Comments on Subchannelization

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Tal Kaitz
Alvarion
21a Habarzel St.
P.O. Box 13139, Tel-Aviv 61131, Israel

Voice: +972-3645273
Fax: +972-36456222
E-mail: tal.kaitz@alvarion.com

Venue:

Kauai HI

Base Document:

To support comment resolution process

Purpose:

Subchannelization related Comments

Alvarion

Background

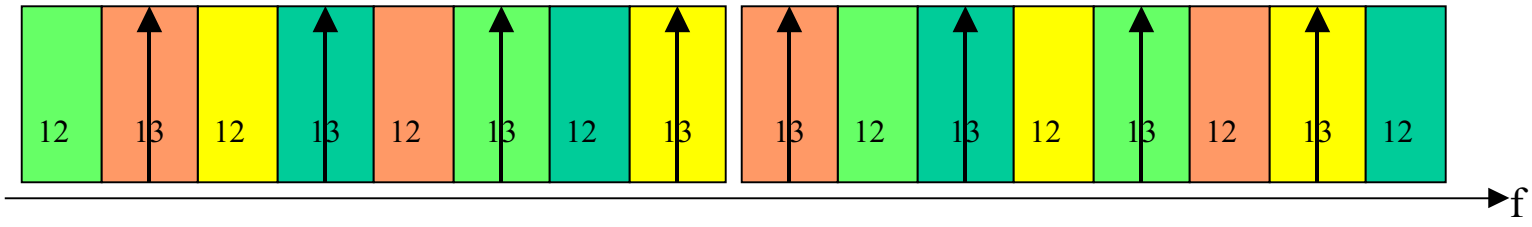
- In 802.16a-D6 a subchannelization was introduced as an optional feature in the OFDM mode.
- Subchannelization is a significant improvement of the OFDM mode:
  - Reduction of overheads for short packets
  - Reduction of data granularity.
  - Increase of 6dB in Uplink system budget.

Background- cntd.

- Subchannelization can be used to enhance the system performance.
- Different vendors may have different views on how to make the best use of the subchannelization.
- In the current draft, the use of subchannelization is *intentionally restricted*.
- In our view: without technical justification.
  - Subject of following slides.

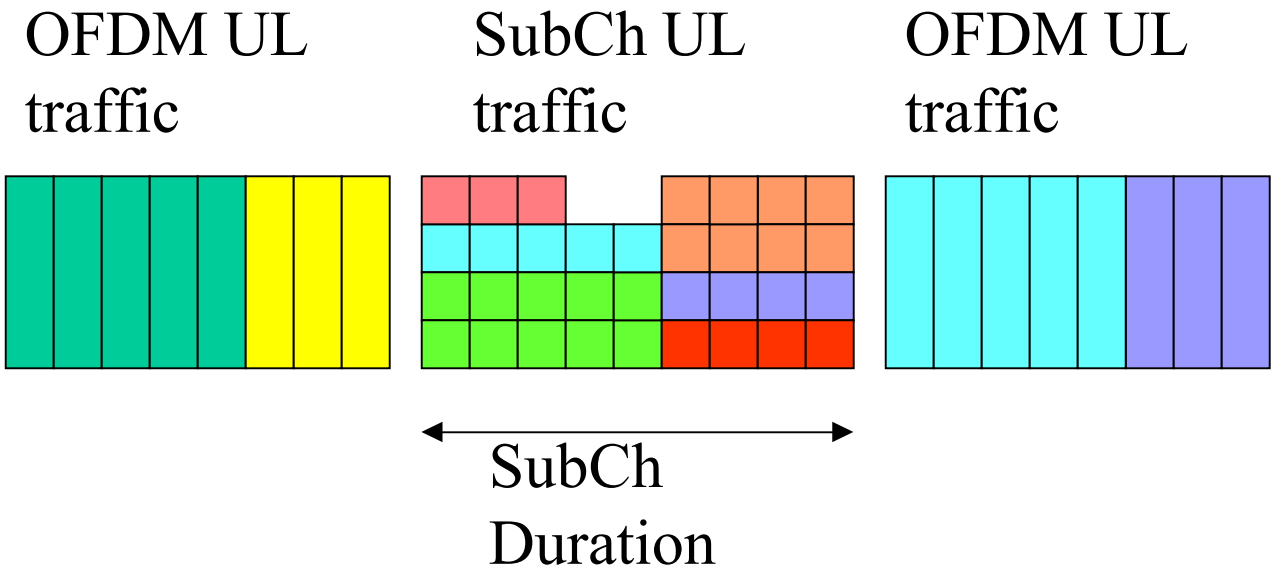
Subchannelization - Principles

- The UL band is divided into 4 subchannels.
- Each sub-channel is composed of 4 contiguous groups of subcarriers.
- Each group contains 12 or 13 subcarriers.
- A compromise between low interference and good frequency diversity.
- The full bandwidth OFDM mode is a special case where all 4 subchannels are used.

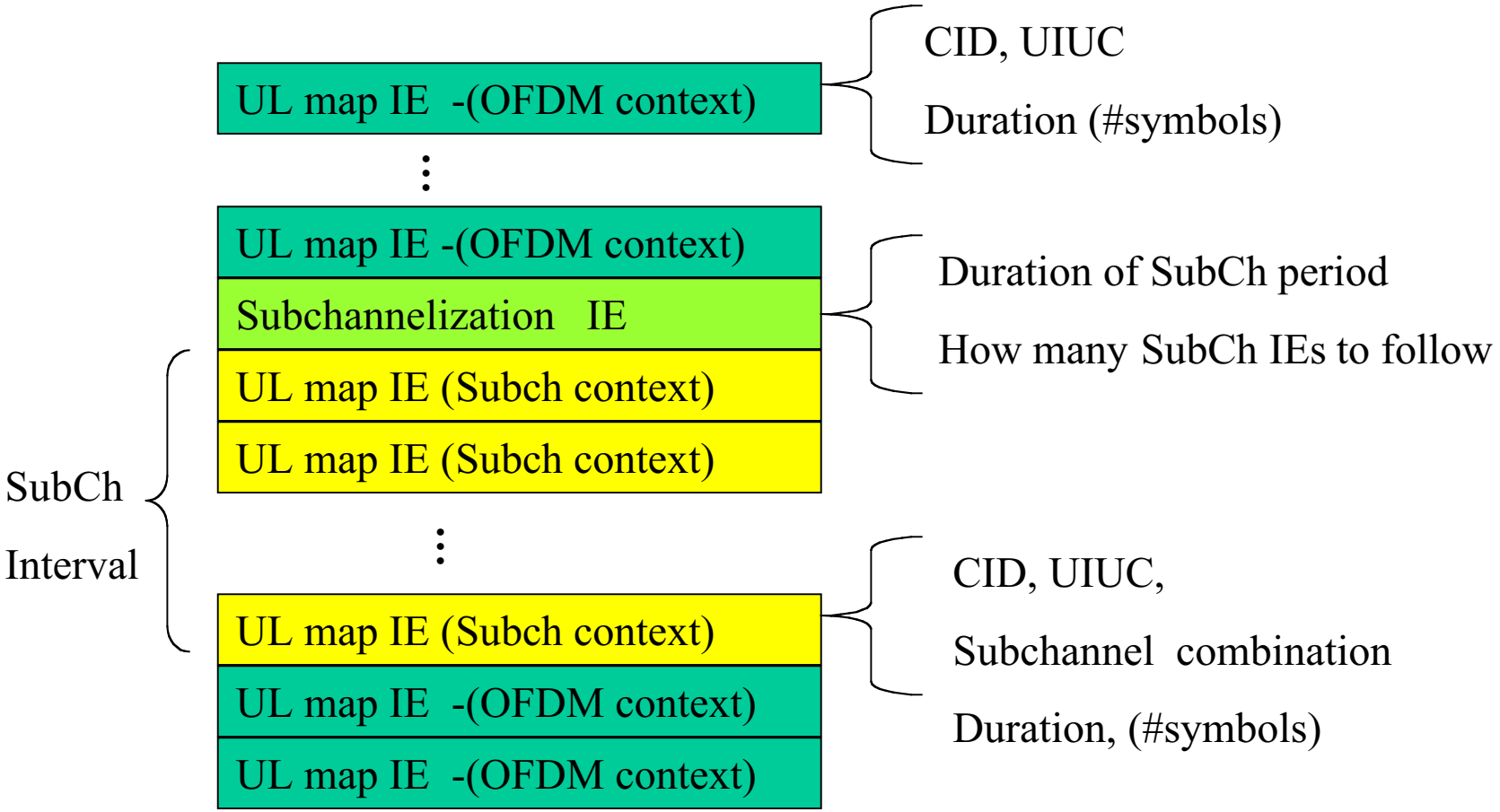


Subchannelization- MAC issues

- A BS can allocate part of the UL for subchannelized operation.



UL Map Structure



Restrictions in SubCh

- No Network entry.
- No full BW requests.
- Burst Duration is limited to 31 symbols.
- No focused BW requests.

- Limitations on Network entry, BW requests, focused BW requests, are due the sentence:

“When subchannelization is active (see 8.4.4.3.5), only UIUCs 5 through 13 shall be used”

Restrictions in Subchannelization

- Limit the utilization of the SubCh
- Removing them:
  - Will not harm interoperability
  - No complexity increase at SS
  - Some Complexity increase at BS:
    - At the hands of the BS vendor.
    - BS can utilize/not utilize the advanced features.

Network entry

- By allowing an optional SubCh network entry, SSs can utilize the 6 dB power concentration gain.
- The additional gain in the UL is important:
  - Reduces PA cost, power consumption of the PA in the SS.
  - By using stronger PA in the BS cell radius can be increased.
- Simulation results show that the 6dB gain is achieved in a real system.

Subchannelization: simulation results

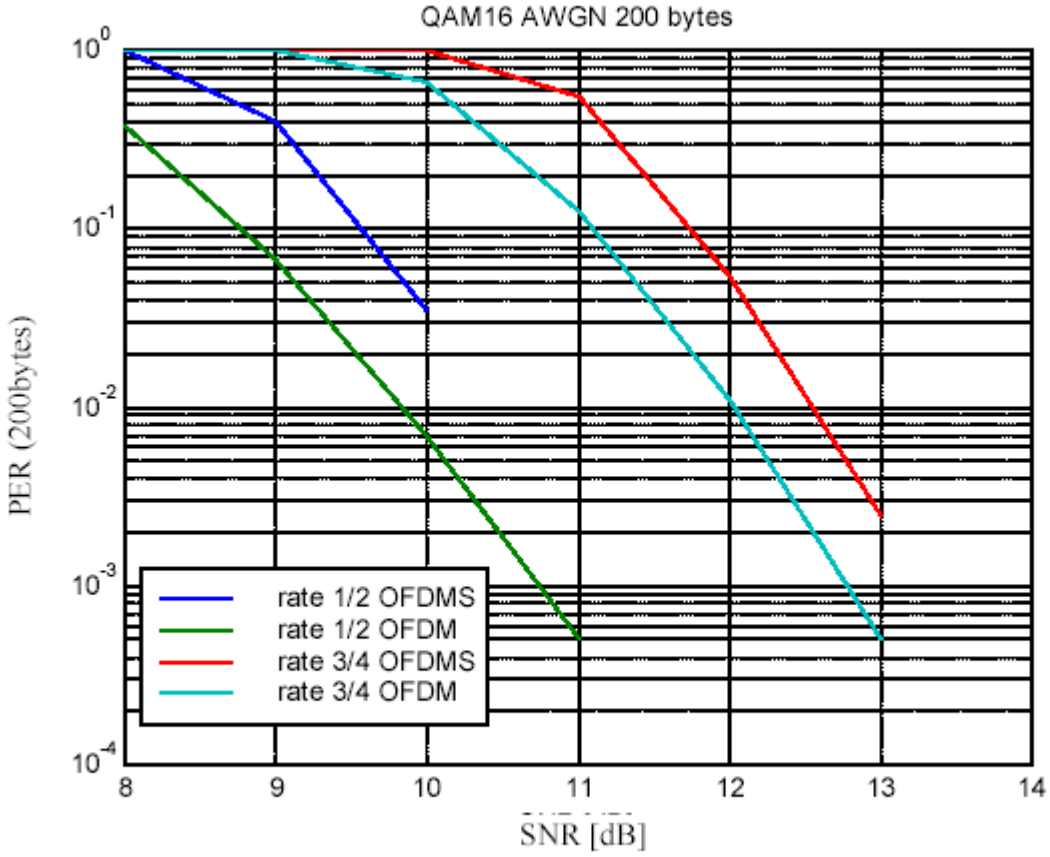


Figure 2 SNR vs. PER for QAM16 in AWGN channels (200B packets)

Source

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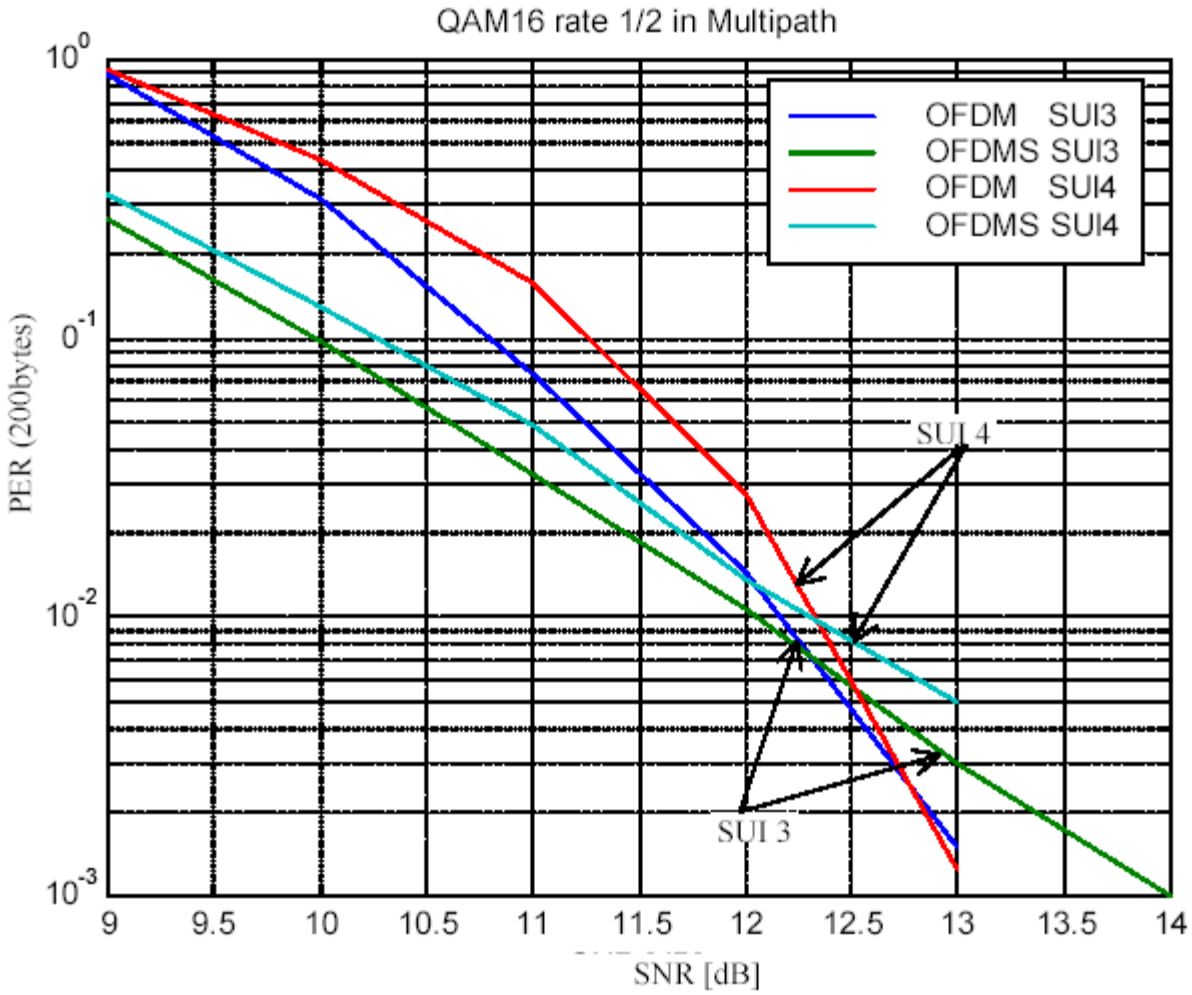
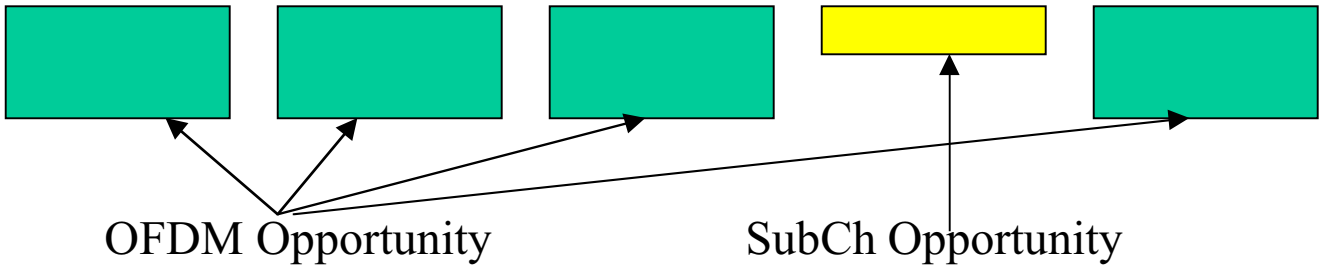
simulation results, cntd.



Proposed Mechanism



- A SS first performs network entry in the OFDM mode
- Only if it fails: It may try in Subch mode.
- Consequence: **Any** SS can enter Subch capable BSs.
- No interoperability problem.

Proposed Text change

- In pg 162…

"The initial ranging interval can be allocated to SSs which use subchannelization. In this case the BS allocates an UL interval , to be used with sub-channelization. Using the procedure of 8.4.4.3.5 and an UIUC code of 1 in the OFDM UL MAP Information Element will be possible to specify on which sub-channel will be sent the initial ranging burst.

An SS will first attempt to perform the initial ranging in full OFDM mode. If the network entry process failed, the SS may try to use the network entry sub-channelization mode."

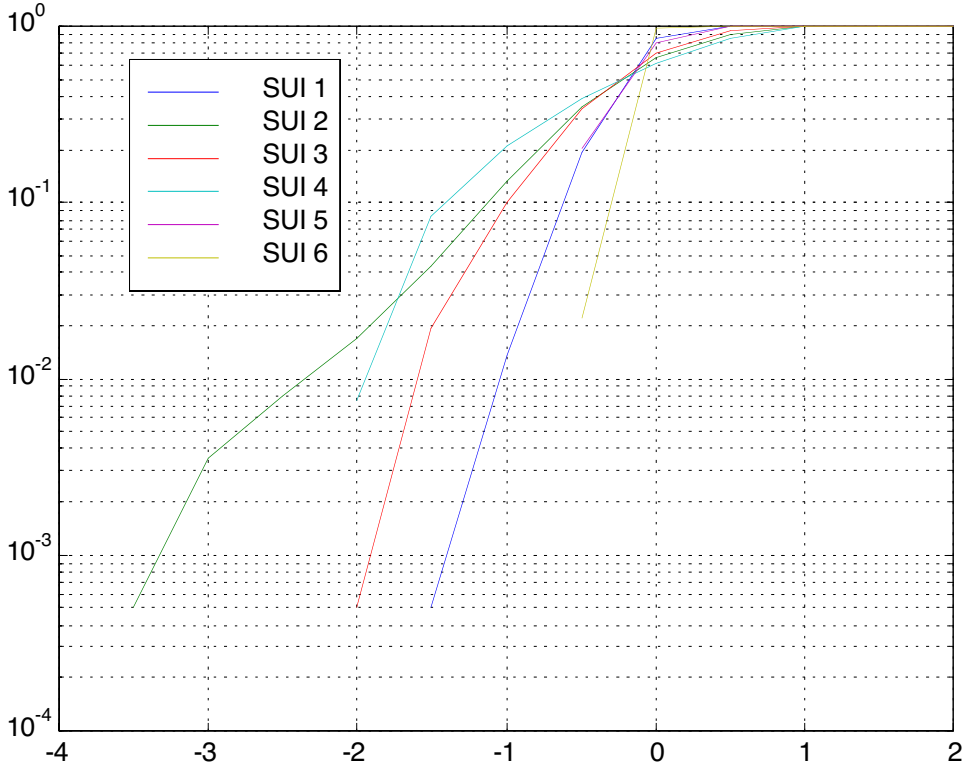
- In pg 170

Change footnote under table 116av to "… UIUC 1 through 13"

Power Ranging Problem

- Potential concern: Power ranging information derived from a subchannelized burst is inadequate.
- Analysis shows that this is not a problem.
- In >99% of the cases, the SubCh power is within 3dB of the full BW power.
- This is smaller than normal power control margins.
- A SS anyway attempts to enter in OFDM mode.
- Only range-challenged SSs will use the SubCh entry. For those SSs, no power ranging problem exists.

Power ranging problem, cntd.



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Restrictions in subchannelization

- No Network entry.
- No full BW requests.
- Burst Duration is limited to 31 symbols.
- No focused BW requests.

BW requests in subchannelization

- BW requests are short messages and as such are far more efficient in SubCh.
- For 6 bytes messages, the SubCh BW requests are 4 times more efficient.
- Only alternative for time –critical services.
- Proposed text change
  - In pg 170:

    Change footnote under table 116av to

    ”… UIUC 1 through 13”

Restrictions in subchannelization

- No Network entry.
- No full region BW requests.
- Burst Duration is limited to 31 symbols.
- No focused BW requests.

Burst Duration

- Relevant fields in the UL MAP IE

if (subchannelization[n]) {		
Subchannel Index	3 bits	0x1 = subchannel 1 0x5 = subchannel 1 and 2 0x2 = subchannel 2 0x6 = subchannel 3 and 4 0x3 = subchannel 3 0x0 = reserved 0x4 = subchannel 4 0x7 = reserved
Duration	5 bits	in OFDM symbols
Reserved	4 bits	Reserved
} else		
Duration	12 bits	

- Duration field in SubCh is 5bits. (12bits in OFDM)
- 4 bits reserved.

Burst Duration

- In Subchannelization, tracking is more complex because there are only 2 pilots per subchannel.
- The proper technical solution is to increase the number of pilots. However, the current scheme was reached as a compromise.
- To alleviate, the BS should implement other tracking mechanisms. (e.g decision aided.)
- This is tricky but feasible.

Burst Duration

- A BS provider may choose either to implement or not to implement enhanced tracking techniques.
- If these techniques are implemented: BS can allocate long bursts.
- If not: BS will allocate only short bursts.

- There is no need to restrict the burst duration.

Restrictions in subchannelization

- No Network entry.
- No full region BW requests.
- Burst Duration is limited to 31 symbols.
- No focused BW requests.

Focused contention BW requests in Subchannelizaton

- Least critical issue.
- Focused contention BW requests in subchannelization will allow:
  - BW requests in parallel with SubCh traffic.
  - To eliminate the need to fragment transmissions to allow BW requests opportunities.
  - Completeness and symmetry.

Focused Contention in SubCh

Required Changes:

- Divided the contention subcarriers so each code falls into exactly one subchannel.
- Allow focused contention in subchannelization.

Summary

- We considered 4 issues
  - Network entry
  - BW requests
  - Burst duration
  - Focused BW requests

Discussion

- Proposed changes:
  - Do not affect interoperability
  - Do not incur complexity at the SS
  - Do not mandate complexity at the BS.
    - Application is at the hands of the BS.
  - Do not change basic mechanisms
    - Most of the changes are “delete …”

Discussion

- The standard should give BS vendors the flexibility to maximize the utilization of the system.
- Different vendors may have different views on SubCh.
- Standard provides the tools. Vendors/Operators may decide on optimal use.
- Should not limit the the usage to the least common denominator. (as with any optional feature)

Discussion

- No delay in the standard is necessary.
  - According to Roger's analysis:
  - Recirculate the changes (We any way need recriculation)
  - 802.16 asks SEC for conditional approval to submit to RevCom
  - SEC (15Nov) conditionally approves submission.
  - Complete Recirc by Dec 4
  - If no problematic comments, RevCom approves draft in Mid Jan
- No delay.

Thank you