EPOC Upstream FEC Code Auto-Detection

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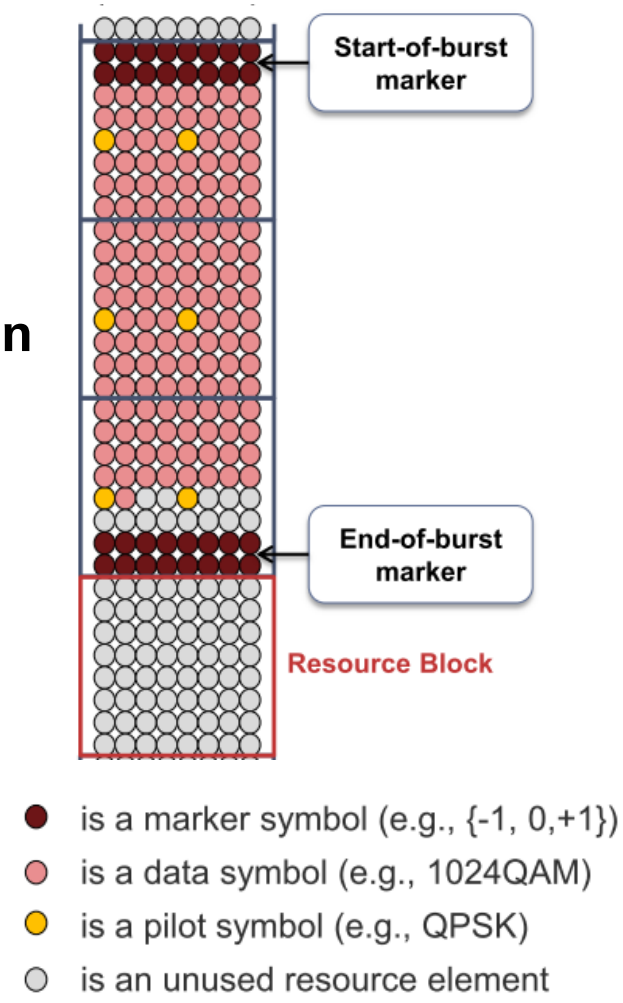
Current problem

- In EPOC, selecting appropriate FEC code of appropriate code length based on the burst length can improve the spectral efficiency.
- There will exist several FEC codes in EPOC upstream. But there is no special control channel (not defined yet) to transmit FEC code between CLT and CNU.
- So how does CLT get FEC code that CNU uses efficiently.

Disadvantages of using burst markers

- FEC code may be transmitted using burst markers.
- It will increase the number of subcarriers in burst marker.
- If more than one FEC types are used in a burst, then more subcarriers may be used.



Proposed FEC code auto-detection method

- CNU and CLT can both use burst markers as burst delimiters to determine the boundary of the code word.

- FEC type can be determined according to the number of bits transmitted by the CNU or received by CLT in real time.
  - ✓ The number of bits is counted in real time. If the number is larger than some threshold, then some corresponding FEC code will be determined for this codeword. After that we restart to count the number of bits, and determine the code of the next codeword. This process will go on till the end marker.

- Multiple FEC types can be used in a burst in order to improve the efficiency.

Method description

Assuming three LDPC codes :

LDPC type	Information Length	Code Length	Check bit length	Code Rate
0	14400	16200	1800	0.889
1	5040	5940	900	0.848
2	850	1120	270	0.75

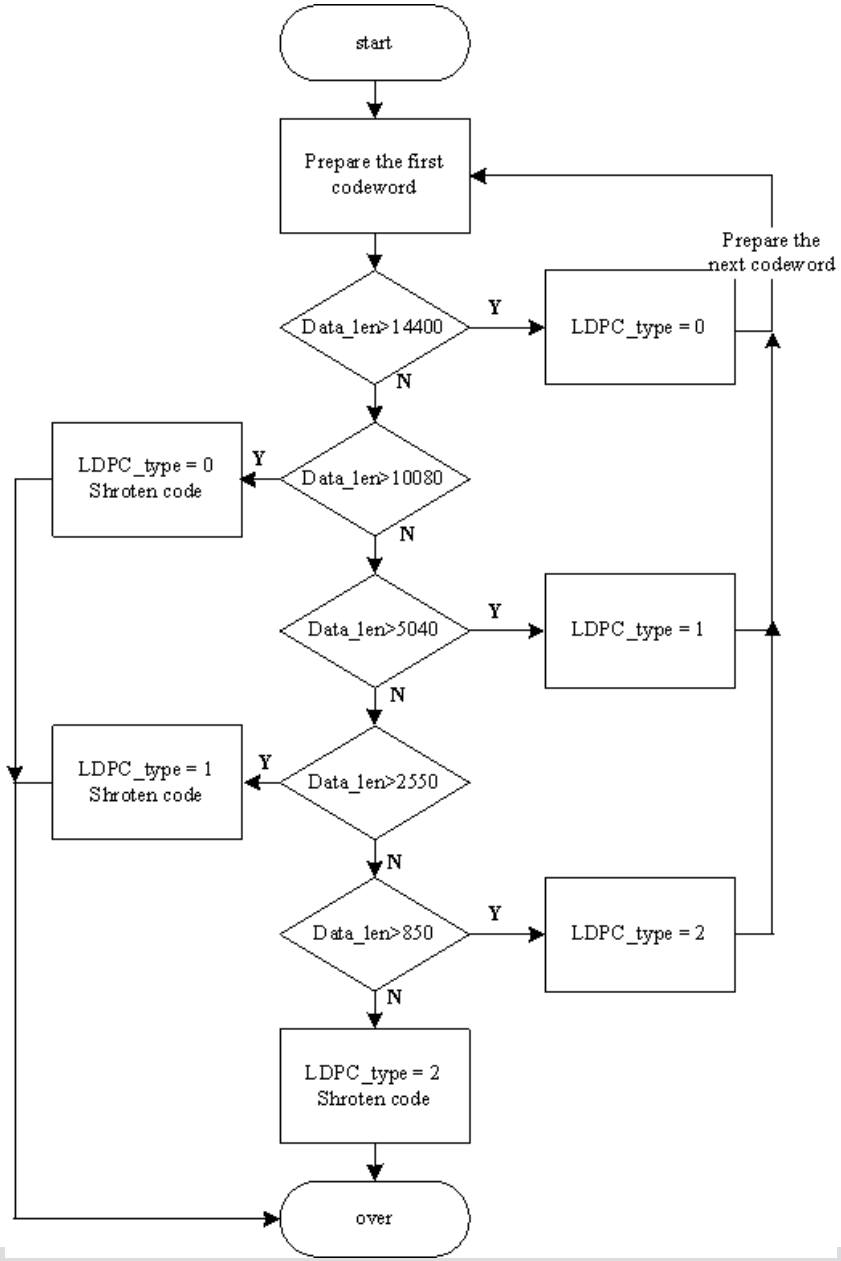
FEC codeword type selection rule for transmitting:

- If transmitting length of bits exceeds information length 14400, then LDPC type zero will be used.
- Else if transmitting length of bits exceeds length 10080 (5040*2), then shorten code of LDPC type zero will be used.
- Else if transmitting length of bits exceeds information length 5040, then LDPC type one will be used.
- Else if transmitting length of bits exceeds length 2550 (850*3), then shorten code of LDPC type one should be used.
- Else if transmitting length of bits exceeds information length 850, then LDPC type two should be used.
- Else shorten code of LDPC type two will be used.

FEC codeword type selection rule for receiving:

- If receiving length of bits exceeds codeword length 16200 (14400+1800), then LDPC type zero will be used.
- Else if receiving length of bits exceeds length 11880 (10080+1800), then shorten code of LDPC type zero will be used.
- Else if receiving length of bits exceeds information length 5940 (5040+900), then LDPC type one will be used.
- Else if receiving length of bits exceeds length 3450(2550+900), then shorten code of LDPC type one should be used.
- Else if receiving length of bits exceeds information length 1120 (850+270), then LDPC type two should be used.
- Else shorten code of LDPC type two will be used.

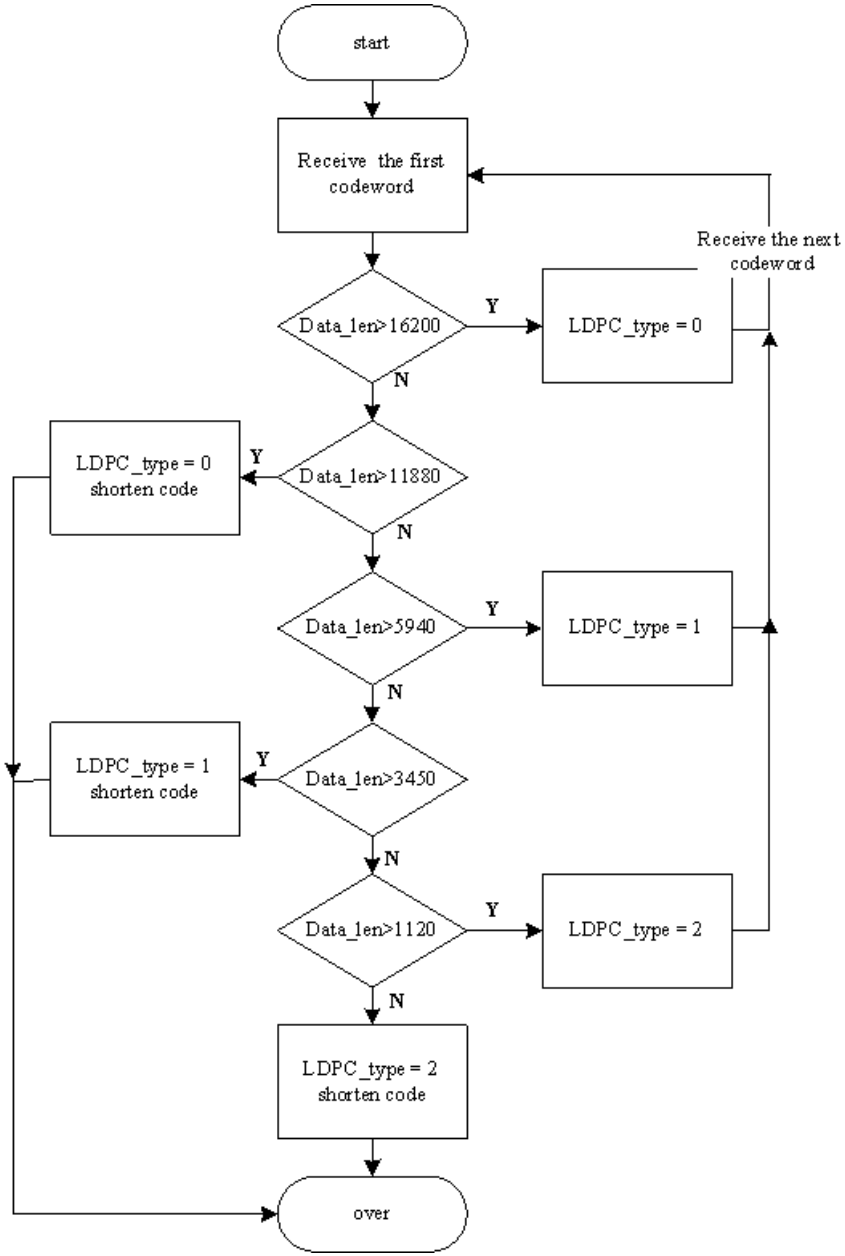
Transmission Flow chart



Code type determining rule for transmitting:

- If transmitted number of bits surpasses 14400, the 14400 bits are coded using long code (type zero).
- Then restart to count transmitted number of bits.
- If the number is less than 14400 but more than 10080, the remaining bits of current burst are coded using shortened code word of long code.
- If the number is less than 10080 but more than 5040, the 5040 bits are coded using medium code (type one).
- Then restart to count transmitted number of bits.
- If the number is less than 5040 but more than 2550, the remaining bits of current burst are coded using shortened code word of medium code.
- If the number is less than 2550 but more than 850, the 850 bits are coded using short code (type two).
- Then restart to count transmitted number of bits.
- If the number is less than 850 but more than 0, the remaining bits of current burst are coded using shortened code word of short code.

Receiving Flow chart



Code type determining rule for receiving:

- If received bit number surpasses 16200, the 16200 bits are decoded using long code (type zero).
- Then restart to count received number of bits.
- If the number is less than 16200 but more than 11880, the remaining bits of current burst are decoded using shorten code of long code.
- If the number is less than 11880 but more than 5940, the 5940 bits are decoded using medium code (type one).
- Then restart to count received number of bits.
- If the number is less than 5940 but more than 3450, the remaining bits of current burst are decoded using shorten code of medium code.
- If the number is less than 3450 but more than 1120, the 1120 bits are decoded using short code (type two).
- Then restart to count received bit number.
- If the number is less than 1120 but more than 0, the remaining bits of current burst are decoded using shorten code of short code.

Advantages of FEC Code auto-Detection Method

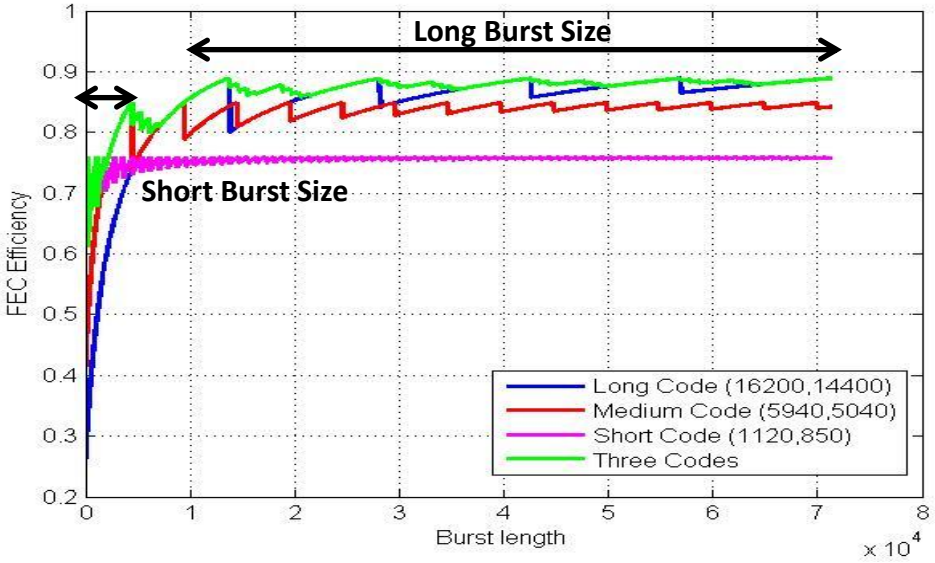
- **No need for additional resources to transfer FEC parameters. This can increase spectral efficiency.**
- **Optimizing selection of FEC codeword according to the bit steam of the burst are made to reduce the redundancy.**

Burst length is variable. If only one codeword is chosen for each burst, then it will generate many redundancies. But if multiple FEC types are used in a burst, a few redundancies will be generated.

E.g. Burst length = 14401 (bit)

- only long codeword (LDPC type 0 and shorten code) will generate 3600 redundancy bits (two codeword ,each generates 1800 check bits).
- only medium codeword (LDPC type 1 and shorten code) will generate 2700 redundancy(three codeword, each generates 900 check bits).
- only short codeword (LDPC type 2 and shorten code) will generate 4590 redundancy (seventeen codeword, each generates 270 check bits).
- Multiple FEC types and shorten code used in a burst only generate 2070 redundancy(one long code and one shorten short code)

Proposed Advantages



- We describe the relationships between burst length in bits and FEC efficiency for single FEC code and multiple FEC codes used in the same burst. For each FEC code, shorten code is supported.
- The figure shows that for short burst size, short code generates higher efficiency. For long burst size, long code generates higher efficiency.
- Multiple codes (three codes) always generate higher efficiency compared with others.

Conclusions

- An upstream FEC type auto-detection method based on the length of bit stream is proposed.
- Shorten codeword is supported.
- No additional frequency spectrum is used to transfer the FEC parameters.
- The method allow multiple FEC types are used in the same burst which can improve FEC efficiency greatly.

Thank You

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