Appendix A. Sync and Steering with Constant Overhead Word Stuffing (COWS)
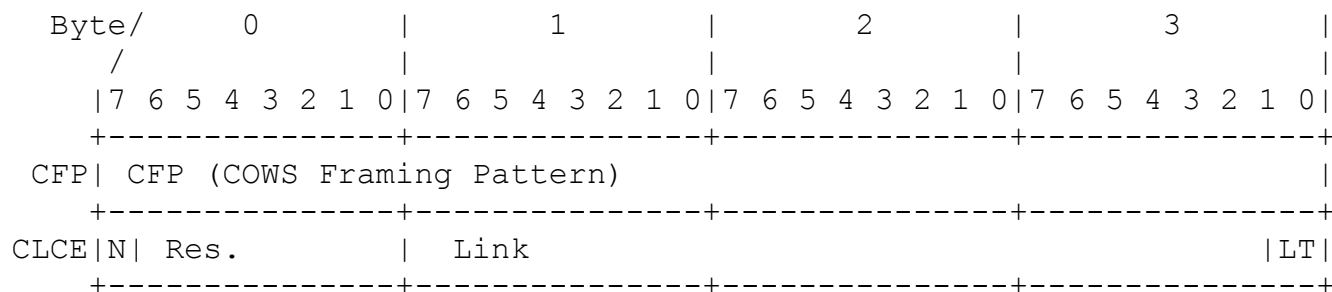
   This appendix presents a simple scheme for synchronization (PDU
   boundary retrieval). The basic mechanism described is inspired by
   [COBS]. However unlike the mechanism outlined in [COBS] there the PDU
   extended by 2 or 3 4 byte words regardless of the PDU length. With
   COWS:

      - the iSCSI PDU is "prefixed" by a 8 byte COWS header (CH)
        including a 4 byte word aligned COWS framing pattern (CFP) and
        a 4 byte COWS link chain element (CLCE)
      - any appearance of the pattern within the PDU is replaced by a
        forward or (for long payloads) a backward link to the next
        appearance of the pattern or to the end (for forward links) or
        an end of chain in indicator formatted as a CLCE.
      - the iSCSI PDU may be followed by trailer consisting of a sin-
        gle CLCE

   All those elements form a COWS Extended PDU (CEPDU)

   COWS uses a framing pattern defined by the sender and a special ver-
   sion of COWS that does not require pattern replacement but requires
   the sender to guarantee that a CH will always appear at the beginning
   of a TCP segment may be used by specialized software stacks and/or
   hardware adapters and its use may be negotiated (PDU Alignment Option
   - PAO).

   The CH format is:

```
    Byte/      0         |       1        |       2        |       3        |
     /                   |                |                |                |
       |7 6 5 4 3 2 1 0|7 6 5 4 3 2 1 0|7 6 5 4 3 2 1 0|7 6 5 4 3 2 1 0|
       +--------------+--------------+--------------+--------------+
   CFP| CFP (COWS Framing Pattern)                                 |
       +--------------+--------------+--------------+--------------+
  CLCE|N| Res.        | Link                                   |LT|
       +--------------+--------------+--------------+--------------+
```

   CFP is a pattern selected by the sender and communicated to the
   receiver during the login phase. A CFP has to be specified by the
   sender for each direction.

   Except for the PAO every occurrence of CFP within the payload is
   replaced by a CLCE.

The CLCE is composed of:

- N a bit is selected to be the complement of the corresponding
  bit in the Framing pattern
- Link - number of non-link 4 byte words to the next/previous
  link
- LT - link type coded as follows:
    - 00 - Forward Last Link - no more links follow - the Link
    field is the number of words to the end of PDU
    - 01 - Forward More Links - the link field is the number
    of words to the next link
    - 10 - Backward Last Link - the link field is 0
    - 11 - Backward More Links - the link field is the number
    of words from the preceding field

The LT field in the CH MUST be 00 or 01 and all CLCE within the iSCSI
header (if any) MUST have an LT field of 00 or 01 (the iSCSI header is
encoded ONLY with forward links).

The backward linking mechanism MAY be used by the sender to avoid
storing very long data payloads before sending them and MUST be pro-
cessed by the receiver.

If using backward linking the sender MUST include in the ECPDU a tail-
ing CLCE and the tailing CLCE is the first CLCE in the "back-tracking
chain" and MUST be linked to by the last CLCE in the "forward-tracking
chain".

COWS ECPDU can follow one of the following outlines:

    a) Only Forward Pointing

        CH (mandatory)
        .
        .
        Forward Pointing CLCE (optional)
        .
        .
        .
        Forward Pointing CLCE (optional)
        .

                .
          Last Payload Word

      b) Forward-and-Backward Pointing

          CH (mandatory)
                .
                .
          Forward Pointing CLCE (optional - may point to trailer if
          last forward)
                .
                .
                .
          Backward Pointing CLCE (optional - may have link of 0)
                .
                .
          Last Payload Word
          Backward Pointing CLCE (mandatory - may have a link of 0)

      c) PDU alignment option

          CH (mandatory)
                .
                .
                .
          Last Payload Word (also end of TCP segment)

   For cases a) and b) the payload on the wire is guaranteed not to con-
   tain a CFP a word aligned pattern anywhere but in CH. For case c) the
   CFP is supposed the appear only aligned to TCP segment boundaries and
   be implement with specialized software stacks and hardware. For this
   case the Link value, LT and the Reserved bits may is used as a further
   validity checks (TBD???).

   I all cases the iSCSI PDUs are not constrained to a one or a limited
   number of TCP segments.

A.1 Negotiation