SL-U CHANNEL ACCESS MECHANISM CONSIDERATIONS

INVENTORS:

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Title: **SL-U Channel Access Mechanism Discussion**

Agenda Item: **9.4.1.1**
Document for: **Discussion and Decision**

1. Introduction

During RAN1 #110 [1], RAN1 #111 [3], RAN1 #112 and RAN1 #112b-e, many agreements have been reached, concerning SL-U Channel Access Mechanism. This paper follows-up on some of the remaining items left for discussion and make adequate proposals.

2. Discussion

2.1 CPE duration and position

During RAN1 #113 [1], the following agreement, concerning CPE transmissions, was reached:

Agreement (1)

Specification supports that CPE can be transmitted between any two consecutive SL transmissions by the same UE to reduce the gap between the two transmissions so that it does not exceed 16µs.

- *Note: for this case, the CPE length should not be longer than up to 2 symbols, as per previous agreements*
- *FFS: details if needed (e.g., considering outcome of discussion on PSFCH-like signal in PHY agenda)*
- *FFS whether PSSCH can be transmitted instead of or in addition to CPE*
- *FFS: how to determine the CPE starting position*

Agreement (2)
A sidelink transmission burst is defined as a set of SL transmissions from a UE without any gaps greater than 16µs. Transmissions from a UE separated by a gap of more than 16µs are considered as separate sidelink transmission bursts. A UE can transmit SL transmission(s) after a gap of up to 16µs within a sidelink transmission burst without sensing the corresponding channel(s) for availability.

This proposal has to be qualified in the context of the Wi-Fi deferred access. A simplified Wi-Fi deferred access description is summarized below.

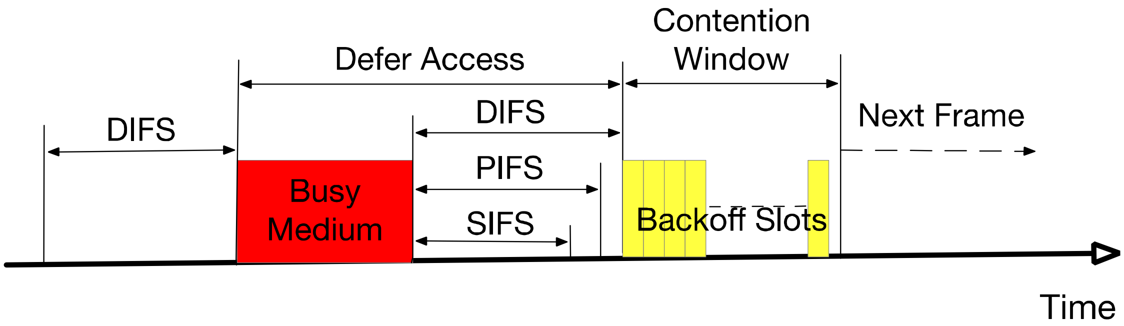

Figure 1. Simplified diagram of 802.11ac/ax Wi-Fi deferred access.

802.11 has different priorities for control, data and time critical packets. This can be achieved by different Inter Frame Times (IFS)
- Short Inter Frame Spacing (SIFS) provides the shortest IFS duration, being used by high priority signals (e.g. ACKs).
- PIFS[1] provides a medium IFS duration, being used by Point-Coordination-Function IFS
- DIFS[2] is a an asynchronous spacing and provides the longest wait duration.

The relationship between these two spacing is:

$$\boldsymbol{DIFS} = \boldsymbol{SIFS} + \mathbf{2} * \boldsymbol{Slots} = 34us$$ **Equation 1**

$$PIFS = SIFS + 1 * Slots = 25us$$ **Equation 2**

$$\boldsymbol{SIFS} = \mathbf{16}\boldsymbol{us}$$ **Equation 3**

In order to align with 802.11 specifications and to also avoid over the air collisions, LTE-U and NR-U defined the 16µs and 25µs gaps governing Type 2A and 2B access.

Observation 1:
Gaps up to the equivalent of the SIFS (16µs) and PIFS (25µs) durations are allowed by NR-U access technology (Type 2A/2B/2C).

Observation 2:
Exceeding 16µs (SIF is the shortest Inter Frame Spacing duration e.g. usable by 802.11ax) and 34 µs (DIFS duration) may be not fair to the coexistent 802.11ax and 802.11ac traffic, respectively.

Somehow similar with this approach, NR-U and SL-U expanded the Cyclic Prefix Extension (CPE) to seize the medium. However, the actual 2 symbols long CPE proposal may trigger coexistence fairness coexistence with Wi-Fi, as follows:

1. Using a CPE up to 2 symbols up (34 µs) to may allow the coexistent 802.11ac Wi-Fi nodes to start transmitting after observing a DIFS period (34 µs), when no back-off timer is required.

[1] PIFS: Point Coordination Function Inter Frame Spacing
[2] DIFS: Distributed Control Function Inter Frame Spacing

2. This condition is respected for SCS=60kHz (symbol duration =16.7 µs). However, [2] specifies band n96, as follows:

n96	15				20				40							
	30				20				40			60		80		100
	60				20				40			60		80		100

Table 1. Sub Carrier Spacing for band n96 (5925-7125 MHz) [2]

It results that SCS =15 and 30 kHz symbols will exceed by x4 and x2 times respectively the 34 µs DIFS interval used 802.11ac (and 802.11ax when operating in an environment with 802.11ac nodes).

In order to mitigate this conflict, we propose to amend Agreement (1) as follows:

Proposal 1 (Agreement 1)

Specification supports that CPE can be transmitted between any two consecutive SL transmissions by the same UE to reduce the gap between the two transmissions so that it does not exceed 16µs.

- **Note: for this case, the CPE length should not be longer than up to 2 symbols (SCS=60kHz), 1 symbol (SCS=30kHz) when band n96 is employed ~~as per previous agreements.~~**
- **FFS the use of SCS=15kHz and lower bands (<6 GHz).**
- **FFS: details if needed (e.g., considering outcome of discussion on PSFCH-like signal in PHY agenda)**
- **FFS whether PSSCH can be transmitted instead of or in addition to CPE**
- **FFS: how to determine the CPE starting position**

During RAN1 #113 meeting the following was agreed on, concerning the definition of the SL transmissions.

RAN1 #113 reached the following provisional agreement attempting the clarify the CPE usage:

Agreement (3)

When UE performs Type 2 channel access to start transmitting within a shared COT (to be further studied and down-selected in RAN1#114):

- *Alt. 1: Use the method for using CPE for the case when UE performs Type 1 channel access to initiate a COT for PSCCH/PSSCH transmission*
- *Alt. 2: Use only the (pre-)configured default CPE starting position*
- *Alt. 3: use CPE to make the gap smaller or equal 16us*
- *Alt. 4: others*

~~Based on the previous discussion, if these two bursts are intended to be part of a single transmission, the max allowable gap duration between two Tx bursts is 16ms, as discussed above,~~

Proposal 2

When UE performs Type 2 channel access to start transmitting within a shared COT (to be further studied and down-selected in RAN1#114):

- ~~**Alt. 1: Use the method for using CPE for the case when UE performs Type 1 channel access to initiate a COT for PSCCH/PSSCH transmission.**~~
- ~~**Alt. 2: Use only the (pre-)configured default CPE starting position**~~
- ~~**Alt. 3: use CPE to make the gap smaller or equal 16us**~~
- **Alt. 4: ~~others~~ No CPE.**

2.2 CW adjustment

RAN1 #113 agreed on the following:
Agreement (4)

If UE performs SL transmission using Type 1 channel access procedures associated with the channel access priority class p on a channel and the SL transmission is not associated with explicit HARQ-ACK feedback by the corresponding UE(s), the following is adopted for the CW adjustment.

- *For every priority class $p \in \{1,2,3,4\}$, use the latest CW_p used for any SL transmissions on the channel using Type 1 channel access procedures associated with the channel access priority class p.*
- *If the same $CW_p \neq CW_{max,p}$ value is consecutively used for X times for generation of N_{init}, CW_p is updated for every priority class $p \in \{1,2,3,4\}$ to the next higher allowed value.*
    - *FFS: whether this only applies to a resource pool without PSFCH configuration*
    - *FFS: value of X*

We provide clarifications on the FFS statement.
[3] section #4.1.4.3 clarifies the common procedures adjustments for DL transmissions as follows
The following applies to the procedures described in clauses 4.1.4.1 and 4.1.4.2:

- *If $CW_p = CW_{max,p}$, the next higher allowed value for adjusting CW_p is $CW_{max,p}$.*
- *If the $CW_p = CW_{max,p}$ is consecutively used K times for generation of N_{init}, CW_p is reset to $CW_{min,p}$ only for that priority class p for which $CW_p = CW_{max,p}$ is consecutively used K times for generation of N_{init}. K is selected by eNB/gNB from the set of values {1, 2, …,8} for each priority class $p \in \{1,2,3,4\}$.*

Accordingly, we propose the following updated Agreement (4). We do not support the extension to PSFCh traffic.

Proposal 3

If UE performs SL transmission using Type 1 channel access procedures associated with the channel access priority class p on a channel and the SL transmission is not associated with explicit HARQ-ACK feedback by the corresponding UE(s), the following is adopted for the CW adjustment.

- **For every priority class $p \in \{1,2,3,4\}$, use the latest CW_p used for any SL transmissions on the channel using Type 1 channel access procedures associated with the channel access priority class p.**
- **If the same $CW_p \neq CW_{max,p}$ value is consecutively used for X times for generation of N_{init}, CW_p is updated for every priority class $p \in \{1,2,3,4\}$ to the next higher allowed value.**
    - ~~**FFS: whether this only applies to a resource pool without PSFCH configuration**~~
    - ~~**FFS: value of X**~~

- If the $CW_p = CW_{max,p}$ is consecutively used K times for generation of N_{init}, CW_p is reset to $CW_{min,p}$ only for that priority class p for which $CW_p = CW_{max,p}$ is consecutively used K times for generation of N_{init}. K is selected by eNB/gNB from the set of values {1, 2, …,8} for each priority class $p \in \{1,2,3,4\}$.
-

We discuss the Working Assumption (5) approved during RAN1 #113.

Working assumption (5)

For the case where a COT initiating UE uses Type 1 channel access procedure to initiate a SL transmission,

- *it is supported that the COT initiating UE can transmit transmission(s) within the same channel occupancy that follows a COT responding UE's SL transmission(s) according to the channel access procedures.*
  - *FFS details of the SL transmission(s) from responding UE*
  - *FFS whether the above should be based on NR-U DL-UL-UL (Clause 4.2.1.0.3 of TS37.213) or DL-UL-DL (Clause 4.1.3 of TS37.213) COT sharing principle and its corresponding transmission gap requirements*
  - *FFS any other condition and restriction*

It is noted that:

- SL-U didn't define DL or UL entities, unlike [3] dealing with gNB or UE nodes, which in return defines DL or UL traffic directions.

- Instead the SL-U agreements rely on the 'initiating UE' and 'responding UE' entities, which may be more suitable for the dual role a SL-U UE may have (with gNB or UE).

Hence before proceeding with such any agreements, we should qualify the DL and UL traffic directions in the light of [3] specifications.

Proposal 4

A SL-U DL traffic direction is determined by the initiating UE transmitting to a responding UE.

Proposal 5

A SL-U UL traffic direction is determined by the responding UE transmitting to the initiating UE.

[3] section #4.1.3 specifies the UL-DL traffic conditions within a shared occupancy channel.
'The transmission shall contain transmission to the UE that initiated the channel occupancy and can include non-unicast and/or unicast transmissions where any unicast transmission that includes user plane data is only transmitted to the UE that initiated the channel occupancy.'

Observation 3
For a shared occupancy channel, unicast UL-DL traffic is supported.

Observation 4
Type 1 UL-DL-UL transmissions are not supported.

Observation 5

Following a UL-DL transmission across a shared occupancy channel, the responding gNB could transmit non-unicast information.

Observation 6
[3] section 4.2.1.0.3 specifies 'Conditions for indicating Type 2 channel access procedures'. Conditions for maintaining Type 1 UL channel access procedures are specified by #4.2.1.0.2

Observation 7
[3] section 4.2.1.0.2 (Type 1 transmissions) doesn't support DL-UL-DL transmissions.

Based on Observations 3-7 and Proposals 4-5, we update the Working Assumptions (5) as follows

Proposal 6
(Working assumptions)
For the case where a COT initiating UE uses Type 1 channel access procedure to initiate a SL transmission,

- **it is supported that the COT initiating UE can transmit transmission(s) within the same channel occupancy that follows a COT responding UE's SL transmission(s) according to the channel access procedures.**
  - **FFS details of the SL transmission(s) from responding UE**
  - **~~FFS whether~~ the above should be based on NR-U DL-UL-~~UL~~ (Clause 4.2.1.0.2~~3~~ of TS37.213) or ~~DL-~~UL-DL (Clause 4.1.3 of TS37.213) COT sharing principle and its corresponding transmission gap requirements.**
  - **FFS any other condition and restriction.**

3. Conclusions

We discussed clarifications concerning SL-U channel access mechanism, as listed below.

Observation 1:
Gaps up to the equivalent of the SIFS (16µs) and PIFS (25µs) durations are allowed by NR-U access technology (Type 2A/2B/2C).

Observation 2:
Exceeding 16µs (SIF is the shortest Inter Frame Spacing duration e.g. usable by 802.11ax) and 34 µs (DIFS duration) are not fair to coexistent 802.11ax and 802.11ac traffic, respectively.

Proposal 1.

Specification supports that CPE can be transmitted between any two consecutive SL transmissions by the same UE to reduce the gap between the two transmissions so that it does not exceed 16µs.

- **Note: for this case, the CPE length should not be longer than up to 2 symbols (SCS=60kHz), 1 symbol (SCS=30kHz) when band n96 is employed, ~~as per previous agreements~~**
- **FFS the use of SCS=15kHz and lower bands (<6 GHz).**
- **FFS: details if needed (e.g., considering outcome of discussion on PSFCH-like signal in PHY agenda)**
- **FFS whether PSSCH can be transmitted instead of or in addition to CPE**

- **FFS: how to determine the CPE starting position**

Proposal 2

When UE performs Type 2 channel access to start transmitting within a shared COT (to be further studied and down-selected in RAN1#114):

- ~~**Alt. 1: Use the method for using CPE for the case when UE performs Type 1 channel access to initiate a COT for PSCCH/PSSCH transmission.**~~
- ~~**Alt. 2: Use only the (pre-)configured default CPE starting position**~~
- ~~**Alt. 3: use CPE to make the gap smaller or equal 16us**~~
- **Alt. 4: ~~others~~ No CPE.**

Proposal 3

If UE performs SL transmission using Type 1 channel access procedures associated with the channel access priority class p on a channel and the SL transmission is not associated with explicit HARQ-ACK feedback by the corresponding UE(s), the following is adopted for the CW adjustment.

- **For every priority class $p \in \{1,2,3,4\}$, use the latest CW_p used for any SL transmissions on the channel using Type 1 channel access procedures associated with the channel access priority class p.**
- **If the same $CW_p \neq CW_{max,p}$ value is consecutively used for X times for generation of N_{init}, CW_p is updated for every priority class $p \in \{1,2,3,4\}$ to the next higher allowed value.**
    - ~~**FFS: whether this only applies to a resource pool without PSFCH configuration**~~
    - ~~**FFS: value of X**~~
    - **If the $CW_p = CW_{max,p}$ is consecutively used K times for generation of N_{init}, CW_p is reset to $CW_{min,p}$ only for that priority class p for which $CW_p = CW_{max,p}$ is consecutively used K times for generation of N_{init}. K is selected by eNB/gNB from the set of values {1, 2, …,8} for each priority class $p \in \{1,2,3,4\}$.**

Proposal 4

A SL-U DL traffic direction is determined by the initiating UE transmitting to a responding UE.

Proposal 5

A SL-U UL traffic direction is determined by the responding UE transmitting to the initiating UE.

Observation 3

For a shared occupancy channel, unicast UL-DL traffic is supported.

Observation 4

UL-DL-UL transmissions are not supported.

Observation 5

Following a UL-DL transmission across a shared occupancy channel, the responding gNB could transmit non-unicast information.

Observation 6

[3] section 4.2.1.0.3 specifies 'Conditions for indicating Type 2 channel access procedures'. Conditions for maintaining Type 1 UL channel access procedures are specified by #4.2.1.0.2

Observation 7
[3] section 4.2.1.0.2 doesn't support DL-UL-DL transmissions.
Based on Observations 3-7 and Proposals 4-5, we update the Working Assumptions (5) as follows

Proposal 6
(Working assumptions)
For the case where a COT initiating UE uses Type 1 channel access procedure to initiate a SL transmission,

- **it is supported that the COT initiating UE can transmit transmission(s) within the same channel occupancy that follows a COT responding UE's SL transmission(s) according to the channel access procedures.**
    - **FFS details of the SL transmission(s) from responding UE**
    - **~~FFS whether~~ the above should be based on NR-U DL-UL~~-UL~~ (Clause 4.2.1.0.2~~3~~ of TS37.213) or ~~DL-~~UL-DL (Clause 4.1.3 of TS37.213) COT sharing principle and its corresponding transmission gap requirements.**
    - **FFS any other condition and restriction.**

References

[1] Chair Notes RAN1#113v20, May 2022

[2] 3GPP TS38.104 V18.1.0 (2022-03).

[3] 3GPP TS37.213 v17.4.0

Attorney Docket No: 62106PROV

UNITED STATES PATENT APPLICATION

For

SL-U CHANNEL ACCESS MECHANISM CONSIDERATIONS

INVENTORS:

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3GPP TSG RAN WG1 #113 R1-23004616
Meeting, May 22nd – 26th, 2023

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Title: **SL-U Channel Access Mechanism Considerations**

Agenda Item: **9.4.1.1**
Document for: **Discussion and Decision**

1. Introduction

During RAN1 #110 [1], RAN1 #111 [3], RAN1 #112 and RAN1 #112b-e, many agreements have been reached, concerning SL-U Channel Access Mechanism. This paper provides clarifications on some of the remaining items left for discussion.

2. Discussion

2.1 Responding UE over a shared COT

During RAN1 #111 [3], the following agreement, concerning a responding UE over a shared COT, was reached:

Agreement
For UE-to-UE COT sharing,

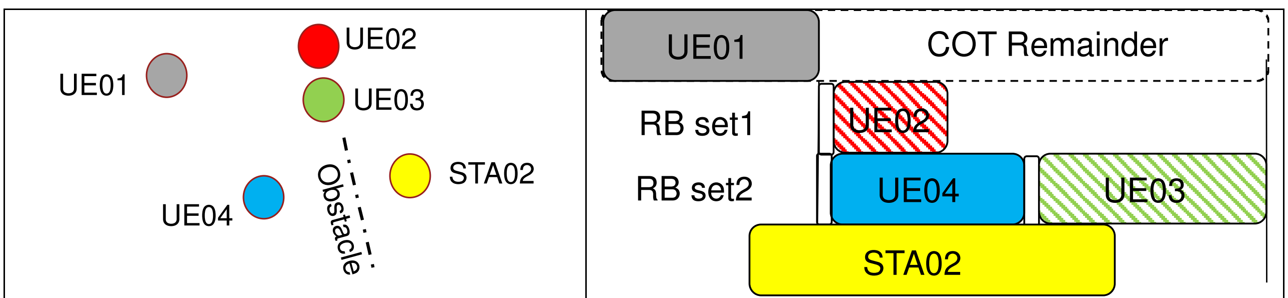
- *When performing S-SSB transmission(s), a responding UE can utilize a COT shared by a COT initiating UE (using type 1 channel access) when the responding UE is intended to transmit S-SSB within RB set(s) corresponding to the shared COT.When performing PSFCH transmission(s), a responding UE can utilize a COT shared by a COT initiating UE at least when at least one of the responding UE's PSFCH transmissions in a symbol/slot within RB set(s) corresponding to the shared COT is intended for the COT initiating UE.*
    - *FFS: whether a responding UE can transmit PSFCH(s) to UE(s) other than the initiator*
- *When performing PSSCH/PSCCH transmission(s), a responding UE can utilize a COT shared by a COT initiating UE at least when the responding UE's PSSCH/PSCCH transmission(s) within RB set(s) corresponding to the shared COT is intended for the COT initiating UE*
    - *FFS whether to support the case if a responding UE transmits PSSCH/PSCCH to destination ID other than the source ID of the COT initiating transmission, where the destination ID of the responding UE's PSSCH/PSCCH transmission(s) can be different from the source/destination IDs of COT initiating UE's PSSCH/PSCCH transmission when sharing the COT information.*
        - *FFS: how to determine / what are the restrictions to the destination ID of the responding UE's PSSCH/PSCCH transmission(s) to utilize the COT shared by the initiating UE.*
        - *FFS whether the responding UE can utilize the COT when at least the responding UE's PSCCH transmission in the reserved resources within the shared COT or MCSt is intended for the COT initiating UE and what are the restrictions (e.g., priority, etc.) and indication to the responding UE.*
- *FFS: UE forwarding/relaying information about a COT initiated by another UE.*

We observe the following:

- The NR-U specs [2] preclude any type of UE-to-UE transmissions.
- The UE-to-UE transmissions increase the risk of hidden node occurrence for any coexistent type of technology (other overlapping NR-U networks and/or Wi-Fi networks).

We discuss COT forwarding/relaying impact on potential coexistence, based on the visual example provided below:

- UE01 could successfully execute Clear Channel Assessment (CCA) procedures against UE02, UE03, UE04 and STA01. UE01 may have no clearance towards STA02. In this case, UE01 may start its transmission (Y), overlapping with transmission (X) from STA02.
- Due to hidden node STA02, the reception of the transmission (X) received at UE02 may be overlapping with the reception of transmission (Y), at UE02 and UE03, resulting into a degraded Rx of transmission Y.
- If UE04 is allowed to transmit PSFCh to UE03 (non-originating UE, then UE03 transmission will overlap with STA02 transmission, resulting in collisions over the air.)



A. Example of hidden node occurrence augmented by the number of UE to UE transmission opportunities

B. Example of SL-U COT sharing.

Figure 1. Example of augmented risk of hidden node, due to multiple UE to UE transmissions.

Observation 1. The higher the number of UE-to-UE transmissions, the higher the risk of hidden node occurrence.

Observation 2. COT forwarding/relaying and/or PSFCh tranmissions to a non-originating UE could result into an increased over their collision risk, augmented by the increased hidden node occurrence probability.

Observation 3: The responding UE transmission should immediately follow the COT initiating UE transmission according with [2].

In this context, the following types of transmissions should be prohibited:

- a UE executing COT forwarding and/or
- a transmitting PSFCh to a UE other than the initiator.

Further explanatory information could be found in section 2.5?

Proposal 1. A responding UE can't transmit PSFCh to a UE(s) other than the COT initiating UE.

Proposal 2. UE can't forward/relay COT sharing information to a UE, other than the COT initiating UE

2.2 SL-U EDT details

Concerning the NR-U EDT applicability to UL transmissions, RAN1 #112b-e [4] agreed on:

Agreement
The existing NR-U EDT procedures for uplink transmissions is taken as the baseline for SL-U in Rel-18.

- *FFS: details for S-SSB and PSFCH transmissions (e.g., EDT determination based on $P_{C,MAX}$ and/or network configured EDT, value for T_A), if needed*

The EDT requirements were specified by [2] #4.1.5. A SL_U UE acting as a gNB (transmitting to a subordinate UE, the transmission may include S-SSB sequence) will operate under the NR-U EDT requirements mentioned above.

For more explanatory information, see also [7].

Proposal 3. The existing NR-U EDT specification is re-used for SL-U Rel 18.

2.3 Dynamic channel access employing Type A or Type B access

The following agreement has been reached during RAN1 #112b-e [4].

Agreement
For dynamic channel access mode with multi-channel case in SL-U, both NR-U DL Type A and Type B multi-channel access procedure are supported for multiple PSFCH transmissions on multiple channels.

- *FFS: It is up to UE implementation to perform either Type A or Type B multi-channel access procedure.*
- *FFS: whether this can initiate a shared COT*
- *FFS: whether there is any special handling needed for transmission in a shared COT on one or more of the channels*

Type A multi-channel access procedure is performed on each channel $c_i \in C$, the counter N ([2], clause 4.1.1) being determined separately for each channel c_i. This type of transmission is intended for use cases not spanning across multiple channels.
Type B multi-channel access employs the selection of channel c_j before each transmission for a certain duration as described by [2] #4.6.2. This type of transmissions is applicable to the cases where PDSCh is scheduled across multiple channels.
Both cases involve the support of the gNB (or the UE acting as a gNB in SL-U case).

Observation 4. Type A or Type B multi-channel transmission shall not be left out to the UE implementation.

[2] allows only single channel COT sharing: section #4.1.1. discusses only about *'**the channel** to be idle' and not about 'channels to be idle'.*

Observation 5. Sharing COT over multi-channels is precluded.

Observation 6. No special handling for multi-channels over a shared COT is necessary since the latter is not supported.

Accordingly, the above agreement should be updated as follows:

Proposal 3
For dynamic channel access mode, with multi-channel SL-U case, a UE could support both NR-U DL Type A and Type B multi-channel access procedures, for multiple PSFCH transmissions on multiple channels, according with NR-U specifications [2] section #4.1.6. COT sharing for multi-channel access is precluded.

- ~~*FFS: It is up to UE implementation to perform either Type A or Type B multi-channel access procedure.*~~
- ~~*FFS: whether this can initiate a shared COT.*~~
- ~~*FFS: whether there is any special handling needed for transmission in a shared COT on one or more of the channels.*~~

2.4 Type 2A/2B/2C transmissions

The following agreement has been reached during RAN1 #110 [6]:

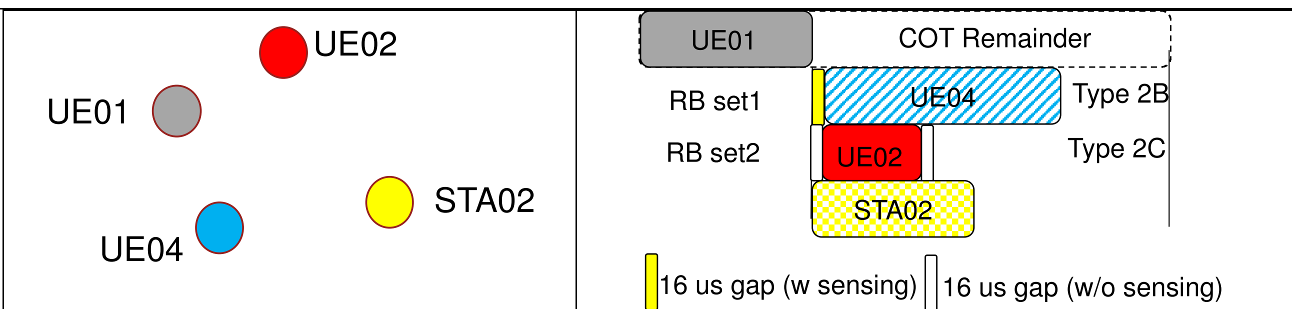
Agreement

- *Type 2A/2B/2C SL channel access procedures*
  - *Type 2A channel access procedure is applicable to the following case:*
    - *Transmission(s) by a UE following transmission(s) by another UE for a gap ≥ 25µs in a shared channel occupancy*
    - *FFS any other transmission by a UE (e.g., other than COT sharing)*
    - *FFS whether Type 2A is used also for the case of short control signalling transmission*
  - *Type 2B channel access procedure is applicable to the following case:*
    - *Transmission(s) by a UE following transmission(s) by another UE at least when the gap is 16µs in a shared channel occupancy*
    - *FFS the case when the gap is between 16 and 25us*

- *FFS any other transmission by a UE (e.g., other than COT sharing)*
  - *Type 2C channel access procedure is applicable to the following case:*
    - *Transmission(s) by a UE following transmission(s) by another UE for a gap ≤ 16μs in a shared channel occupancy and the duration of the corresponding transmission is at most 584us.*
    - *FFS any other transmission by a UE (e.g., other than COT sharing)*
    - *FFS whether Type 2C is used also for the case of short control signalling transmission*
  - *FFS under which conditions (other than the gap) UEs can apply the Type 2A/2B/2C SL channel access procedures*
  - *FFS under which conditions Type 2B or Type 2C is applied in case of a gap of 16 μs*

During the meetings, following RAN1 #110, no consensus was reached on the conditions and limitations (marked as FFS) surrounding this Agreement. Until these conditions are discussed and agreed on (e.g., FFS are eliminated), this agreement can't be considered as valid. The contentious conditions/limitations are highlighted (yellow).

Type 2C is considered the most aggressive type of access (shared spectra concerning), since it doesn't use any channel sensing.
In the NR-U case, the gNB and UE roles are clearly defined, but in the SL-U case, any UE could assume either the gNB or the UE role.
We present a visual possible COT sharing traffic example of mixed SL_U Type 2B/2C traffic (Figure 2), based on the above agreement.



A. Example of SL-U UE cluster.	B. COT Sharing traffic using Type 2B and 2C, based on the left side topology

Figure 2. Example of a cluster of SL-U UEs employing mixed Type 2B/2C access.

We observe the following:

- UE04 (Type 2B access) detects STA02's transmission's start and it doesn't transmit.
- UE02 (Type 2C access) doesn't execute any sensing and the UE02 transmission may overlap with a STA02 transmission, started during the 16us gap preceding the UE02 transmission

Observation 7. The usage of Type2C traffic doesn't support a fair traffic model against other coexistent technologies.

Concerning the NR-U case, the gNB and UE roles are clearly defined but (in the SL-U case) any UE could assume either the gNB or the UE role.

Observation 8. The applicability of Type 2C traffic shall be limited only to one responding UE using one RB set, as defined by NR-U specs.

Observation 9. The extension of Type 2C traffic to multiple SL-U UEs, employing different RB sets shall not be allowed due to the increased probability of hidden node occurrence.

Concerning the following '*FFS the case when the gap is between 16 and 25us':*

- [2] sections #4.1.2 and 4.2.1 define exactly the gap duration for DL/UL Type 2B/2C (16us including the sensing slot) and Type 2A (25us consisting of duration Tf=16us, followed by a 9us sensing slot). There is no support for a variable gap duration (e.g. between 16 and 25us).

Observation 10. SL-U shall not support and modified type 2B or 2C traffic employing gaps other than 16 (Type 2B/2C) or 25us (Type 2A).

Concerning the following statement: '*FFS whether Type 2C is used also for the case of short control signaling transmission':*

- NR-U specs [2] considered either Type 1 or Type 2A type of traffic for short signaling transmissions.

Observation 11. Type 2C traffic shall not be used for supporting Short Control Signaling traffic.

Concerning the following '*FFS under which conditions Type 2B or Type 2C is applied in case of a gap of 16 µs':*

- This FFS is not clear what is referring to.

Observation 12. There are no additional conditions outside [2] workframe applicable to Type 2B or Type 2C traffic.

Based on all observations stated in this section, we propose the following modified agreement:

Proposal 4

Agreement

……………………

- ***Type 2B channel access procedure is applicable to the following case:***
  - ***Transmission(s) by a COT responding UE following transmission(s) by a COT initiating UE, at least when the gap is 16µs in a shared channel occupancy***
  - ~~***FFS the case when the gap is between 16 and 25us***~~

- ~~*FFS any other transmission by a UE (e.g., other than COT sharing)*~~
- *Type 2C channel access procedure is applicable to the following case:*
  - *Transmission(s) by a COT responding UE following transmission(s) by a COT initiating UE for a gap of 16us, in a shared channel occupancy and the duration of the corresponding transmission is at most 584us.*
  - ~~*FFS any other transmission by a UE (e.g., other than COT sharing)*~~
  - ~~*FFS whether Type 2C is used also for the case of short control signalling transmission*~~
- ~~*FFS under which conditions (other than the gap) UEs can apply the Type 2A/2B/2C SL channel access procedures*~~
- ~~*FFS under which conditions Type 2B or Type 2C is applied in case of a gap of 16 µs*~~

3. Conclusions

We discussed a number of clarifications concerning SL-U channel access mechanism, as listed below.

Observation 1. The multiplication of UE-to-UE transmissions multiply the risk of hidden node occurrence.

Observation 2. COT forwarding/relaying and/or PSFCh tranmissions to a non-originating UE could result into an increased over their collision risk, augmented by the increased hidden node occurrence probability.

Observation 3: The responding UE transmission should immediately follow the COT initiating UE transmission according with [2].

Proposal 1. A responding UE can't transmit PSFCh to a UE(s) other than the COT initiating UE.

Proposal 2. UE can't forward/relay COT sharing information to a UE, other than the COT initiating UE

Proposal 3. The existing NR-U EDT specification is re-used for SL-U Rel 18.

Observation 4. Type A or Type B multi-channel transmission shall not be left out to the UE implementation.

Observation 5. Sharing COT over multi-channels is precluded.

Observation 6. No special handling for multi-channels over a shared COT is necessary since the latter is not supported.

Proposal 4

For dynamic channel access mode, with multi-channel SL-U case, a UE could support both NR-U DL Type A and Type B multi-channel access procedures, for multiple PSFCH transmissions on multiple channels, according with NR-U specifications [2] section #4.1.6. COT sharing for multi-channel access is precluded.

- ~~*FFS: It is up to UE implementation to perform either Type A or Type B multi-channel access procedure.*~~
- ~~*FFS: whether this can initiate a shared COT.*~~
- ~~*FFS: whether there is any special handling needed for transmission in a shared COT on one or more of the channels.*~~

Observation 7. The usage of Type2C traffic doesn't support a fair traffic model against other coexistent technologies.

Observation 8. The applicability of Type 2C traffic shall be limited only to one responding UE using one RB set, as defined by NR-U specs.

Observation 9. The extension of Type 2C traffic to multiple SL-U UEs, employing different RB sets shall not be allowed due to the increased probability of hidden node occurrence.

Observation 10. SL-U shall not support and modified type 2B or 2C traffic employing gaps other than 16 (Type 2B/2C) or 25us (Type 2A).

Observation 11. Type 2C traffic shall not be used for supporting Short Control Signaling traffic.

Observation 12. There are no additional conditions outside [2] workframe applicable to Type 2B or Type 2C traffic.

Proposal 5

Agreement

……………………

- ***Type 2B channel access procedure is applicable to the following case:***
  - ***Transmission(s) by a COT responding UE following transmission(s) by a COT initiating UE, at least when the gap is 16µs in a shared channel occupancy***
  - ~~***FFS the case when the gap is between 16 and 25us***~~
  - ~~***FFS any other transmission by a UE (e.g., other than COT sharing)***~~
- ***Type 2C channel access procedure is applicable to the following case:***
  - ***Transmission(s) by a COT responding UE following transmission(s) by a COT initiating UE for a gap of 16us, in a shared channel occupancy and the duration of the corresponding transmission is at most 584us.***
  - ~~***FFS any other transmission by a UE (e.g., other than COT sharing)***~~
  - ~~***FFS whether Type 2C is used also for the case of short control signalling transmission***~~
- ~~***FFS under which conditions (other than the gap) UEs can apply the Type 2A/2B/2C SL channel access procedures***~~
- ~~***FFS under which conditions Type 2B or Type 2C is applied in case of a gap of 16 µs***~~

References

[1] R1-2208321, "3GPP TSG RAN WG1 Meeting #110. Final report', August 2022

[2] “3GPP TS 37.213. Physical layer procedures for shared spectrum channel access”

[3] “3GPP TSG RAN WG1 Meeting #111. Final minutes report v100’, November 2022

[4] “Draft minutes report of RAN1 ##12b-e v010”, May 2023

[5] “Final Minutes Report of RAN1 #112

[6] R1-2208321, “Final report of 3GPP TSG RAN WG1 #110 v1.0.0”

[7] R1-2303002, “SL-U Channel Access Mechanism Clarifications”, CableLabs, April 2023

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3GPP RAN 1 #113

SL-U Strategy

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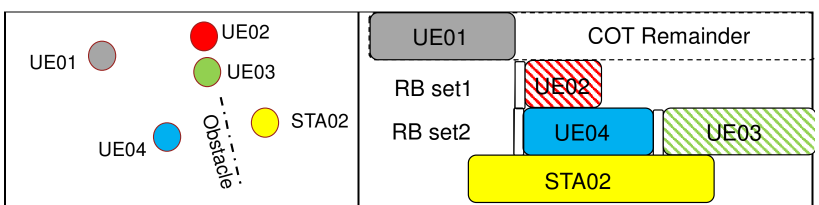
CableLabs 3GPP team

SideLink* in Unlicensed bands (SL-U) 1/3

Title	Comments
SideLink	Major items not agreed on** • UE COT forwarding (RAN1 110 - leftovers) ▪ *FFS: whether a responding UE can transmit PSFCH(s) to UE(s) other than the initiator* ▪ *FFS: UE forwarding/relaying information about a COT initiated by another UE.* ▪ Our proposal*** ○ **A responding UE can't transmit PSFCh to a UE(s) other than the COT initiating UE.** ○ **UE can't forward/relay COT sharing information to a UE, other than the COT initiating UE** • EDT modifications (RAN1 111) ▪ *FFS: details for S-SSB and PSFCH transmissions (e.g., EDT determination based on* $P_{C,MAX}$ *and/or network configured EDT, value for* T_A*), if needed* ▪ Our proposal*** ○ **The existing NR-U EDT specification is re-used for SL-U Rel 18.**



A. Example of hidden node occurrence augmented by the number of UE to UE transmission opportunities

B. Example of SL-U COT sharing.

- The higher the number of UE-to-UE transmissions, the higher the risk of hidden node occurrence.
- COT forwarding/relaying and/or PSFCh transmissions to a non-originating UE could result into an increased over their collision risk, augmented by the increased hidden node occurrence probability.
- NR-U specs (TS37.213) cover neither UE to UE nor gNB to multiple UE transmissions.

COT: Channel Occupancy Time
EDT: Energy Detection Threshold
FFS: For Further Study
PSFCh: Physical Sidelink Feedback Channel
SL-U Sidelink in Unlicensed Spectra
S-SSB: SideLink Synchronization Signal Block

* RP-222806 (SID)
** R1-2304301
*** R1-2304616

Type 2A/2B/2C. To be clarified

Session	Comments
#110	*Type 2A/2B/2C SL channel access procedures* *Type 2A channel access procedure is applicable to the following case:* *Transmission(s) by a UE following transmission(s) by another UE for a gap ≥ 25μs in a shared channel occupancy* *FFS any other transmission by a UE (e.g., other than COT sharing)* *FFS whether Type 2A is used also for the case of short control signalling transmission* *Type 2B channel access procedure is applicable to the following case:* *Transmission(s) by a UE following transmission(s) by another UE at least when the gap is 16μs in a shared channel occupancy* *FFS the case when the gap is between 16 and 25us* *FFS any other transmission by a UE (e.g., other than COT sharing)* *Type 2C channel access procedure is applicable to the following case:* *Transmission(s) by a UE following transmission(s) by another UE for a gap ≤ 16μs in a shared channel occupancy and the duration of the corresponding transmission is at most 584us.* *FFS any other transmission by a UE (e.g., other than COT sharing)* *FFS whether Type 2C is used also for the case of short control signalling transmission* *FFS under which conditions (other than the gap) UEs can apply the Type 2A/2B/2C SL channel access procedures* *FFS under which conditions Type 2B or Type 2C is applied in case of a gap of 16 μs*
#112b-e	

Type 2A/2B/2C. Proposals

Session	Comments
#113	*Type 2A/2B/2C SL channel access procedures* *Type 2A channel access procedure is applicable to the following case:* *Transmission(s) by a COT UE following transmission(s) by another UE for a gap ≥ 25μs in a shared channel occupancy* *FFS any other transmission by a UE (e.g., other than COT sharing)* *FFS whether Type 2A is used also for the case of short control signalling transmission* *Type 2B channel access procedure is applicable to the following case:* *Transmission(s) by a COT responding UE following transmission(s) ~~by another~~ a COT initiating UE at least when the gap is 16μs in a shared channel occupancy* *~~FFS the case when the gap is between 16 and 25us~~* *~~FFS any other transmission by a UE (e.g., other than COT sharing)~~* *Type 2C channel access procedure is applicable to the following case:* *Transmission(s) by a COT responding UE following transmission(s) by ~~another~~ COT initiating UE for a gap ≤ < 16μs in a shared channel occupancy and the duration of the corresponding transmission is at most 584us.* *~~FFS any other transmission by a UE (e.g., other than COT sharing)~~* *~~FFS whether Type 2C is used also for the case of short control signalling transmission~~* *~~FFS under which conditions (other than the gap) UEs can apply the Type 2A/2B/2C SL channel access procedures~~* *~~FFS under which conditions Type 2B or Type 2C is applied in case of a gap of 16 μs~~*
#113	

Type 2A/2B/2C. Proposals

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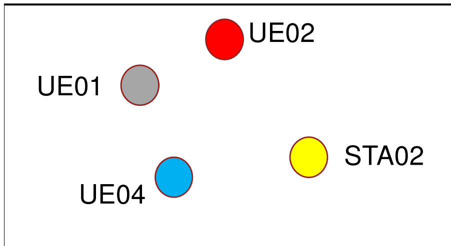
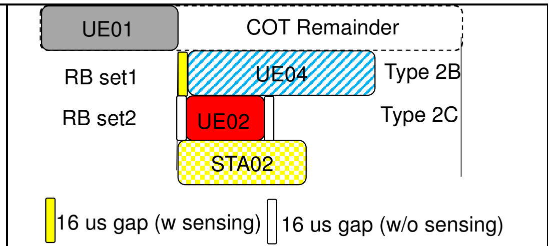


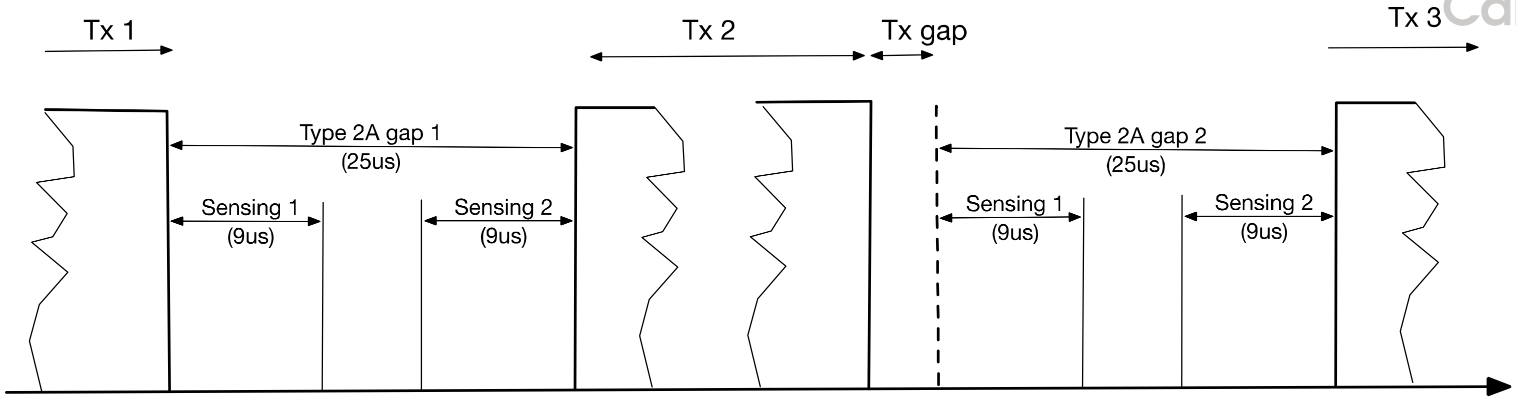
A. Example of SL-U UE cluster.



B. COT Sharing traffic using Type 2B and 2C, based on the left side topology

- UE04 (Type 2B access) may or may not detect STA02's transmission's start, due to the timing uncertainty.
- UE02 (Type 2C access - no sensing) will not detects neither STA02 nor UE04 (FDM-ed) transmissions, resulting in mutual interference

Type 2A Access



4.2.1.2.1 Type 2A UL channel access procedure

If a UE is indicated to perform Type 2A UL channel access procedures, the UE uses Type 2A UL channel access procedures for a UL transmission. The UE may transmit the transmission immediately after sensing the channel to be idle for at least a sensing interval $T_{\text{short\_ul}} = 25\mu s$. $T_{\text{short\_ul}}$ consists of a duration $T_f = 16\mu s$ immediately followed by one sensing slot and T_f includes a sensing slot at start of T_f. The channel is considered to be idle for $T_{\text{short\_ul}}$ if both sensing slots of $T_{\text{short\_ul}}$.are sensed to be idle.

Comments:

- DL/UL Type 2A allow multiple Type 2A transmissions separated by multiple gaps, each one including one 25us gaps.

Type 2B/2C Access

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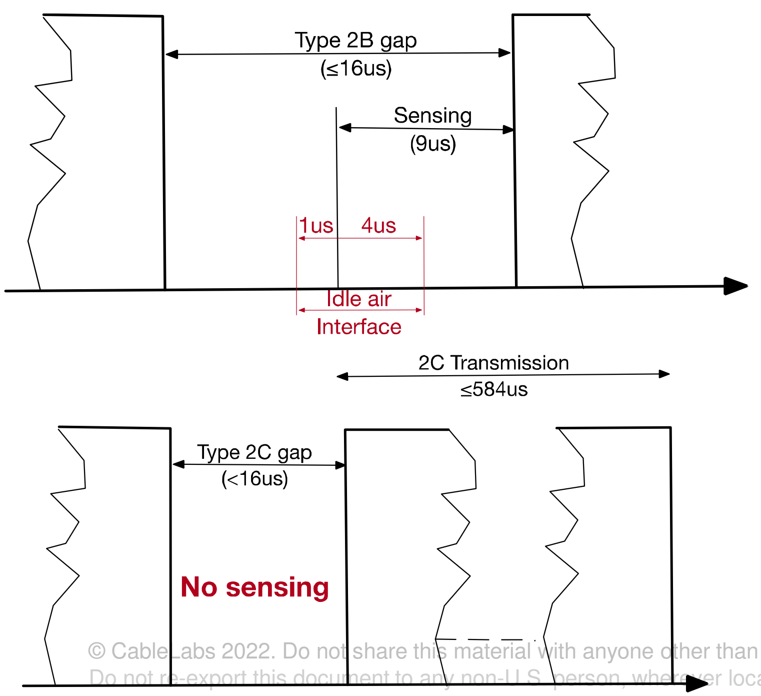

- gNB could share a COT, following a Type 1 UE transmission, using a Type 2A transmission (25us gap), or a Type 2B transmission (16us gap) or a Type 2C transmission (<16us gap with no sensing).
- Multiple UEs transmissions following Type 1 transmission, when shared COT, are precluded.
- 37.213 does not support multiple UEs sharing a COT, due to the increased hidden node risk.
  - TBD the exception case for FDM-ed transmissions of multiple RB Sets.
- Type 2C is the most aggressive transmission type:
  - Not allowed to be left to UE implementation
  - The responding UE follows the COT initiating UE transmission.
  - Not allowed to support SCS (Type 2A is specifically dedicated for SCS transmissions).

Type 2A/2B/2C Access. References 1/3

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4.1.2 Type 2 DL channel access procedures

This clause describes channel access procedures to be performed by an eNB/gNB where the time duration spanned by sensing slots that are sensed to be idle before a downlink transmission(s) is deterministic.

If an eNB performs Type 2 DL channel access procedures, it follows the procedures described in clause 4.1.2.1.

Type 2A channel access procedures as described in clause 4.1.2.1 are only applicable to the following transmission(s) performed by an eNB/gNB:

- Transmission(s) initiated by an eNB including discovery burst and not including PDSCH where the transmission(s) duration is at most $1ms$, or
- Transmission(s) initiated by a gNB with only discovery burst or with discovery burst multiplexed with non-unicast information, where the transmission(s) duration is at most $1ms$, and the discovery burst duty cycle is at most $1/20$, or
- Transmission(s) by an eNB/ gNB following transmission(s) by a UE after a gap of $25\mu s$ in a shared channel occupancy as described in clause 4.1.3.

Type 2B or Type 2C DL channel access procedures as described in clause 4.1.2.2 and 4.1.2.3, respectively, are applicable to the transmission(s) performed by a gNB following transmission(s) by a UE after a gap of $16\mu s$ or up to $16\mu s$, respectively, in a shared channel occupancy as described in clause 4.1.3.

4.1.2.1 Type 2A DL channel access procedures

An eNB/gNB may transmit a DL transmission immediately after sensing the channel to be idle for at least a sensing interval $T_{short\_dl} = 25\mu s$. T_{short_dl} consists of a duration $T_f = 16\mu s$ immediately followed by one sensing slot and T_f includes a sensing slot at start of T_f. The channel is considered to be idle for T_{short_dl} if both sensing slots of T_{short_dl} are sensed to be idle.

4.1.2.2 Type 2B DL channel access procedures

A gNB may transmit a DL transmission immediately after sensing the channel to be idle within a duration of $T_f = 16\mu s$. T_f includes a sensing slot that occurs within the last $9\mu s$ of T_f. The channel is considered to be idle within the duration T_f if the channel is sensed to be idle for a total of at least $5\mu s$ with at least $4\mu s$ of sensing occurring in the sensing slot.

4.1.2.3 Type 2C DL channel access procedures

When a gNB follows the procedures in this clause for transmission of a DL transmission, the gNB does not sense the channel before transmission of the DL transmission. The duration of the corresponding DL transmission is at most $584\mu s$.

Type 2A/2B/2C Access. References 2/3

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4.1.3 DL channel access procedures in a shared channel occupancy

For the case where an eNB shares a channel occupancy initiated by a UE, the eNB may transmit a transmission that follows an autonomous PUSCH transmission by the UE as follows:

- If 'COT sharing indication' in AUL-UCI in subframe n indicates '1', an eNB may transmit a transmission in subframe $n + X$, where X is subframeOffsetCOT-Sharing, including PDCCH but not including PDSCH on the same channel immediately after performing Type 2A DL channel access procedures in clause 4.1.2.1, if the duration of the PDCCH is less than or equal to duration of two OFDM symbols and it shall contain at least AUL-DFI or UL grant to the UE from which the PUSCH transmission indicating COT sharing was received.

If a gNB shares a channel occupancy initiated by a UE using the channel access procedures described in clause 4.2.1.1 on a channel, the gNB may transmit a transmission that follows a UL transmission on scheduled resources or a PUSCH transmission on configured resources by the UE after a gap as follows:

- The transmission shall contain transmission to the UE that initiated the channel occupancy and can include non-unicast and/or unicast transmissions where any unicast transmission that includes user plane data is only transmitted to the UE that initiated the channel occupancy.
  - If the higher layer parameters *ul-toDL-COT-SharingED-Threshold-r16* is not provided, the transmission shall not include any unicast transmissions with user plane data and the transmission duration is not more than the duration of 2, 4 and 8 symbols for subcarrier spacing of 15, 30 and 60 kHz of the corresponding channel, respectively.
- \- If the gap is up to $16\mu s$, the gNB can transmit the transmission on the channel after performing Type 2C DL channel access as described in clause 4.1.2.3.
- If the gap is $25\mu s$ or $16\mu s$, the gNB can transmit the transmission on the channel after performing Type 2A or Type 2B DL channel access procedures as described in clause 4.1.2.1 and 4.1.2.2, respectively.

For the case where a gNB shares a channel occupancy initiated by a UE with configured grant PUSCH transmission, the gNB may transmit a transmission that follows the configured grant PUSCH transmission by the UE as follows:

- If the higher layer parameter *ul-toDL-COT-SharingED-Threshold-r16* is provided, the UE is configured by *cg-COT-SharingList-r16* where *cg-COT-SharingList-r16* provides a table configured by higher layer. Each row of the table provides a channel occupancy sharing information given by higher layer parameter *CG-COT-Sharing-r16*. One row of the table is configured for indicating that the channel occupancy sharing is not available.
  - If the 'COT sharing information' in CG-UCI detected in slot n indicates a row index that corresponds to a *CG-COT-Sharing-r16* that provides channel occupancy sharing information, the gNB can share the UE channel occupancy assuming a channel access priority class p= *channelAccessPriority-r16*, starting from slot $n+O$, where O=*offset-r16* slots, for a duration of D=*duration-r16* slots where *duration-r16*, *offset-r16*, and *channelAccessPriority-r16* are higher layer parameters provided by *CG-COT-Sharing-r16*.
- If the higher layer parameter *ul-toDL-COT-SharingED-Threshold-r16* is not provided, and if 'COT sharing information' in CG-UCI indicates '1', the gNB can share the UE channel occupancy and start the DL transmission X= *cg-COT-SharingOffset-r16**14 symbols from the end of the slot where CG-UCI is detected, where *cg-COT-SharingOffset-r16* is provided by higher layer. The transmission shall not include any unicast transmissions with user plane data and the transmission duration is not more than the duration of 2, 4 and 8 symbols for subcarrier spacing of 15, 30 and 60 kHz of the corresponding channel, respectively.

For the case where a gNB uses channel access procedures as described in clause 4.1.1 to initiate a transmission and shares the corresponding channel occupancy with a UE that transmits a transmission as described in clause 4.2.1.2, the gNB may transmit a transmission within its channel occupancy that follows the UE's transmission if any gap between any two transmissions in the gNB channel occupancy is at most $25\mu s$. In this case the following applies:

- If the gap is $25\mu s$ or $16\mu s$, the gNB can transmit the transmission on the channel after performing Type 2A or 2B DL channel access procedures as described in clause 4.1.2.1 and 4.1.2.2, respectively.
- If the gap is up to $16\mu s$, the gNB can transmit the transmission on the channel after performing Type 2C DL channel access as described in clause 4.1.2.3.

Type 2A/2B/2C Access. References 3/3

4.2.1 Channel access procedures for uplink transmission(s)

A UE can access a channel on which UL transmission(s) are performed according to one of Type 1 or Type 2 UL channel access procedures. Type 1 channel access procedure is described in clause 4.2.1.1. Type 2 channel access procedure is described in clause 4.2.1.2.

If a UL grant scheduling a PUSCH transmission indicates Type 1 channel access procedures, the UE shall use Type 1 channel access procedures for transmitting transmissions including the PUSCH transmission unless stated otherwise in this clause.

A UE shall use Type 1 channel access procedures for transmitting transmissions including the autonomous or configured grant PUSCH transmission on configured UL resources unless stated otherwise in this clause.

If a UL grant scheduling a PUSCH transmission indicates Type 2 channel access procedures, the UE shall use Type 2 channel access procedures for transmitting transmissions including the PUSCH transmission unless stated otherwise in this clause.

A UE shall use Type 1 channel access procedures for transmitting SRS transmissions not including a PUSCH transmission. UL channel access priority class $p = 1$ in Table 4.2.1-1 is used for SRS transmissions not including a PUSCH.

If a DL assignment triggering SRS but not scheduling a PUCCH transmission indicates Type 2 channel access procedures, the UE shall use Type 2 channel access procedures.

If a UE is scheduled by an eNB/gNB to transmit PUSCH and SRS in contiguous transmissions without any gaps in between, and if the UE cannot access the channel for PUSCH transmission, the UE shall attempt to make SRS transmission according to uplink channel access procedures specified for SRS transmission.

If a UE is scheduled by a gNB to transmit PUSCH and one or more SRSs by a single UL grant in non-contiguous transmissions, or a UE is scheduled by a gNB to transmit PUCCH and/or SRSs by a single DL assignment in non-contiguous transmissions, the UE shall use the channel access procedure indicated by the scheduling DCI for the first UL transmission scheduled by the scheduling DCI. If the channel is sensed by the UE to be continuously idle after the UE has stopped transmitting the first transmission, the UE may transmit further UL transmissions scheduled by the scheduling DCI using Type 2 channel access procedures or Type 2A UL channel access procedures without applying a CP extension if the further UL transmissions are within the gNB Channel Occupancy Time. Otherwise, if the channel sensed by the UE is not continuously idle after the UE has stopped transmitting the first UL transmission or the further UL transmissions are outside the gNB Channel Occupancy Time, the UE may transmit the further UL transmissions using Type 1 channel access procedure, without applying a CP extension.

A UE shall use Type 1 channel access procedures for PUCCH transmissions unless stated otherwise in this clause. If a DL grant determined according to Clause 9.2.3 in [7, TS38.213] or a random access response (RAR) message for successRAR scheduling a PUCCH transmission indicates Type 2 channel access procedures, the UE shall use Type 2 channel access procedures.

When a UE uses Type 1 channel access procedures for PUCCH transmissions or PUSCH only transmissions without UL-SCH, the UE shall use UL channel access priority class $p = 1$ in Table 4.2.1-1.

A UE shall use Type 1 channel access procedure for PRACH transmissions and PUSCH transmissions without user plane data related to random access procedure that initiate a channel occupancy. In this case, UL channel access priority class $p = 1$ in Table 4.2.1-1 is used for PRACH transmissions, and UL channel access priority class used for PUSCH transmissions is determined according to Clause 5.6.2 in [9].

When a UE uses Type 1 channel access procedures for PUSCH transmissions on configured resource, the UE determines the corresponding UL channel access priority p in Table 4.2.1-1 following the procedures described in Clause 5.6.2 in [9].

When a UE uses Type 1 channel access procedures for PUSCH transmissions with user plane data indicated by a UL grant or related to random access procedure where the corresponding UL channel access priority p is not indicated, the UE determines p in Table 4.2.1-1 following the same procedures as for PUSCH transmission on configured resources using Type 1 channel access procedures.

When a UE uses Type 2A, Type 2B, or Type 2C UL channel access procedures for PUSCH transmissions indicated by a UL grant or related to random access procedures, where the corresponding UL channel access priority p is not indicated, the UE assumes that the channel access priority class $p = 4$ is used by the gNB for the *Channel Occupancy Time*.

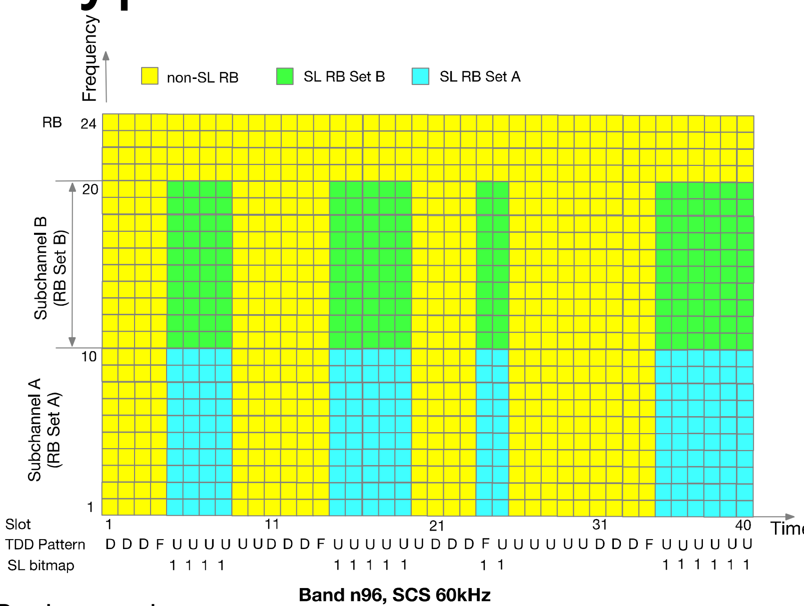
A UE shall not transmit on a channel for a *Channel Occupancy Time* that exceeds $T_{ulm\,cot,p}$ where the channel access procedure is performed based on the channel access priority class p associated with the UE transmissions, as given in Table 4.2.1-1.

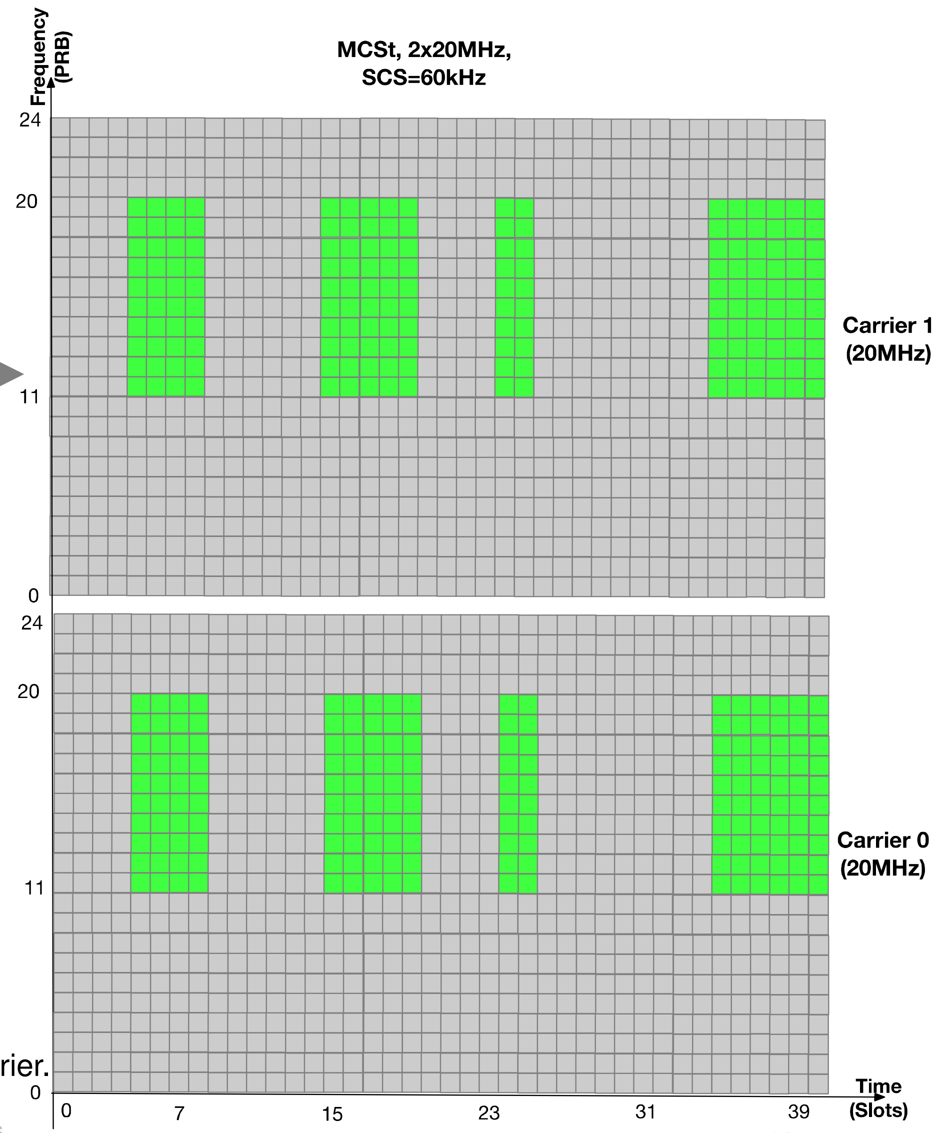
Type A or Type B Access. Proposals.

Title	Comments
#112b-e Agreement	• Type A or Type B multi-channel access** --------------------------- *For dynamic channel access mode with multi-channel case in SL-U, both NR-U DL Type A and Type B multi-channel access procedure are supported for multiple PSFCH transmissions on multiple channels.* • *FFS: It is up to UE implementation to perform either Type A or Type B multi-channel access procedure.* • *FFS: whether this can initiate a shared COT* • *FFS: whether there is any special handling needed for transmission in a shared COT on one or more of the channels*
#113 Proposal	• Type A or Type B multi-channel access** --------------------------- *For dynamic channel access mode, with multi-channel in SL-U case, a UE could support both NR-U DL Type A and Type B multi-channel access procedures, for multiple PSFCH transmissions on multiple channels, according with NR-U specifications [2] section #4.1.6. COT sharing for multi-channel access is precluded.* ~~• *FFS: It is up to UE implementation to perform either Type A or Type B multi-channel access procedure.*~~ *A UE could perform Type A only with X% ChBW efficiency. FFS X%.* ~~• *FFS: whether this can initiate a shared COT.*~~ ~~• *FFS: whether there is any special handling needed for transmission in a shared COT on one or more of the channels.*~~

* RP-222806 (SID)
** R1-2304616

Type A/B Access. Justification





Background

- RB Set B uses 41.6% PRB resources
- Since it can't increase Tx traffic capacity (subchannel wise),

it attempts MCSt (x2 traffic capacity) and 0.5 latency.

- Inefficient resource allocation: 21%/42% SL traffic* blocks 100% Wi-Fi traffic
- MCSt Type B c_j set is selected every 1s, while LBT could fail every 6ms (Type 1 Allocation).

Conclusions

1. MCSt Type B is not well suited for NR-U traffic.
2. MCSt Type A could be used provided by X% of ChBW is occupied by SL-U carrier. FFS X%.

* SCS 30/60kHz

Type A and B Multi-Channel Access. References 1/2

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4.1.6.1 Type A multi-channel access procedures

An eNB/gNB shall perform channel access on each channel $c_i \in C$, according to the procedures described in clause 4.1.1, where C is a set of channels on which the eNB/gNB intends to transmit, and $i = 0,1, \dots q-1$, and q is the number of channels on which the eNB/gNB intends to transmit.

The counter N described in clause 4.1.1 is determined for each channel c_i and is denoted as N_{c_i}. N_{c_i} is maintained according to clause 4.1.6.1.1 or 4.1.6.1.2.

If a gNB configures a carrier without intra-cell guard bands as described in clause 7 in [8], the gNB may not transmit on channel $c_i \in C$ within the bandwidth of the carrier, if the gNB fails to access any of the channels of the carrier bandwidth.

4.1.6.1.1 Type A1 multi-channel access procedures

Counter N as described in clause 4.1.1 is independently determined for each channel c_i and is denoted as N_{c_i}.

If the absence of any other technology sharing the channel cannot be guaranteed on a long term basis (e.g. by level of regulation), when the eNB/gNB ceases transmission on any one channel $c_j \in C$, for each channel $c_i \neq c_j$, the eNB/gNB can resume decrementing N_{c_i} when idle sensing slots are detected either after waiting for a duration of $4 \cdot T_{sl}$, or after reinitializing N_{c_i}.

For determining CW_p for channel c_i, any PDSCH that fully or partially overlaps with channel c_i, is used in the procedures described in clause 4.1.4.2.

4.1.6.1.2 Type A2 multi-channel access procedures

Counter N is determined as described in clause 4.1.1 for channel $c_j \in C$, and is denoted as N_{c_j}, where c_j is the channel that has the largest CW_p value. For each channel c_i, $N_{c_i} = N_{c_j}$.

When the eNB/gNB ceases transmission on any one channel for which N_{c_i} is determined, the eNB/gNB shall reinitialize N_{c_i} for all channels.

For determining CW_p for channel c_i, any PDSCH that fully or partially overlaps with channel c_i, is used in the procedures described in clause 4.1.4.2.

Type A and B Multi-Channel Access. References 2/2

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4.1.6.2 Type B multi-channel access procedure

A channel $c_j \in C$ is selected by the eNB/gNB as follows:

- the eNB/gNB selects c_j by uniformly randomly choosing c_j from C before each transmission on multiple channels $c_i \in C$, or
- the eNB/gNB selects c_j no more frequently than once every 1 second,

where C is a set of channels on which the eNB/gNB intends to transmit, $i = 0,1, \dots q - 1$, and q is the number of channels on which the eNB intends to transmit.

To transmit on channel c_j

- the eNB/gNB shall perform channel access on channel c_j according to the procedures described in clause 4.1.1 with the modifications described in clause 4.1.6.2.1 or 4.1.6.2.2.

To transmit on channel $c_i \neq c_j$, $c_i \in C$

- for each channel c_i, the eNB/gNB shall sense the channel c_i for at least a sensing interval $T_{\text{mc}} = 25\mu s$ immediately before transmitting on channel c_j, and the eNB/gNB may transmit on channel c_i immediately after sensing the channel c_i to be idle for at least the sensing interval T_{mc}. The channel c_i is considered to be idle for T_{mc} if the channel is sensed to be idle during all the time durations in which such idle sensing is performed on the channel c_j in given interval T_{mc}.

The eNB/gNB shall not transmit a transmission on a channel $c_i \neq c_j$, $c_i \in C$, for a period exceeding $T_{m\,cot,p}$ as given in Table 4.1.1-1, where the value of $T_{m\,cot,p}$ is determined using the channel access parameters used for channel c_j.

For the procedures in this clause, the channel frequencies of the set of channels C selected by gNB, is a subset of one of the sets of channel frequencies defined in [6].

If a gNB configures a carrier without intra-cell guard band(s) as described in clause 7 in [8], the gNB may not transmit on channel $c_i \in C$ within the bandwidth of the carrier, if the gNB fails to access any of the channels of the carrier bandwidth.

4.1.6.2.1 Type B1 multi-channel access procedure

A single CW_p value is maintained for the set of channels C.

For determining CW_p for channel access on channel c_j, step 2 of the procedure described in clause 4.1.4.1 is modified as follows

- if at least $Z = 80\%$ of HARQ-ACK values corresponding to PDSCH transmission(s) in reference subframe k of all channels $c_i \in C$ are determined as NACK, increase CW_p for each priority class $p \in \{1,2,3,4\}$ to the next higher allowed value; otherwise, go to step 1.

For determining CW_p for a set of channels C, any PDSCH that fully or partially overlaps with any channel $c_i \in C$, is used in the procedure described in clause 4.1.4.2.

4.1.6.2.2 Type B2 multi-channel access procedure

A CW_p value is maintained independently for each channel $c_i \in C$ using the procedure described in clause 4.1.4.

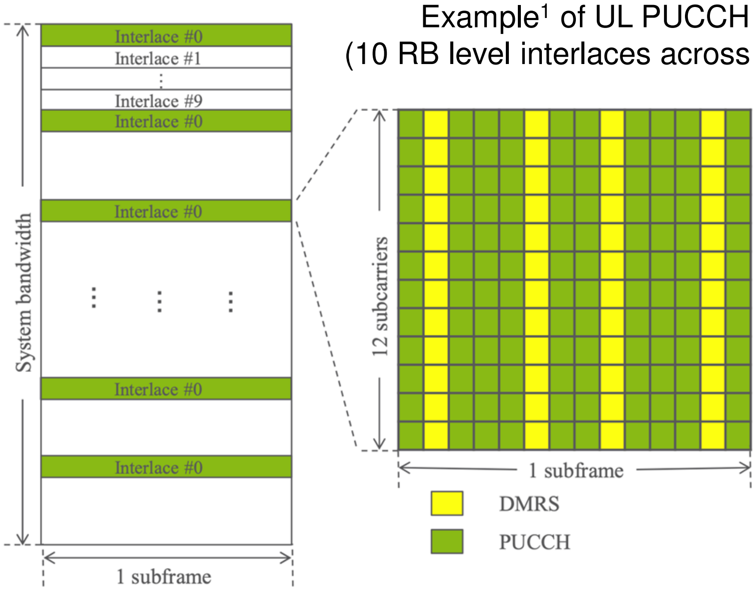
For determining CW_p for channel c_i, any PDSCH that fully or partially overlaps with channel c_i, is used in the procedure described in clause 4.1.4.2.

For determining N_{init} for channel c_j, CW_p value of channel $c_{j1} \in C$ is used, where c_{j1} is the channel with largest CW_p among all channels in set C.

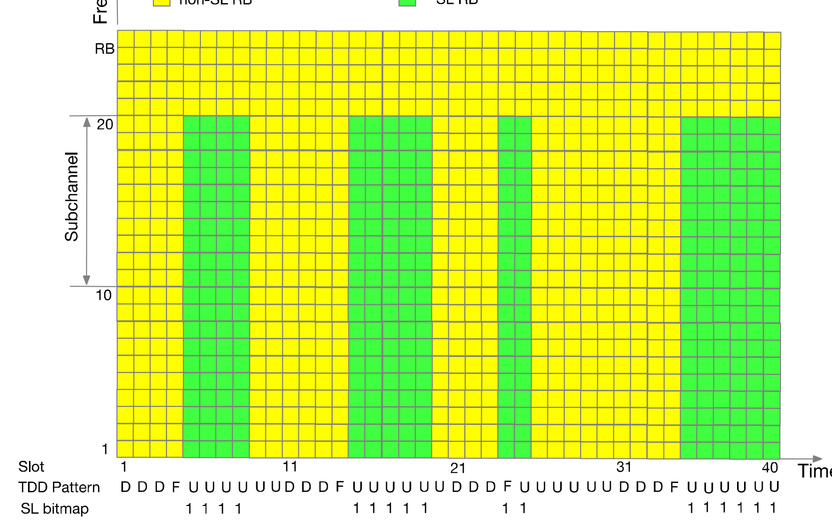
Appendix

Appendix1. SL-U Subchannel and Interlaces

Example[1] of UL PUCCH transmission
(10 RB level interlaces across a 20MHz channel)



Example[3] of SL resource pool and related subchannels structure



- Min(Subchannel size)=20MHz
- SCS≥30kHz (ChBW=20MHz) may not accommodate 10 interlaced subchannels

SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	35 MHz	40 MHz	45 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz
	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}
15	25	52	79	106	133	160	188	216	242	270	N/A	N/A	N/A	N/A	N/A
30	11	24	38	51	65	78	92	106	119	133	162	189	217	245	273
60	N/A	11	18	24	31	38	44	51	58	65	79	93	107	121	135

Maximum transmission BW configuration[4]

- Max(TX_PSD)=10dBm/MHz[2]
- For UE PC2 (23dBm):
  - SCS=15kHz: 18 interlaces
  - SCS=30kHz: 17 interlaces
  - SCS=30kHz: 17 interlaces

1. ‘HARQ Feedback in Unlicensed Spectrum LTE: Design and Perfomance Evaluation’, IEEE Xplore, A. Mukherjee et all
2. ETSI 301 893
3. ‘What is SideLink?’, D. Viorel, Y. Yi, CableLabs, Jan 2023
4. 3GPP TS 38.101-1 (2022-12)

RAN1 Status*

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Title		Completed?		Target completion date		SR
		RAN1	Overall	Agreed	Proposed	
NR MIMO evolution for downlink and uplink	WI	No	No	RAN#101	RAN#101	RP-230102
NR sidelink evolution	WI	No	No	RAN#101	RAN#101	RP-230075
Expanded and Improved NR Positioning	WI	No	No	RAN#101	RAN#101	RP-230327
Enhanced support of reduced capability NR devices	WI	No	No	RAN#101	RAN#101	RP-230111
Network energy savings for NR	WI	No	No	RAN#101	RAN#101	RP-230565
NR network-controlled repeaters	WI	**YES**	No	RAN#101	RAN#101	RP-230174
Enhancement of NR Dynamic Spectrum Sharing (DSS)	WI	**YES**	No	RAN#101	RAN#101	RP-230412
Multi-carrier enhancements for NR	WI	**YES**	No	RAN#101	RAN#101	RP-230356
Further NR coverage enhancements	WI	No	No	RAN#101	RAN#101	RP-230308
Study on Artificial Intelligence (AI)/Machine Learning (ML) for NR air interface	SI	No	No	RAN#101	RAN#101	RP-230661
Study on evolution of NR duplex operation	SI	No	No	RAN#101	RAN#101	RP-230291
Study on low-power Wake-up Signal and Receiver for NR	SI	No	No	RAN#101	RAN#101	RP-230369
(RAN2-led) NR support for UAV (Uncrewed Aerial Vehicles)	WI	No	No	RAN#101	RAN#101	RP-230258
(RAN2-led) XR enhancements for NR	WI	No	No	RAN#101	RAN#101	RP-230277
(RAN2-led) NR NTN (Non-Terrestrial Networks) enhancements	WI	No	No	RAN#101	RAN#101	RP-230119
(RAN2-led) Further NR mobility enhancements	WI	No	No	RAN#101	RAN#101	RP-230635
(RAN4-led) NR support for dedicated spectrum less than 5MHz for FR1	WI	No	No	RAN#101	RAN#101	RP-230114

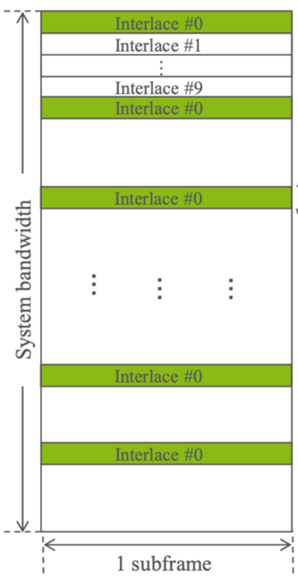
Selected topics

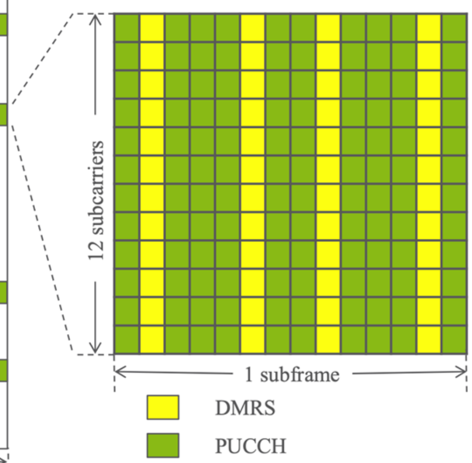
- CableLabs focus: yellow, Completed WIDs: gray

* RP-230003

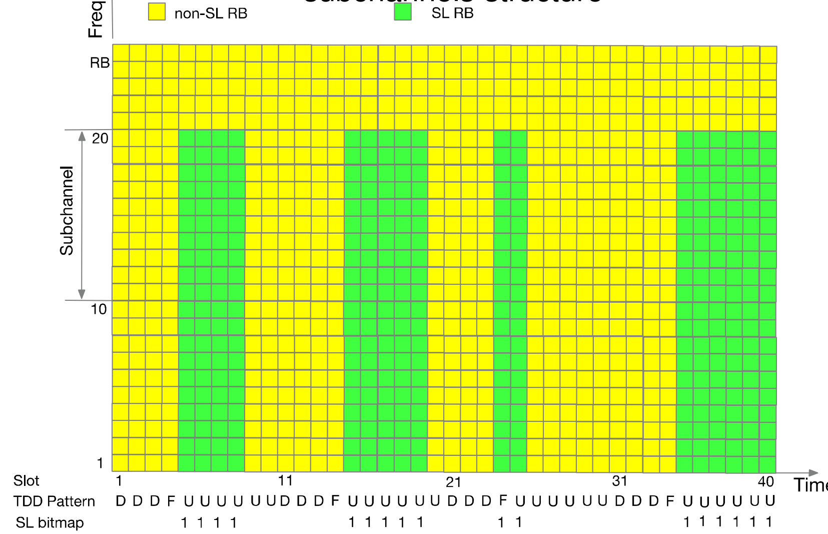
Appendix1. SL-U Subchannel and Interlaces

Example[1] of UL PUCCH transmission
(10 RB level interlaces across a 20MHz channel)





Example[3] of SL resource pool and related subchannels structure



- Max(TX_PSD)=10dBm/MHz[2]
- UE PC2 (23dBm) requires 20 interlaces
- 1 interlace = 6 PRB (1.08 MHz)

- Min(Subchannel size)=20MHz
- SCS≥30kHz (ChBW=20MHz) may not accommodate 10 interlaced subchannels

SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	35 MHz	40 MHz	45 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz
	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}
15	25	52	79	106	133	160	188	216	242	270	N/A	N/A	N/A	N/A	N/A
30	11	24	38	51	65	78	92	106	119	133	162	189	217	245	273
60	N/A	11	18	24	31	38	44	51	58	65	79	93	107	121	135

Maximum transmission BW configuration[4]

1. 'HARQ Feedback in Unlicensed Spectrum LTE: Design and Perfomance Evaluation', IEEE Xplore, A. Mukherjee et all
2. ETSI 301 893
3. 'What is SideLink?', D. Viorel, Y. Yi, CableLabs, Jan 2023
4. 3GPP TS 38.101-1 (2022-12)

RAN1 112b-e Attendance**

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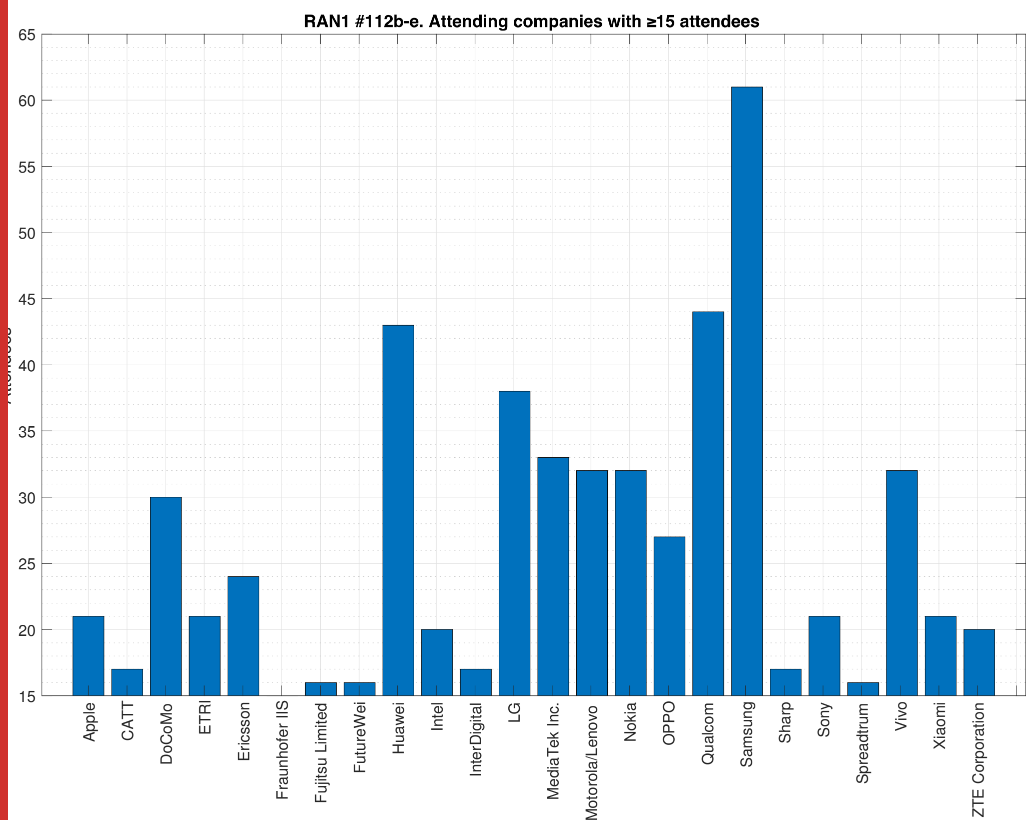

- Online meeting: 1085 registered attendees
- Companies* with the highest number of registered attendees
  1. Samsung 61
  2. Huawei (43) + Futurewei (16) = 59
  3. Qualcomm 44
  4. LG 38
  5. Mediatek 33
- Apple's attendees (21), are assigned to multiple Apple subsidiaries, albeit not all these subsidiaries may be involved in wireless R&D.
- Lenovo has multiple subsidiaries listed as either Lenovo or Motorola.

- Subsidiaries included

** Only companies with N≥15 attendees plotted