Proposal for burst partition, bit selection and repetition

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Venue:

IEEE 802.16m-08/053r1, “Call for Comments and Contributions on Project 802.16m Amendment Working Document”,

Target Topic: “Channel coding and HARQ”

Base Contribution:

None

Purpose:

To be discussed and adopted by TGm for 802.16m amendment

Proposal for burst partition, bit selection and repetition

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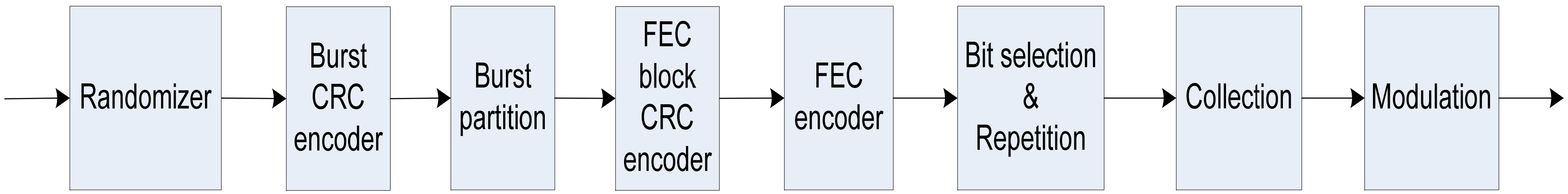
About This Contribution

- Goal and scope of this contribution
  - Propose schemes for burst partition, bit selection and repetition
- Issue to be addressed in this contribution
  - Block diagram of channel coding chain for IEEE 802.16m
  - Burst partition rule
  - Resource segmentation rule
  - Bit selection and repetition rule
  - Starting position for IR HARQ transmission

Block diagram of channel coding chain

- When the burst size including burst CRC exceeds maximum FEC block size, the burst is partitioned into the several blocks.
- Bit selection and repetition is performed to generate the subpacket



Burst partition

- Burst is partitioned when it exceeds N_{EP_MAX}.
- The size of each partitioned burst is same as N_{EP}, the FEC input block size.

$$NUM\_FEC\_BLOCK = \lceil MOD \cdot CodeRate \cdot N_{RE} / N_{EP\_MAX} \rceil$$

$$N_{EP} = \underset{X \in \{N_{EP}\}}{\arg\max}\, X \le (MOD \cdot CodeRate \cdot N_{RE} / NUM\_FEC\_BLOCK)$$

- N_{RE} is the number of resource element allocated for burst transmission.
- N_{EP_MAX} = 4800 bit
- $\{N_{EP}\}$ is a set of FEC encoder input

Burst partition

- $\{N_{EP}\}$ – the set of FEC encoder input

Index	Nep	Index	Nep	Index	Nep	Index	Nep	Index	Nep	Index	Nep	Index	Nep
1	48	24	264	46	472	68	800	90	1312	112	2048	134	3456
2	64	25	272	47	480	69	816	91	1352	113	2112	135	3520
3	72	26	288	48	488	70	832	92	1376	114	2176	136	3592
4	80	27	296	49	496	71	848	93	1408	115	2248	137	3648
5	88	28	304	50	512	72	864	94	1440	116	2304	138	3712
6	96	29	312	51	528	73	880	95	1472	117	2368	139	3776
7	104	30	320	52	544	74	904	96	1504	118	2432	140	3840
8	120	31	328	53	568	75	912	97	1536	119	2496	141	3904
9	128	32	344	54	576	76	928	98	1576	120	2560	142	3968
10	136	33	352	55	592	77	944	99	1600	121	2624	143	4040
11	144	34	360	56	608	78	960	100	1632	122	2696	144	4096
12	152	35	368	57	624	79	976	101	1664	123	2752	145	4160
13	160	36	376	58	640	80	992	102	1696	124	2816	146	4224
14	176	37	384	59	656	81	1024	103	1728	125	2880	147	4288
15	184	38	400	60	680	82	1056	104	1760	126	2944	148	4352
16	192	39	408	61	688	83	1088	105	1800	127	3008	149	4416
17	200	40	416	62	704	84	1128	106	1824	128	3072	150	4488
18	208	41	424	63	720	85	1152	107	1856	129	3144	151	4544
19	216	42	432	64	736	86	1184	108	1888	130	3200	152	4608
20	232	43	440	65	752	87	1216	109	1920	131	3264	153	4672
21	240	44	456	66	768	88	1248	110	1952	132	3328	154	4736
22	248	45	464	67	792	89	1280	111	1984	133	3392	155	4800
23	256												

Burst partition

- The burst size N_B including burst CRC and FEC block CRC

$$N_B = NUM\_FEC\_BLOCK \times N_{EP}$$

- The pure payload size excluding burst CRC and FEC block CRC

$$N_{PAYLOAD} = NUM\_FEC\_BLOCK \times (N_{EP} - k \times N_{CRC-FEC}) - N_{CRC-BURST}$$

  - k is 0 when NUM_FEC_BLOCK=1, 1 when NUM_FEC_BLOCK>1
  - $N_{CRC-FEC}$ is the size of FEC block CRC equal to 16 bits
  - $N_{CRC-BURST}$ is the size of burst CRC equal to 16 bits

Resource segmentation

- Simple rules for resource segmentation
  - Each FEC block gets roughly the same number of resource elements

$$N_{RE\_PER\_FEC\_BLOCK_{i,k}} = \begin{cases} N_{RE_i} - (NUM\_FEC\_BLOCK - 1) \cdot \left\lfloor \frac{N_{RE_i}}{NUM\_FEC\_BLOCK} \right\rfloor, & k = 0, \\ \left\lfloor \frac{N_{RE_i}}{NUM\_FEC\_BLOCK} \right\rfloor & k = 1, \cdots, NUM\_FEC\_BLOCK\text{-}1 \end{cases}$$

$$N_{i,k} = N_{RE\_PER\_FEC\_BLOCK_{i,k}} \cdot MOD_i$$

  - i is a HARQ-subpacket index.
  - k is an index from 0 to NUM_FEC_BLOCK-1 for k-th FEC block.
  - $N_{i,k}$ is the number of codeword bits that shall be transmitted from the k-th FEC encoder output for the i-th HARQ-subpacket.
  - MOD_i is a modulation order for the i-th HARQ-subpacket.

Bit selection and repetition

- Let the selected bit be numbered from zero with the 0-th bit being the first bit in the sequence. Then, the index of the *j*-th bit from the *k*-th FEC encoder output for the *i*-th HARQ-subpacket shall be:

$$S_{i,j} = (P_i + j) \bmod (3 \cdot N_{EP})$$

  - j is a running index from 0 to $N_{i,k}$ -1.
  - P_i is the starting position for the *i*-th HARQ-subpacket.

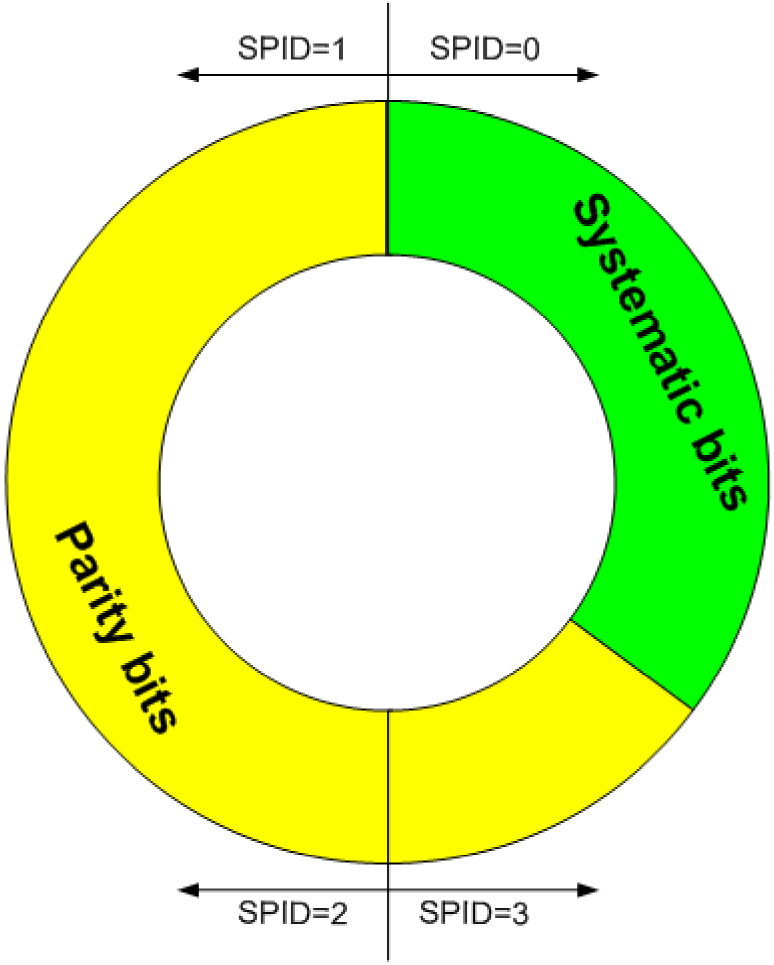
Starting position for IR HARQ transmission

- IR HARQ is used by changing the starting position of the bit selection for HARQ retransmissions.
- For uplink, it is determined as the end of the last transmission.
- For downlink, it is determined as a function of SPID
  - Necessary due to possible resource adaptation in retransmissions
  - 1 bit in the SPID indicating the starting position of the redundancy version
  - One starting position is the beginning of the buffer, i.e., the 1st bit
  - The other starting position is in the middle of the buffer
  - 1 bit in the SPID indicating the direction the circular buffer is addressed

Starting position for IR HARQ transmission

- Starting position

SPID	Starting position (P_i)
0	0
1	$-N_{i,k} \bmod 3N_{EP}$
2	$\lfloor 3N_{EP}/2 \rfloor$
3	$\lfloor 3N_{EP}/2 \rfloor - N_{i,k} \bmod 3N_{EP}$



Text Proposal to 802.16m amendment

- Proposed text for 802.16m amendment is captured in the contribution IEEE C80216m-09/0300 or its latest version at the following chapters:
  - 15.x.1. Channel coding
  - 15.x.1.4. Burst partition
  - 15.x.1.5. Bit selection and repetition
  - 15.x.2. HARQ
  - 15.x.2.1. IR HARQ