

Wideband Channel Estimation in Upstream EPoC

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Introduction

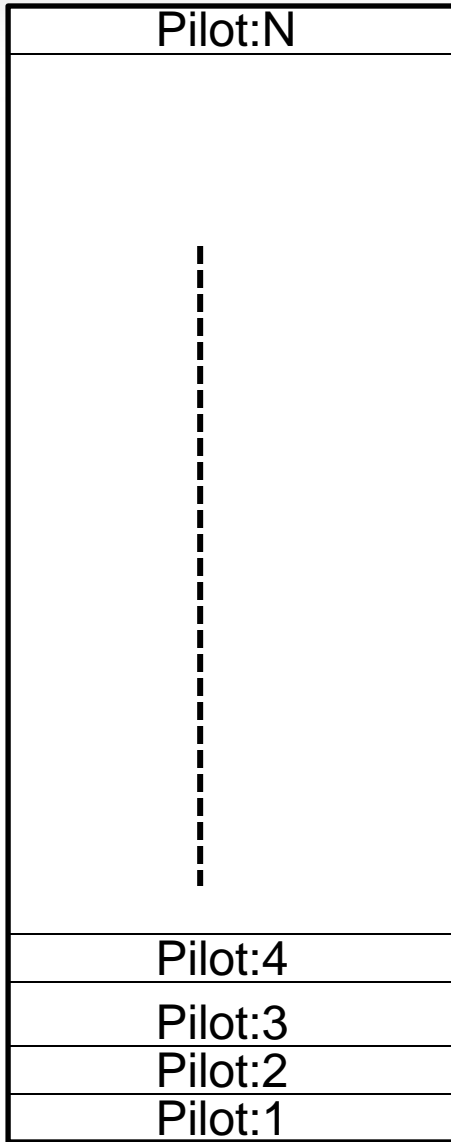
- The CLT needs to know the upstream channel conditions of each CNU, across the entire upstream bandwidth for:
 - measuring sub-carrier SNR (for bit loading)
 - for pre-equalization
- To estimate the upstream channel conditions of each CNU, across the full RF channel, CLT requires each CNU to transmit pilots that scan the entire upstream spectrum (OFDM symbol).
- The CNU transmit these pilots initially and also periodically.

Introduction-2

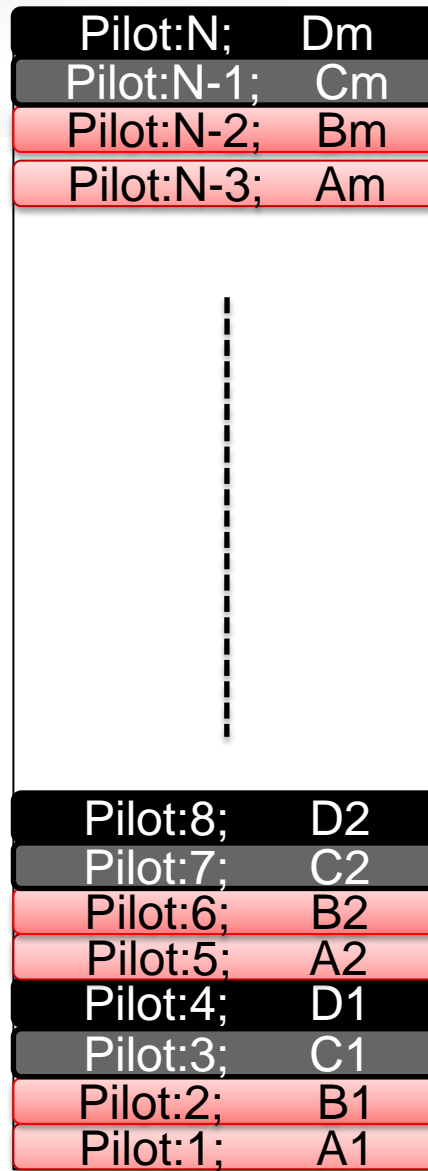
- The CNU can use all the sub-carriers of a OFDM symbol to transmit the pilots. But this is a highly inefficient usage of the bandwidth.
- This proposal, provides a scheme, which allows multiple CNU's to share the same OFDM symbol, to transmit their respective pilots, and yet scan the entire OFDM symbol.

Proposed Scheme

- The OFDM symbol is divided into a set of orthogonal “Probing Resource Blocks” (PRBs).
- Each PRB is a group of scattered pilots scanning the entire OFDM symbol.
- The OFDM symbol used for these pilots, shall be called as probing symbol.

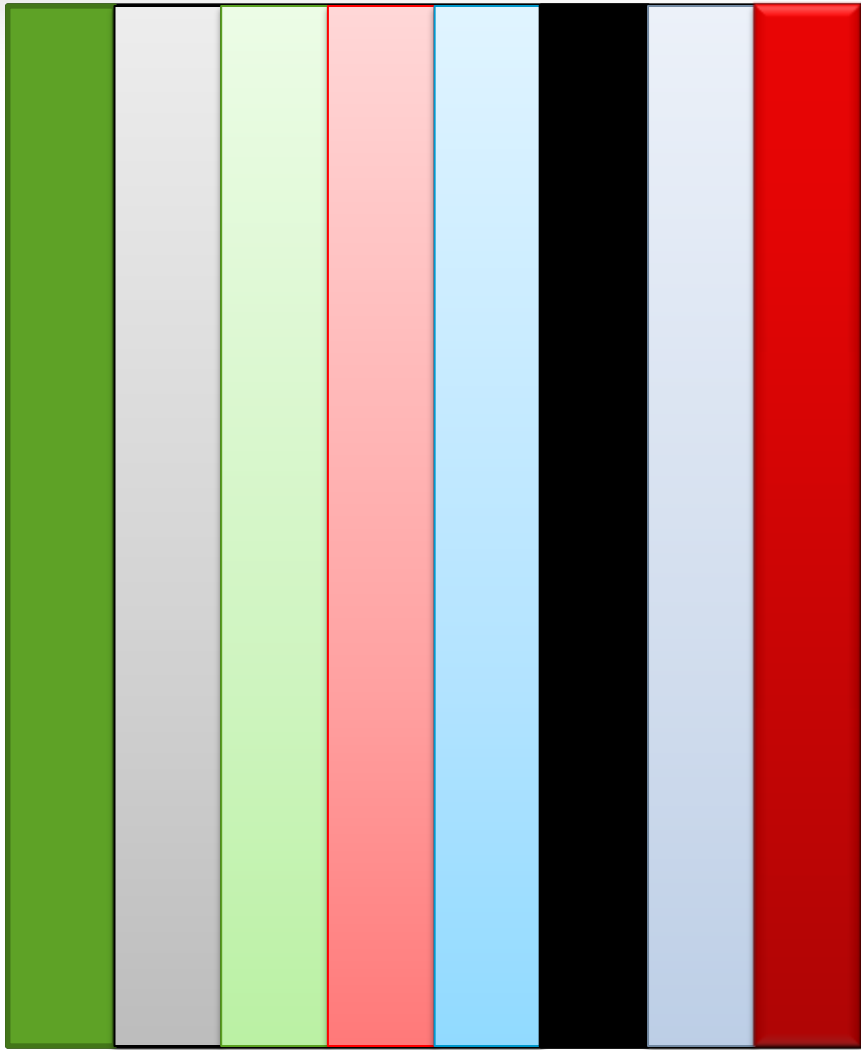


One Probing symbol per CNU

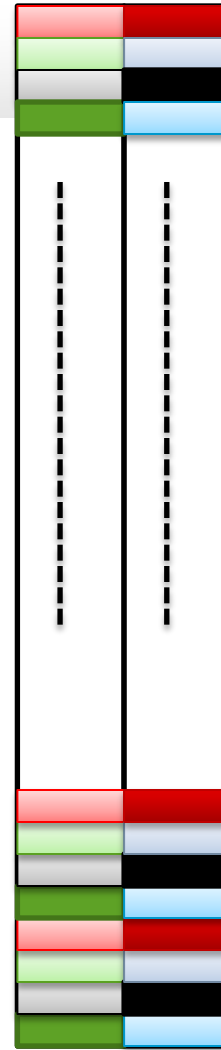


Proposed Probing Symbol :
One probing symbol for 4 CNU in this example

Example of Probing 4 CNU in 1 Symbol:
 A1,A2,...,Am are pilots for PRB-A / CNU1
 B1,B2,...,Bm are pilots for PRB-B / CNU2
 C1,C2,...,Cm are pilots for PRB-C / CNU3
 D1,D2,...,Dm are pilots for PRB-D / CNU4



Probing 8 CNU's using 8 symbols



Proposed structure example:
Probing 4 CNU's in 1 Symbol
or 8 CNU's using 2 Symbols

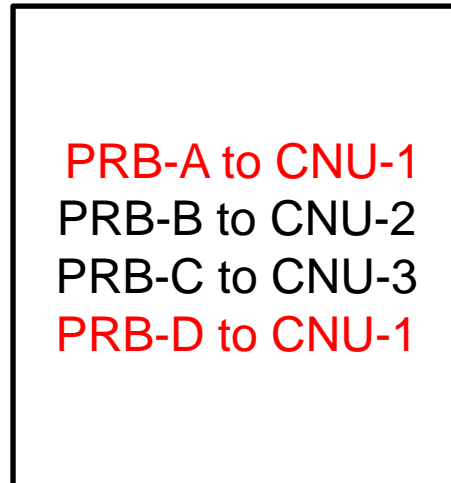
Defining PRBs

- Option-1: The PRBs can be pre-defined in the standard.
- Option-2 (Recommended option):
 - The CLT defines 'M' (the total number of PRBs) in the probing symbol (suggested number of bits for 'M' is 4, to probe up to 16 CNU within a symbol)
 - The CLT transmits only 'M' and 'i' (The PRB number) to the CNU (suggested number of bits for 'i' is 4)
 - Using the values of 'M' and 'i' the CNU can figure out the sub-carriers of the PRB, within the probing symbol using the following rules:
 - i-th PRB will start from i-th Sub-carrier
 - The pilots of a PRB are separated by 'M' sub- carriers
 - When 'M' = 0, the CNU may ignore 'i', In this case the entire symbol is used by one CNU

Allocating PRB to CNU

- The CLT can allocate one or more PRBs to a particular CNU in the same OFDM symbol.

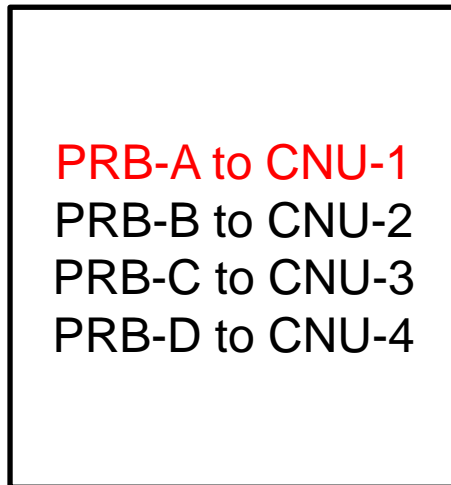
OFDM Symbol



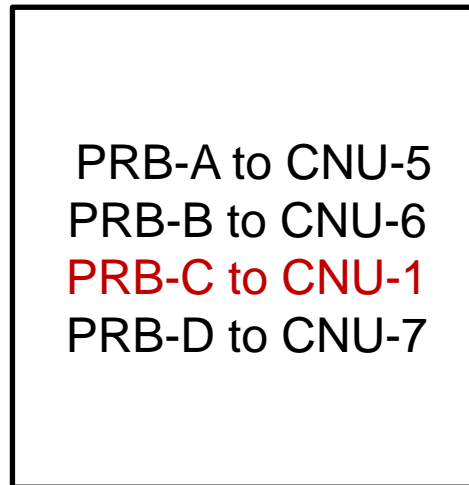
Allocating PRB to CNU...

- For the same CNU, the CLT can also allocate different PRBs in different OFDM symbols.

OFDM Symbol



OFDM Symbol



Advantages of the proposed structure

- **Bandwidth Efficiency:** The CLT can allocate multiple CNUMs in a single probing symbol. As an example, for 4 CNUMs the bandwidth efficiency of probing symbol is 4 times more.
- CLT Vendor differentiation.
- Highly flexible scheme.
- Very low CNUM overhead (~8 bits).



Thank you
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