normalized by Scheme 1 performances)

	Scheme 1: One stream SU-MIMO transmission	**Scheme 2: SU-MIMO transmission with adaptation between one or two streams depending on user channel condition**	**Scheme 3: Adaptive switching between single-stream SU-MIMO and MU-MIMO (single stream per user) transmission**
Sector spectral efficiency	1.0	1.45	1.15
Cell-edge spectral efficiency	1.0	1.0	0.99

The above simulation results show that by adaptively switching between one and two MIMO streams, the average sector spectral efficiency can be improved by about 45% over using only one MIMO stream in a 3sectors/cell configuration and frequency re-use 3 deployment in Urban Macro (UMa) environment. It is also shown that there is no loss in cell edge spectral efficiency by adaptively switching between one and two MIMO streams.

In **Table 2**, the simulation results also indicate that, adaptively switching between SU-MIMO and MU-MIMO transmission scheme with the restriction of only one MIMO streams per user provides much smaller gain over the SU-MIMO transmission scheme with one MIMO stream; the sector spectral efficiency improved by 15% while there were no noticeable change in the cell-edge spectral efficiency.

3. Proposed Text Changes

[Modify Table 827 on page 310 as follows:]

Table 827—Supported Permutation for each DL MIMO mode outside the OL region

	DLRU	NLRU	SLRU
MIMO mode 0	Yes	Yes	No
MIMO mode 1	Yes, with M_t=2	Yes, with M_t4≤	Yes
MIMO mode 2	No	Yes~~, with M_t=1~~	Yes
MIMO mode 3	No	No	Yes
MIMO mode 4	No	Yes	Yes
MIMO mode 5	No	No	No

[Modify Table 831 on page 414 as follows:]

Delete (Mt=1) in the row that starts on line 40.

[Modify Table 887 on page 503 as follows:]

Table 887—Feedback formats for MIMO feedback mode 0, 1, 4, and 7

MFM	FBCH	Number of reports	Report Period	Feedback Fields	Size in bits	Description/Notes
0	PFBCH	2	Short	Wideband CQI and STC rate	N/A	Joint encoding of CQI and STC rate Encoding type 0
			Long	Wideband CQI and STC rate	N/A	Joint encoding of CQI and STC rate Encoding type 0 Long term FPI for FFR

1	PFBCH	2	Short	Wideband CQI and STC rate	N/A	Joint encoding of CQI and STC rate Encoding type 0
			Long	Wideband CQI and STC rate	N/A	Joint encoding of CQI and STC rate Encoding type 0. Long term FPI for FFR
4	PFBCH	2	Short	Wideband CQI and STC rate	N/A	~~STC rate = 1~~ Encoding type 0
			Long	Wideband PMI	N/A	PMI ~~for rank 1~~ Encoding type 2
7	PFBCH	2	Short	Wideband CQI	N/A	STC rate = 1 Encoding type 0
			Long	Wideband PMI	N/A	PMI for rank 1 Encoding type 2

[Modify Table 666 on page 28 (starting at line 7) as follows:]

}		
If (MFM == 4 ~~or 7~~){		
Wideband STC rate	1 to 2	Depending on MaxMt
Wideband CQI	4	
Wideband PMI	3 to 6	Depending on Nt and CS
}		
If (MFM == 7){		
Wideband CQI	4	
Wideband PMI	3 to 6	Depending on Nt and CS
}		
If (MFM == 2){		