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International application number:	PCT/KR2017/003657
International filing date:	03 April 2017 (03.04.2017)
Document type:	Certified copy of priority document
Document details:	Country/Office: US
	Number: 62/403,061
	Filing date: 01 October 2016 (01.10.2016)
Date of receipt at the International Bureau:	08 April 2017 (08.04.2017)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-bis)

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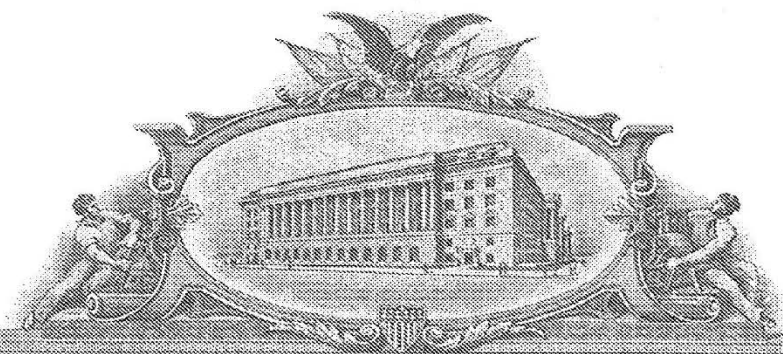
Application number: 62403061

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THE UNITED STATES OF AMERICA

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UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

April 10, 2017

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 62/403,061
FILING DATE: *October 01, 2016*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US62/403,061*



Certified by

Michelle W. Lee

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor	1				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Seungmin		EE		
Residence Information (Select One) US Residency • Non US Residency Active US Military Service					
City	Seoul		Country of Residence ⁱ	KR	
Mailing Address of Inventor:					
Address 1		19, Yangjae-daero 11gil, Seocho-gu			
Address 2					
City	Seoul		State/Province		
Postal Code	06772		Country ⁱ	KR	
Inventor	2				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Hanbyul		SEO		
Residence Information (Select One) US Residency • Non US Residency Active US Military Service					
City	Seoul		Country of Residence ⁱ	KR	
Mailing Address of Inventor:					
Address 1		19, Yangjae-daero 11gil, Seocho-gu			
Address 2					
City	Seoul		State/Province		
Postal Code	06772		Country ⁱ	KR	
Inventor	3				Remove
Legal Name					

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		

Prefix	Given Name	Middle Name	Family Name	Suffix
	Myoungseob		KIM	
Residence Information (Select One) US Residency ☒ Non US Residency Active US Military Service				
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Mailing Address of Inventor:

Address 1	19, Yangjae-daero 11gil, Seocho-gu			
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City	Seoul	State/Province		
Postal Code	06772	Country ⁱ	KR	
Inventor	4	Remove		
Legal Name				

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	Youngdae		EE	
Residence Information (Select One) US Residency ☒ Non US Residency Active US Military Service				
City	Seoul	Country of Residence ⁱ	KR	

Mailing Address of Inventor:

Address 1	19, Yangjae-daero 11gil, Seocho-gu			
Address 2				
City	Seoul	State/Province		
Postal Code	06772	Country ⁱ	KR	
Inventor	5	Remove		
Legal Name				

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jaewook		LEE	
Residence Information (Select One) US Residency ☒ Non US Residency Active US Military Service				
City	Seoul	Country of Residence ⁱ	KR	

Mailing Address of Inventor:

Address 1	19, Yangjae-daero 11gil, Seocho-gu			
Address 2				
City	Seoul	State/Province		
Postal Code	06772	Country ⁱ	KR	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ An Address is being provided for the correspondence information of this application.

Customer Number	67487		
Email Address	info@kpatent.com	Add Email	Remove Email
Email Address	uspto@kpatent.com	Add Email	Remove Email

Application Information:

Title of the Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		
Attorney Docket Number	UT16-1424-US	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		
Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.			
Please Select One: ☒ Customer Number ☐ US Patent Practitioner ☐ Limited Recognition (37 CFR 11.9)			
Customer Number	67487		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78. When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)¹ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ¹	Filing Date (YYYY-MM-DD)	Access Code ¹ (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		
☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.			

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.				
Applicant	1	Remove		
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.				
		Clear		
Assignee	Legal Representative under 35 U.S.C. 117		Joint Inventor	
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest		
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:				
Name of the Deceased or Legally Incapacitated Inventor:				
If the Applicant is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Applicant:				
Address 1				
Address 2				
City		State/Province		
Country		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Applicant Data may be generated within this form by selecting the Add button. Add				

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
Remove				
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add				

Signature:[Remove](#)

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet must be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Andrew S. Park/			Date (YYYY-MM-DD)	2016-09-30
First Name	Andrew	Last Name	Park	Registration Number	47841
Additional Signature may be generated within this form by selecting the Add button. Add					

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UT16-1424-US
		Application Number	
Title of Invention	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PROVISIONAL APPLICATION FOR UNITED STATES PATENT
IN THE NAMES OF

**Seungmin LEE, Hanbyul SEO, Myoungseob KIM, Youngdae LEE
and Jaewook LEE**

for

DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES

Customer Number: 67487

Attorney Docket Number: UT16-1424-US

Total Number of pages: 23 (including cover)

Provisional Application

Title of Invention	DCI Design for Multiple SL/UL SPS Processes
Inventors	
Related Technology Field	Wireless Communications
Related Specification	LTE Advanced
Reference	

1. Summary of Invention
2. Background and Prior Arts in the Same Field of the Invention
3. Composition and Method of the Invention

In a case where a plurality of SIDELINK (SL) and/or UPLINK (UL) SEMI-PERSISTENT SCHEDULING (SPS) PROCESS(S)/(CONFIGURATION(S)) are configured (e.g., 'MULTIPLE SPS CONFIGURATION(S)/(PROCESS(S)) FOR UL (UL + SL), EX) ONE FOR VOIP, ONE FOR ITS'), the proposed methods that will hereinafter be described in detail propose methods for efficiently managing and operating such processes (e.g., SPS PROCESS (/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATION, HARQ RETRANSMISSION). Herein, for example, the wordings 'SL SPS PROCESS (/CONFIGURATION)' and 'UL SPS PROCESS (/CONFIGURATION)' may each be interpreted as an SPS PROCESS (/CONFIGURATION) for supporting 'PC5 LINK based V2X message transmission' and an SPS PROCESS (/CONFIGURATION) for supporting 'UU LINK based V2X message transmission.

[Proposed Method #1] By configuring (/signaling) (part of) a different (new) 'V2X_SPS-RNTI' per 'SL and/or UL SPS PROCESS (/CONFIGURATION)', independent management and operation (e.g., SPS PROCESS (/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATION, HARQ RETRANSMISSION) may be achieved for each 'SL and/or UL PROCESS (/CONFIGURATION)'. Herein, for example, in case the corresponding rule is applied, this may be interpreted as (part of) different 'RNTI' values being configured (/signaled) between a plurality of SL SPS PROCESS (/CONFIGURATION) (or UL SPS PROCESS (/CONFIGURATION)) and/or as (part of) different 'RNTI' values being configured (/signaled) between a SL SPS PROCESS (/CONFIGURATION) and an UL SPS PROCESS (/CONFIGURATION). Herein, as another example, (part of) different (or common) 'RNTI' values may also be configured (/signaled) between the existing (or conventional) WAN (VOIP (/UL)) communication related SPS PROCESS (/CONFIGURATION) (e.g., 'SPS C-RNTI') and the (V2X) UL SPS PROCESS (/CONFIGURATION) (and/or SL SPS PROCESS (/CONFIGURATION)).

[Proposed Method #2] A (single) common (or shared) ‘V2X_SPS-RNTI’ is configured (/signaled) to a plurality of ‘SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S))’, and this method may identify (or distinguish) to which ‘SL (and/or UL) SPS PROCESS (/CONFIGURATION)’ the corresponding control information is related through a (new) pre-defined (/signaled) specific field within a ‘(SL (and/or UL)-SPS) (ACTIVATION/RELEASE) DCI’ that is decoded by using the corresponding RNTI (e.g., a ‘SL (and/or UL) SPS PROCESS (/CONFIGURATION) INDEX (/ID)’ field and/or a field announcing an ‘LCID’ being linked (/interconnected) to a ‘SL (and/or UL) SPS PROCESS (/CONFIGURATION) INDEX (/ID)’ (that is configured (/signaled) through a pre-defined signaling)). Herein, for example, as field(s) being used for the above-described purpose, a ‘DM-RS CS (3 bit) field’ (e.g., a case where a UL (and/or SL)-SPS) (ACTIVATION/RELEASE) DCI’ of the (existing) ‘DCI format 0’ type is (re-)used (for the purpose of a ‘(SL (and/or (V2X) UL)-SPS) (ACTIVATION/RELEASE) DCI’ (refer to Table 3.3)) and/or a ‘HARQ ID (3/4 bit)/RV (2 bit) field’ (e.g., a case where a (VOIP) UL (/downlink) (and/or SL)-SPS) (ACTIVATION/RELEASE) DCI’ of the (existing) ‘DCI format 1/1A/2/2A/2B/2C/2D’ type is (re-)used (for the purpose of a V2X) SL (and/or UL)-SPS) (ACTIVATION/RELEASE) DCI’ (refer to Table 3.3)) may be (re-)used. Herein, for example, a size (X_size) of the field being used for the corresponding purpose may be fixed to a pre-configured (/signaled) value (e.g., ‘3 bit’), and, in case a (maximum) number of ‘SL (and/or UL) SPS PROCESS (/CONFIGURATION)’ (SPS NUM) being configured (/signaled) (in the form of a ‘CARRIER(/CELL)-SPECIFIC (PRE)CONFIGURATION’) from a network (or (serving) cell) can be varied (or changed), ‘($X_size - \text{ceiling}(\text{LOG}_2(\text{SPS NUM}))$)’ (and/or ‘($X_size - \text{floor}(\text{LOG}_2(\text{SPS NUM}))$))’ bits (herein, for example, the ‘ceiling(X)’ and the ‘floor(X)’ may indicate a function drawing a ‘minimum integer value that is greater than or equal to X’ and a function drawing a ‘maximum integer value that is smaller than or equal to X’) may be processed with zero (or a specific pre-configured (/signaled) value) padding (e.g., this may be used for the purpose of a ‘VIRTUAL CRC’). Herein, for example, in case a common ‘RNTI’ value is configured (/signaled) between an existing WAN (VOIP (/UL)) communication related SPS PROCESS (/CONFIGURATION) and a (V2X) UL SPS PROCESS (/CONFIGURATION) (and/or in case a (/an) ‘(ACTIVATION/RELEASE) DCI’ having the same (payload) size is used), it may be distinguished to which one of the existing WAN (VOIP (/UL)) communication related SPS PROCESS (/CONFIGURATION) and the (V2X) UL SPS PROCESS (/CONFIGURATION) the corresponding control information is related through (a re-usage of) (A) a pre-defined (/signaled) new field (e.g., ‘1 bit’) and/or (B) a pre-designated (/signaled) existing field within the ‘(ACTIVATION/RELEASE) DCI’ being decoded by using the corresponding common RNTI ($C_V2XARDCI$) (for example, in case the ‘(ACTIVATION/RELEASE) DCI’ of the (existing) ‘DCI format 0’ type is (re-)used (refer to Table 3.3), an ‘MCS/RV (5 bits) field (MSB (1 bit))’ and/or a ‘TPC (2 bits) field (MSB (1 bit))’ and/or a ‘CS DM RS (3 bits) field (MSB (1 bit))’ may be (re-)used). Herein, for example, by defining a new field in the $C_V2XARDCI$, in case the (payload) size becomes larger than the ‘(ACTIVATION/RELEASE) DCI’ that is related to the existing WAN (VOIP (/UL)) communication (that is transmitted within the same USS (/CSS)), in order to prevent an increase in the number of blind decoding sessions of the UE, zero (or a specific pre-configured (/signaled) value) padding may be performed (e.g., this may be used for the purpose of a ‘VIRTUAL CRC’) until the WANARDCI (payload) size becomes identical to the (payload) size of the $C_V2XARDCI$.

Table 3.3: Example of SPS ACTIVATION/RELEASE operations (related to WAN (VOIP(/UL)) communications) under existing LTE systems.

9.2 PDCCH/EPDCCH/MPDCCH validation for semi-persistent scheduling [1]

A UE shall validate a Semi-Persistent Scheduling assignment PDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the PDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'. In case of DCI formats 2, 2A, 2B, 2C and 2D, the new data indicator field refers to the one for the enabled transport block.

A UE shall validate a Semi-Persistent Scheduling assignment EPDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the EPDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'. In case of DCI formats 2, 2A, 2B, 2C and 2D, the new data indicator field refers to the one for the enabled transport block.

A UE shall validate a Semi-Persistent Scheduling assignment MPDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the MPDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI
- the new data indicator field is set to '0'.

Validation is achieved if all the fields for the respective used DCI format are set according to Table 9.2-1 or Table 9.2-1A, 9.2-1B, 9.2-1C.

If validation is achieved, the UE shall consider the received DCI information accordingly as a valid semi-persistent activation or release.

If validation is not achieved, the received DCI format shall be considered by the UE as having been received with a non-matching CRC.

Table 9.2-1: Special fields for Semi-Persistent Scheduling Activation PDCCH/EPDCCH Validation

	DCI format 0	DCI format 1/1A	DCI format 2/2A/2B/2C/2D
TPC command for scheduled PUSCH	set to '00'	N/A	N/A
Cyclic shift DM RS	set to '000'	N/A	N/A
Modulation and coding scheme and redundancy version	MSB is set to '0'	N/A	N/A
HARQ process number	N/A	FDD: set to '000' TDD: set to '0000'	FDD: set to '000' TDD: set to '0000'

Modulation and coding scheme	N/A	MSB is set to '0'	For the enabled transport block: MSB is set to '0'
Redundancy version	N/A	set to '00'	For the enabled transport block: set to '00'

Table 9.2-1A: Special fields for Semi-Persistent Scheduling Release PDCCH/EPDCCH Validation

	DCI format 0	DCI format 1A
TPC command for scheduled PUSCH	set to '00'	N/A
Cyclic shift DM RS	set to '000'	N/A
Modulation and coding scheme and redundancy version	set to '11111'	N/A
Resource block assignment and hopping resource allocation	Set to all '1's	N/A
HARQ process number	N/A	FDD: set to '000' TDD: set to '0000'
Modulation and coding scheme	N/A	set to '11111'
Redundancy version	N/A	set to '00'
Resource block assignment	N/A	Set to all '1's

Table 9.2-1B: Special fields for Semi-Persistent Scheduling Activation MPDCCH Validation

	DCI format 6-0A	DCI format 6-1A
HARQ process number	set to '000'	FDD: set to '000' TDD: set to '0000'
Redundancy version	set to '00'	set to '00'
TPC command for scheduled PUSCH	set to '00'	N/A
TPC command for scheduled PUCCH	N/A	set to '00'

Table 9.2-1C: Special fields for Semi-Persistent Scheduling Release MPDCCH Validation

Value of 'TPC command for PUCCH'	$n_{\text{PUCCH}}^{(1,p)}$
'00'	The first PUCCH resource value configured by the higher layers
'01'	The second PUCCH resource value configured by the higher layers

'10'	The third PUCCH resource value configured by the higher layers
'11'	The fourth PUCCH resource value configured by the higher layers

For the case that the DCI format indicates a semi-persistent downlink scheduling activation, the TPC COMMAND for PUCCH field shall be used as an index to one of the four PUCCH resource values configured by higher layers, with the mapping defined in Table 9.2-2

Table 9.2-2: PUCCH resource value for downlink semi-persistent scheduling

Value of 'TPC COMMAND for PUCCH'	$n_{\text{PUCCH}}^{(1,p)}$
'00'	The first PUCCH resource value configured by the higher layers
'01'	The second PUCCH resource value configured by the higher layers
'10'	The third PUCCH resource value configured by the higher layers
'11'	The fourth PUCCH resource value configured by the higher layers

[Proposed Method #3] (For example, in case a (single) common 'V2X_SPS-RNTI' and '(ACTIVATION/RELEASE) DCI format' are used for the management and operation of a plurality of 'SL and/or UL SPS PROCESS (/CONFIGURATION)' a SUBFRAME (SF) SET (/CELL SET) (and/or a search space (SS) type (CSS/USS) and/or a control channel (PDCCH/EPDCCH SET) type) in which the related '(SL and/or UL-SPS) (ACTIVATION/RELEASE) DCI' is received for each 'SL and/or UL SPS PROCESS (/CONFIGURATION)' may be differently (or independently) configured (/signaled).

Herein, for example, such operation may also be (limitedly) applied only in a situation where a plurality of SL and/or UL SPS transmissions are not performed in one SF. For example, in case (part of) the above-described proposed methods (e.g., [Proposed Method #1], [Proposed Method #2], [Proposed Method #3]) are applied, (A) a differentiation (related to SPS PROCESS (/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATION, HARQ RETRANSMISSION operation (/instruction)) may be performed between a plurality of 'SL SPS PROCESS (/CONFIGURATION)' (or 'UL SPS PROCESS (/CONFIGURATION)') and/or (B) a differentiation (related to SPS PROCESS (/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATION, HARQ RETRANSMISSION operation (/instruction)) may be performed between a 'SL SPS PROCESS (/CONFIGURATION)' and an 'UL SPS PROCESS (/CONFIGURATION)'.

For example, a (single) common 'V2X_SPS-RNTI' may be configured (/signaled) to a plurality of 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))', and an 'ACTIVATION/RELEASE' (/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION) instruction that is related to a plurality of 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' may be performed at the same time through one or more (new) pre-defined (/signaled) specific fields within a '(SL and/or UL-SPS) (ACTIVATION/RELEASE) DCI', which is decoded by the corresponding RNTI.

Herein, for example, (A) in case the (new) specific field(s) can be implemented in the form of a bitmap (e.g., in case (a maximum of) '4' 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' can be processed with 'activation/release' (/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION) at the same time), the corresponding field may be implemented in the form of a bitmap having a length of '4 BIT(S)' ('WXYZ') (For example, it means 'W = 1/0' → 'SL and/or UL SPS PROCESS(/CONFIGURATION) #0 ACTIVATION/RELEASE', 'X=1/0' → 'SL and/or UL SPS PROCESS(/CONFIGURATION) #1 ACTIVATION/RELEASE', 'Y=1/0' → 'SL and/or UL SPS PROCESS(/CONFIGURATION) #2 ACTIVATION/RELEASE', 'Z=1/0' → 'SL and/or UL SPS PROCESS(/CONFIGURATION) #3 ACTIVATION/RELEASE', respectively). Herein, for example, this may also be understood as the 'SL and/or UL SPS PROCESS(/CONFIGURATION) INDEX (/ID)' (information) that is linked with (/interconnected to) a specific field value being pre-configured (/signaled) in advance; alternatively, (B) the (new) specific field(s) may be implemented in the same number of fields as the (maximum) number of 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' that can be processed with 'ACTIVATION/RELEASE' (/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION) at the same time. For example, in case (a maximum of) '4' 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' may be 'ACTIVATED/RELEASED' at the same time, and, in case the 'SL and/or UL SPS PROCESS (/CONFIGURATION) INDEX (/ID)' is expressed as '3 BIT(S)', the corresponding field(s) may be implemented as '4' fields each having the length of '3 BIT(S)'. Herein, for example, (According to the proposed method, in case 'ACTIVATION' (/RELEASE/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION) related to a plurality of 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' are indicated (or instructed) at the same time, in order to reduce collision between 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' having the same 'cycle period value' and/or 'frequency (/time) resource position value', among the corresponding 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' (that are simultaneously instructed (or indicated)), the 'SF OFFSET' information per 'SL and/or UL SPS PROCESS (/CONFIGURATION)' may be configured through a 'SF OFFSET' information field per 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' being (newly) defined within (A) a 'higher layer signaling (e.g., 'RRC')' or (B) a '(SL and/or UL-SPS) (ACTIVATION/RELEASE) DCI'. Herein, for example, 'SF GAP' information being applied between a plurality of 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' (that are indicated at the same time) may be configured (/signaled) (e.g., in case '2' 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' having the same 'cycle period value (P)' and 'frequency (/time) resource position value' are 'ACTIVATED' at the same time, (according to an increasing order (or a decreasing order) of the 'SL and/or UL SPS PROCESS (/CONFIGURATION) INDEX (/ID)') a (periodic) resource related to 'SL and/or UL SPS PROCESS (/CONFIGURATION) #1' may be indicated in 'SF#0, SF#P, . . . , SF#(N·P)' (or 'SF#(0+SF GAP), SF#(P+SF GAP), . . . , SF#(N·P+SF GAP)'), and a (periodic) resource related to 'SL and/or UL SPS PROCESS (/CONFIGURATION) #2' may be indicated in 'SF#(0+SF GAP), SF#(P+SF GAP), . . . , SF#(N·P+SF GAP)' (or in 'SF#0, SF#P, . . . , SF#(N·P)'). Herein, as an additional example, the 'SL and/or UL SPS PROCESS (/CONFIGURATION)' that is processed with 'ACTIVATION' (/RELEASE/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION) may be limited to those having different 'cycle period values' and/or 'frequency (time) resource position values'.

For example, (A) (according to the above-described proposed method) in case 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' having the same 'cycle period value' and/or 'frequency (/time) resource position value' are processed with 'activation' (/RELEASE/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION) at the same time and/or (B) in case a plurality of 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' having (partially) different 'RB SIZE/LOCATION' and/or 'cycle period values' and/or 'MCS values', and so on, are configured (/signaled), which 'SL and/or UL SPS PROCESS (/CONFIGURATION)' is valid within the current subframe (set) may be announced (or notified) through a pre-defined (higher layer/physical layer) signaling (e.g., a '(SL and/or UL-SPS) (ACTIVATION/RELEASE) DCI').

Herein, as an additional example, a (partially) different parameter (set) (e.g., ‘resource block size/position’, ‘MCS value’) may be mapped (/signaled) per pre-configured (/signaled) SF SET, and the corresponding parameter (set) may be applied to the ‘SL and/or UL SPS PROCESS (/CONFIGURATION)’ that is valid (/‘on’) (or being used) within a specific SF SET.

For example, (unlike the above-described proposed method) in case the ‘SL and/or UL SPS PROCESS (CONFIGURATION) INDEX (/ID)’ field(s) is/are not defined within the ‘(SL and/or UL-SPS) (ACTIVATION/RELEASE) DCI’ and a periodic resource related to ‘SL and/or UL SPS PROCESS (/CONFIGURATION) #X’ is indicated at a time point of ‘SF#N’, the ‘(SL and/or UL-SPS) release (/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION) DCI’, which is received at a time point of ‘SF#(N-K)’ (e.g., ‘K=4’), may be viewed (/assumed) as a DCI (implicitly) indicating a ‘release (/FREQUENCY RESOURCE REALLOCATION/HARQ RETRANSMISSION)’ of the corresponding ‘SL and/or UL SPS PROCESS (/CONFIGURATION) #X’.

For example, (A) the ‘Mode 1 DCI’ announcing (or notifying) (PSCCH and/or PSSCH) scheduling information related to SL (and/or UL) SPS may be configured of (part of) the following fields. And/Or, (B) ‘K’ number of (repeated) re-transmission operations related to the same TB may be defined to be performed in accordance with (part of) the following rules. Herein, for example, the decoding of ‘Mode 1 DCI’ may be attempted to be performed by using an (additionally configured (/signaled)) ‘RNTI’ that is different from (or the same as) the (above-described) ‘(SL and/or UL-SPS) (ACTIVATION/RELEASE) DCI’. Herein, for example, (Part of) The field(s) within the ‘Mode 1 DCI’ (e.g., at least one of (Example #1-1) and/or (Example #1-2) and/or (Example #1-3) and/or (Example #1-5) and/or (Example #1-6), etc.) may be re-configured (/used) as a field (/fields) of ‘SA (/PSCCH)’.

- Types of fields configuring the ‘Mode 1 DCI’

- (Example #1-1) A ‘SL and/or UL SPS PROCESS (/CONFIGURATION) INDEX (/ID)’ field.
- (Example #1-2) A ‘TIMING GAP’ (indication) field between ‘DATA (/PSSCH)’ being interconnected to the ‘SA (/PSCCH)’ (and/or an interval (indication)) field between a ‘RESOURCE (RE-)SELECTION TRIGGERING TIMING’ and a ‘scheduling assignment (/PSCCH) TX TIMING’. Herein, for example, when being operated in ‘Mode 1’, the corresponding field value may be fixed to a pre-defined (/signaled) specific value (e.g., ‘TIMING GAP=0’), and, in this case, the corresponding field may also be omitted.
- (Example #1-3) A ‘RE-TRANSMISSION NUMBER COUNTER (/INDICATOR) (related to the same TB)’ field (and/or ‘a RV (related to the same TB)’ field). Herein, for example, the corresponding field may, most particularly, be useful (only) when the ‘Mode 1 DCI’ (and/or ‘SA (/PSCCH)’ is (/are) transmitted along with one another (or collectively) during each re-transmission related to the same TB.
- (Example #1-4) A ‘SA (/PSCCH)’ related frequency (/time) resource information field.

- (Example #1-5) A 'DATA (/PSSCH)' related frequency (/time) resource information field.
 - (Example #1-6) A 'SA (/PSCCH)' and/or 'DATA (/PSSCH)' related 'transmit power control (TPC) command' field (e.g., in case a size of the corresponding 'TPC COMMAND' field is equal to '1 BIT', a '0' value may indicate an 'application of a pre-configured (/signaled) (maximum) transmission power value (i.e., 'NO OPEN-LOOP POWER CONTROL')', and a '1' value may indicate a 'determination of the transmission power value according to a pre-defined 'OPEN-LOOP POWER CONTROL' equation) and/or a field announcing (or notifying) whether or not a 'DATA (/PSSCH)' related 'FREQUENCY HOPPING' is applied and/or a 'DATA (/PSSCH)' related 'time resource pattern (T-RPT)' field.
 - (Example #1-7) An indicator field related to a 'SL and/or UL SPS PROCESS(/CONFIGURATION) ACTIVATION (/RELEASE)'.
 - (Example #1-8) An information field related to a time period having a pre-determined length (/size) (e.g., 'subframe' unit) during which a resource related to a 'SL and/or UL SPS PROCESS(/CONFIGURATION)' is maintained (or an information field indicating a number of 'SL and/or UL SPS PROCESS(/CONFIGURATION)' cycle periods during which the corresponding resource is maintained). This field may be interpreted as a type of 'ACTIVATION DURATION TIMER' information.
- In case the above-described 'Mode 1 DCI' is received, a rule of 'K' number of (repeated) re-transmission operations that is related to the same TB
 - (Example #2-1) In case the 'Mode 1 DCI' (and/or 'SA (/PSCCH)') is (/are) transmitted along with one another (or collectively) during each re-transmission (/initial transmission) related to the same TB, the re-transmission (/initial transmission) may be performed in accordance with the ('SA (/PSCCH)' and/or 'DATA (/PSSCH)') scheduling information that is announced (/indicated) by the above-described fields within the corresponding 'Mode 1 DCI' (e.g., (Example #1-1)/(Example #1-2)), (Example #1-3), (Example #1-4), (Example #1-5), and so on).
 - (Example #2-2) In order to perform 'K' number of (repeated) re-transmissions related to the same TB, in case only one 'Mode 1 DCI' (and/or 'SA (/PSCCH)') related to the initial transmission scheduling is transmitted, (A) it may be assumed that the ('DATA (/PSSCH)') re-transmission is performed within consecutive subframes by using the same frequency resource as the initial transmission or (B) time resource pattern (T-RPT) information being related to the ('DATA (/PSSCH)') re-transmission (/initial transmission) may be announced (or notified) within (one) 'Mode 1 DCI' (and/or 'SA (/PSCCH)') related to the initial transmission scheduling. (For example, in case of (B), it may be assumed that the re-transmission related frequency resource is identical to the frequency resource of the initial transmission.)

For example, in case a plurality of 'SL and/or UL SPS PROCESS(S) (/CONFIGURATION(S))' are configured (/signaled), for example, 'TIMING GAP' values between the 'DATA (/PSSCH)' being interconnected to the 'SA (/PSCCH)' per 'SL and/or UL SPS PROCESS(/CONFIGURATION) (SET)' (and/or an interval (or gap) between a 'RESOURCE (RE-)SELECTION TRIGGERING TIMING' and a 'SA (/PSCCH) TX TIMING' and/or a 'sensing window size (that is based on SA decoding/energy measurement)' and/or an '(open-loop) TX POWER PARAMETER(S)') may be differently configured (/signaled). Accordingly, parameter levels between the 'SL and/or UL SPS PROCESS(/CONFIGURATION) (SET)' may be (implicitly) designated differently.

Herein, for example, by configuring (/signaling) a 'TIMING GAP' having a relatively large value (or small value) (and/or an interval (or gap) between a 'RESOURCE (RE)SELECTION TRIGGERING TIMING' and a 'SA(/PSCCH) TX TIMING' and/or a '(SA DECODING/ENERGY MEASUREMENT-BASED) sensing window size') within a 'SL and/or UL SPS PROCESS(/CONFIGURATION) (SET)' having a relatively high priority level, a V2X UE performing V2X communication through the configuration (/signaling) of a 'SL and/or UL SPS PROCESS(/CONFIGURATION) (SET)' having a relatively low priority level (i.e., a 'TIMING GAP' having a relatively small value (or large value) (and/or an interval (or gap) between a 'RESOURCE (RE-)SELECTION TRIGGERING TIMING' and a 'SA (/PSCCH) TX TIMING' and/or a '(SA DECODING/ENERGY MEASUREMENT-BASED) SENSING WINDOW SIZE') may be capable of detecting (/sensing) a 'SA (/PSCCH)' having a relatively high priority level (at a high probability) and may also be capable of selecting (/scheduling) its own 'DATA (/PSSCH)' resource while avoiding (as much as possible) the 'DATA (/PSSCH)' being scheduled by the corresponding 'SA (/PSCCH)'. Herein, for example, the '(open-loop) TX POWER PARAMETER(S)' having a relatively high value (e.g., 'P_O' and/or 'ALPHA', and so on) having a relatively large value may be configured (/signaled) within a 'SL and/or UL SPS PROCESS(/CONFIGURATION) (SET)' having a relatively high priority level. Herein, for example, the 'SL and/or UL SPS PROCESS(/CONFIGURATION) (SET)' having a relatively high priority level may be used (/assigned) for an 'event-triggered V2X MESSAGE TRANSMISSION (/SERVICE TYPE)' and/or a 'SERVICE TYPE requiring a relatively high 'reliability'.

For example, in case a pre-defined event occurs (e.g., in case a speed/travel direction/position variation (or change), and so on, equal to or greater than a pre-defined (/signaled) threshold value (as compared to a previous time point at which a 'V2X MESSAGE TX' has been performed) occurs, a 'V2X message (e.g., 'CAM') GENERATION (/TX)' may be (immediately) triggered. Accordingly, a 'V2X MESSAGE GENERATION (/TX)' related 'cycle period' and/or 'size variation pattern' (and/or an interval between consecutive 'V2X MESSAGE GENERATION (/TX)'), and so on, may be changed (or varied) (within the time domain). Herein, for example, when considering such problem (/phenomenon), it may be difficult for the V2X UE to perform 'V2X MESSAGE TX' of high 'reliability' (and/or satisfying the 'latency requirement') through a specific cycle period and/or a time/frequency resource size and/or MCS of a 'single SPS configuration/process', which is/are configured (/signaled) by the base station. Herein, for example, in order to resolve this problem, the cycle period related to the 'single SPS configuration (/process)' may be configured to be (extremely) short and a large size of the (time/frequency) resource may be assigned. However, in the aspect of efficient resource management, this method is not preferable. As a solution, the base station may configure (/signal) 'multiple SPS configurations (/processes)' (having different cycle periods and/or (time/frequency) resource sizes (and/or MCS)) to the V2X UE and, then, may also allow the V2X UE to report (part of) the following information. Herein, for example, the information report may be performed through a pre-defined (/signaled) channel (e.g., 'PUSCH (/PUCCH)', 'SR'). The base station that has received (/been reported of) such information may 'release' (/de-activate) the 'SPS configuration (/process)' that is not used by the corresponding V2X UE (or (most) inappropriate to the corresponding V2X UE), or the corresponding base station may newly configure (/signal) a (most) appropriate 'SPS configuration (/process)' to the corresponding V2X UE (or the cycle period and/or (time/frequency) resource size (and/or MCS) related to the (existing) 'SPS configuration (/process)'). As another example, the base station that has received (/been reported of) such information may (finally) instruct the corresponding V2X UE to perform switching to the (most) appropriate 'SPS configuration (/process)' among the 'multiple SPS configurations (/processes)'. Herein, for example, the corresponding switching instruction may be performed through a pre-defined (/signaled) channel (e.g., '(E)PDCCH (/PDSCH)'). Herein, for example, this rule may be limitedly applied only to the 'Mode 1 (i.e., a method according to which the base station controls (/signals) the 'V2X MESSAGE TX' related scheduling information)' based V2X communication and/or 'RC_CONNECTED(/IN-COVERAGE) V2X UE'.

(Example #A) ‘SPS configuration (/process) (index/ID) information’ that is used by the corresponding V2X UE (or (most) appropriate to the corresponding V2X UE) (and/or that is not used by the corresponding V2X UE (or (most) inappropriate to the corresponding V2X UE), among the configured (/signaled) ‘multiple SPS configurations (/processes)’.

(Example #B) ‘Utilization information’ and/or ‘collision (with another V2 UE) detection information’ and/or ‘interference (/energy) measurement information’ and/or ‘timing misalignment’ information between a time point (/cycle period) at which its (current) ‘V2X MESSAGE TX (/generation) is misaligned per configured (/signaled) ‘multiple SPS configurations (/processes)’.

As another example, a V2X UE being configured (/signaled) with ‘multiple SPS configurations (/processes)’ having different cycle periods and/or (time/frequency) resource sizes (and/or MCS) from the base station may select/use a ‘SPS configuration (/process)’ that is most appropriate to the corresponding V2X UE, and the V2X UE may report the respective result (e.g., ‘SPS configuration (/process) (index/ID) information’ that is selected/used by the V2X UE) to the base station.

As another example, Table 3.1 and Table 3.2 show how to efficiently support SL SPS operations (related to V2X communications) and UL SPS operations, respectively (e.g., by configuring DCI FORMAT fields).

Table 3.1: Example of how to efficiently support SL SPS operations (related to V2X communications)

1. Introduction

RAN aspects for signaling to/from eNB for V2V operation were discussed in RAN1#84bis and RAN1#85.

The following agreements were reached with regard to SL semi-persistent scheduling [1]:

Agreement:

- For SPS of V2V traffic for mode-1 SPS on PC5:
 - The eNB may configure multiple SPS configurations for a given UE
 - At least SPS-configuration-specific MCS (if MCS is part of the SPS-configuration) and SPS-configuration-specific periodicity can be configured
 - FFS if/which other SPS parameters can differ across the SPS-configurations
 - The eNB can dynamically trigger/release the different SPS-configurations by use of (E)PDCCH
 - Details of the trigger/release are FFS
 - Working assumption: The UE can indicate to the eNB that it does not intend to transmit data before a transmission associated to an SPS configuration
 - FFS any details of the signaling protocol
 - FFS whether eNB acknowledgment of the UE indication is needed

Agreements:

- Support cross carrier scheduling for sidelink SPS and dynamic scheduling for V2V with mode-1
- PC5-based V2V design will support the multiple-operator scenario but not be optimized for it.
- Details FFS, e.g.,
 - How to handle timing difference between eNB timing and PC5 timing, when it exists
 - PC5 resource partitioning among multiple operators
 - Resource coordination across operators is out of 3GPP scope.

This contribution discusses on the remaining issues on the sidelink semi-persistent scheduling, especially on the multiple SPS configuration and SPS trigger / release.

2. Discussion**2.1. Multiple SPS configuration**

For SPS of V2V traffic for mode-1 SPS on PC5, the eNB may configure multiple SPS configurations for a given UE [1] and the parameters for each configuration can be pre-defined via higher layer signaling. For example, the SPS offset can be differentiated according to the SPS configuration and the exact mapping between the configuration index and the SPS offset value can be defined by RRC signaling.

The UE can request the desired SPS configuration and the eNB may activate the SPS configuration according to the UE's request. The configuration index can be conveyed in the SPS trigger message (e.g., (E)PDCCH) in order to confirm the desired configuration. When the UE can operate only one SPS configuration at a time, the index of the SPS configuration can be converted to some bits (e.g., In the presence of 8 configuration, 3bit indication is possible.) and carried in an SPS trigger message. On the other hand, when the UE can operate multiple SPS configurations simultaneously, the indices of the multiple (activated and/or to be activated) SPS configurations can be expressed as a bitmap (e.g., In the presence of 8 configuration, 8bit bitmap indication is possible.) and carried in an SPS trigger message.

If the eNB is not monitoring the sidelink messages after the SPS trigger or release of sidelink SPS configuration, the eNB cannot be convinced that the UE actually transmits the SPS messages or stops the transmission. Therefore, the UE should transmit the A/N feedback about whether the sidelink SPS trigger / release message is received correctly.

Proposal: The UE should transmit the A/N feedback after receiving the (E)PDCCH message for SPS trigger / release.

2.2. (E)PDCCH for sidelink SPS

LTE Rel 12/13 DCI format (e.g., DCI format 5) can be used as a baseline for design of sidelink SPS (E)PDCCH and the contents of the DCI format 5 are as follows [2]:

- Resource for PSCCH – 6 bits as defined in section 14.2.1 of [3]
- TPC command for PSCCH and PSSCH – 1 bit as defined in sections 14.2.1 and 14.1.1 of [3]
- SCI format 0 fields according to 5.4.3.1.1:
 - Frequency hopping flag (1 bit)
 - Resource block assignment and hopping resource allocation (5~13 bits depending on the bandwidth)
 - Time resource pattern (7 bits)

If the number of information bits in DCI format 5 mapped onto a given search space is less than the payload size of format 0 for scheduling the same serving cell, zeros shall be appended to DCI format 5 until the payload size equals that of format 0 including any padding bits appended to format 0 [2]. However, the number of the (zero) padding bits can be variable or can be also even zero. Thus, it is not desirable to use the padding bits as a new field of the new DCI type. Eventually, it is needed to modify some of the existing fields of a DCI format in order to introduce a new field (e.g. SPS configuration index) while reusing the existing DCI format (e.g. DCI format 5) as shown in Figure 1.

Each UE can be configured with multiple SPS configurations [1] which can be distinguished from a UE aspect and we can consider 2 alternatives of representing different configurations for both detection (i.e. blind decoding) complexity and (E)PDCCH resource saving aspect.

- Alt 1) To use different RNTI per SPS configuration (no additional DCI bits in (E)PDCCH)
- Alt 2) To introduce a SPS configuration field in (E)PDCCH (using common RNTI)

As a method for not increasing the DCI bit, each configuration can be assigned to a specific RNTI (e.g. SL SPS C-RNTI 0, SL SPS C-RNTI 1, ...) as depicted in Alt 1. Then, it may require excessive number of RNTI and the UE shall have to perform large number of blind decoding only for the detection of the SPS trigger / release message. Thus, it is preferred to use the common RNTI for all the SPS trigger / release messages of a UE and try to find a proper field which indicates the SPS configuration in a certain area of the (E)PDCCH for SPS trigger / release of sidelink SPS as depicted in Alt 2.

The SPS configuration field can be expressed as an index of the SPS configuration. For example, when there are 7 configurations, the size of the SPS configuration field can be 3 bits. The SPS configuration field can be also expressed as a full bitmap (e.g. 7 bits) format which may be appropriate to indicate the simultaneous operation of multiple SPS configuration when the number of SPS configuration is limited to a reasonable number or there remains enough area in the DCI.

As agreed in RAN1#85, cross carrier scheduling for sidelink SPS and dynamic scheduling for V2V with

mode-1 is supported and the (E)PDCCH design for SL SPS should be compatible with SL dynamic scheduling. One simple approach is to place a one indicator field whether it is for dynamic scheduling or SPS scheduling. A more resource saving method is to differentiate the scheduling mode by the SPS configuration field itself. For example, the value of '000' in SPS configuration field indicates the dynamic scheduling or single transmission (i.e., transmitting one TB) only. Then, other values can be matched to SPS configuration 0 ~ SPS configuration 7 as shown in Table 1. For the dynamic scheduling case, the UE shall automatically release the SL resources allocated by eNB just after transmitting one TB, and all the other behaviors can be the same as that of SL SPS operations (Herein, for example, which VALUE (/STATE) of the SPS CONFIGURATION (/PROCESS) (INDEX (/ID)) field will indicate DYNAMIC SCHEDULING mode (and/or SPS SCHEDULING mode) may be signaled in advance from the base station (via higher layer signaling) or may be fixed in the specification).

Validation (whether it is a DCI format for SL SPS trigger / release) can be achieved if all the (predetermined) special fields for the DCI format are set according to the pre-defined sequences as shown in Figure 1. Especially, for SPS release, as the actual SPS data transmission does not occur, the values for the DCI fields related to resource allocation (e.g., the MCS, RV and resource block assignment, ...) are no longer necessary and these can be set to some pre-defined sequences (e.g., set to all '0's).

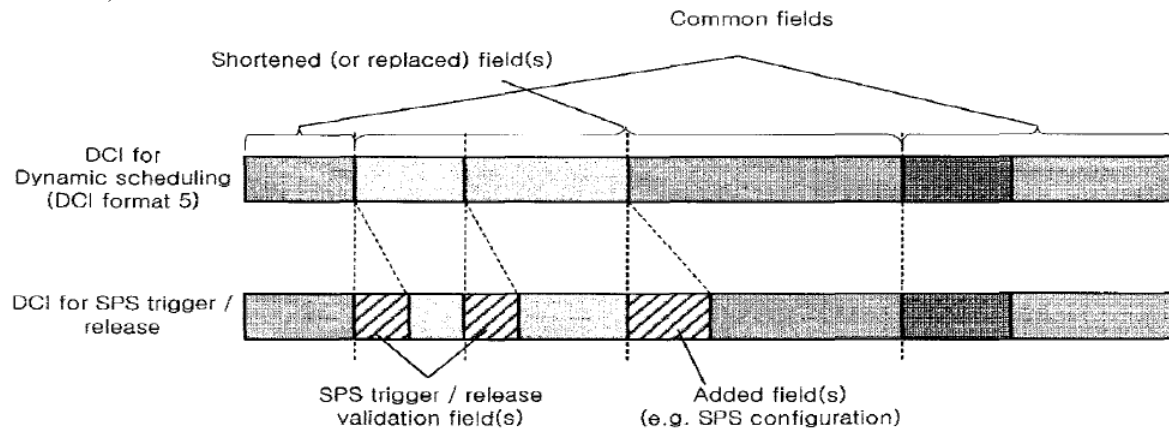


Figure 1. Common DCI format for dynamic scheduling and SPS (with special fields for SPS trigger release validation and SPS configuration field)

Table 1. Mapping of Cyclic shift DM RS field with V2X UL SPS configuration index

Value of SPS configuration field in sidelink (E)PDCCH	Usage
'000'	sidelink dynamic scheduling
'001'	sidelink SPS configuration 0 for V2X
'010'	sidelink SPS configuration 1 for V2X
'011'	sidelink SPS configuration 2 for V2X

'100'	sidelink SPS configuration 3 for V2X
'101'	sidelink SPS configuration 4 for V2X
'110'	sidelink SPS configuration 5 for V2X
'111'	sidelink SPS configuration 6 for V2X

To save the DCI fields in DCI format 5, the flexibility of resource allocation for SPS can be somewhat restricted. For scheduling of eNB indicated sidelink V2V (including SPS), according to the dependency of location between SA and data, the amount of DCI bits of the associated DCI field can be shortened and other information (e.g. SPS trigger / release validation or SPS configuration) can be filled alternatively as shown in Figure 1 or Figure 2. When SPS data is transmitted according to the T-RPT pattern, the T-RPT field, frequency hopping flag field and/or redundancy version field can be utilized. However, if every SPS (re)transmission follows the associated DCI, these DCI fields may not be necessary.

When the time gap between SA transmission and data transmission is known in advance or fixed, no time indication field (e.g., timing offset between SA and data) for data transmission is needed. In addition, if SA can indicate the starting point of the frequency allocation of data, the resource block assignment field in DCI should only inform the RB size of the data. Then, the resource block assignment field in Table 2 can be reduced to 3~7 bits. Similarly, by subchannelization of data region, more DCI bits can be saved. For example, by dividing the data region into 10 subchannels, the resource block assignment field is reduced to only 4bits. These are summarized in Table 2.

Table 2. Modification of DCI format 5 for sidelink SPS

DCI field for DCI format 5 for sidelink SPS	No modification	No T-RPT	No T-RPT, RB assign indicates only RB size	No T-RPT, RB assign indicates subch. index (e.g. 10 subchannels))
Freq. Hopping Flag	1	1	1	1
RB assign	5~13	5~13	3~7	4
TPC	1	1	1	1
SA resource	6	6	6	6
T-RPT	7			
SPS configuration	X	3	3	3
Total size	20~28	16~24	14~18	15

Proposal: The DCIs with different SPS configuration is associated with a common RNTI which is different from that of dynamic scheduling from a UE aspect.

Proposal: DCI format 5 can be used for (E)PDCCH for sidelink SPS trigger / release with some modification.

Proposal: The resource block assignment block field and T-RPT field for DCI format 5 can be shortened or even excluded according to the dependency of the time and frequency location between SA and Data.

3. Conclusion

This contribution discussed on the details of sidelink SPS (E)PDCCH design considering multiple SPS configuration and SPS trigger / release. Our observations and proposals can be summarized as follows:

Proposal: The UE should transmit the A/N feedback after receiving the (E)PDCCH message for SPS trigger / release.

Proposal: The DCIs with different SPS configuration is associated with a common RNTI which is different from that of dynamic scheduling from a UE aspect.

Proposal: DCI format 5 can be used for (E)PDCCH for sidelink SPS trigger / release with some modification.

Proposal: The resource block assignment block field and T-RPT field for DCI format 5 can be shortened or even excluded according to the dependency of the time and frequency location between SA and Data.

Reference

[1] Chairman's note, 3GPP RAN1 #84bis

[2] 3GPP TS 36.212: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

[3] 3GPP TS 36.213: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

Table 3.2: Example of how to efficiently support UL SPS operations (related to V2X communications)

1. Introduction

UL SPS was discussed in RAN#84bis as possible enhancement for Uu-based V2X. It was also discussed that this discussion is related with the SL SPS design in SL-based V2V WI on which the following agreements were made [1]:

Agreement:

- For SPS of V2V traffic for mode-1 SPS on PC5:
 - The eNB may configure multiple SPS configurations for a given UE

- At least SPS-configuration-specific MCS (if MCS is part of the SPS-configuration) and SPS-configuration-specific periodicity can be configured
 - FFS if/which other SPS parameters can differ across the SPS-configurations
- The eNB can dynamically trigger/release the different SPS-configurations by use of (E)PDCCH
 - Details of the trigger/release are FFS
- Working assumption: The UE can indicate to the eNB that it does not intend to transmit data before a transmission associated to an SPS configuration
 - FFS any details of the signaling protocol
 - FFS whether eNB acknowledgment of the UE indication is needed

This contribution discusses on the details of (E)PDCCH design for uplink SPS, while maintaining the commonality with the sidelink SPS (E)PDCCH as mentioned in the companion contribution [2] that the uplink SPS design for V2X is based on the outcome on sidelink SPS in sidelink-based V2V WI

2. Discussion

2.1. (E)PDCCH design for uplink SPS

UL SPS and SL SPS share lots of commonality in that both target the same or similar V2X message transmissions and resource is granted from the eNB. Thus, it is desirable to make them as common as possible. As SL SPS discussion is in the WI phase, it would be reasonable to first wait for the progress on the SL SPS design. Then, modifications for UL operation can be discussed.

For UL SPS (E)PDCCH design, the DCI for UL grant (e.g. DCI format 0) can be a baseline. Considering the properties of SPS, the UL SPS (E)PDCCH should distinguish SPS trigger / release and should support multiple SPS configuration. Thus, it may be needed to modify some of the existing fields of a DCI format in order to introduce a new field (e.g. SPS configuration index) while reusing the existing DCI format (e.g. DCI format 0). The SPS configuration field can be expressed as an index of the SPS configuration. For example, when there are 7 configurations, the size of the SPS configuration field can be 3 bits. Observing the existing LTE UL SPS, the 3 bit cyclic shift DM RS field is set to '000' for validation of both SPS trigger / release. For example, if the cyclic shift DM RS field is utilized as SPS configuration index, remaining values except for '000' can be matched to SPS configuration 0 ~ SPS configuration 7 as shown in Table 1. Validation of V2X uplink SPS trigger / release can be achieved similar to LTE UL SPS except that the cyclic shift DM RS field is already reserved for V2X UL SPS configuration index.

Table 1. Mapping of Cyclic shift DM RS field with V2X UL SPS configuration index

Value of Cyclic shift DM RS field in DCI format 0	Usage
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'000'	Legacy LTE UL SPS
'001'	UL SPS configuration 0 for V2X
'010'	UL SPS configuration 1 for V2X
'011'	UL SPS configuration 2 for V2X
'100'	UL SPS configuration 3 for V2X
'101'	UL SPS configuration 4 for V2X
'110'	UL SPS configuration 5 for V2X
'111'	UL SPS configuration 6 for V2X

The SPS configuration field can be also expressed as a full bitmap (e.g. 8 bits) format which may be appropriate to indicate the simultaneous operation of multiple SPS configuration when the number of SPS configuration is limited to a reasonable number or there remains enough area in the DCI.

Proposal: UL SPS design for V2X is based on the outcome on SL SPS in SL-based V2V WI.

Proposal: DCI format 0 can be reused for design of UL SPS (E)PDCCH for V2X.

2.2. Handling of collision between different SPS configurations

An important topic in UL SPS is how to handle the variation in the message arrival pattern. Once the message arrival pattern changes, a UE needs to report this to eNB so that a proper action can be taken. As proposed above, UE report for SL SPS discussed in [3] can be the benchmark of the UL SPS design, and we reiterate the discussion below for the convenience of technical discussion.

The details of the working assumption "The UE can indicate to the eNB that it does not intend to transmit data before a transmission associated to an SPS configuration" can be further discussed. One topic is whether the intention of no data transmission is limited to a single SPS transmission opportunity of an SPS configuration or the intention will last for relatively long time duration for an SPS configuration.

For the indication of a long-term intention, the UE report is a kind of "request to change/release the SPS configuration." That is, if a UE does not intend to use a certain SPS configuration for a while due to the change in the message arrival pattern, it can report this situation so that the eNB can activate a different SPS configuration more aligned with the new message pattern. We note that it is agreed to dynamically activate/release different SPS configurations and such report is needed to assist the eNB operation. As this indication will not be as frequent as the SPS period which is not shorter than 100 ms, high layer signaling seems proper in order to avoid excessive UL overhead for this report. So the details of the report can be discussed in RAN2.

For the indication of a short-term intention, the UE report is a kind of "confirmation on a single transmission opportunity" and the eNB can know whether a certain SPS opportunity will be actually used by the UE or not. As

a design detail, the confirmation can be either "positive confirmation" or "negative confirmation." In case of positive confirmation, the UE reports when it transmits data and the absence of this positive confirmation is interpreted as indication of no data transmission such that the corresponding resources can be used for the other purpose. In case of negative confirmation, the UE reports when it does not transmit data. Comparing these two possibilities, positive confirmation seems a better choice in the sense that it can reduce the number of transmissions for this report. If the indication of a short-term intention is to address the difficulty in eNB's tracking fast change in the message arrival pattern, eNB needs to allocate many transmission opportunities with a short SPS period and a UE will use only a part of them while skipping the other opportunities. Thus, having positive confirmation has the benefit that transmission of the confirmation message is not more than the actual SPS data transmission. This benefit becomes much clearer when a UE is configured with multiple SPS configurations, e.g., in order to handle the message size variation, because, in case of negative confirmation, a UE needs to transmit something before all the unused SPS opportunities. On the other hand, positive configuration can be generalized to the "selector" of SPS configuration in each data transmission when the confirmation can indicate the SPS configuration which is actually used. For example, a PUCCH resource can be allocated to a UE and the index of the SPS configuration which will be used for the next data transmission can be included in the PUCCH transmission.

Figure 1 illustrates an example where the two discussed reports are used together. Here, a UE is configured with three SPS configurations with different periods, 1000, 500, and 100 ms. The UE is first activated with SPS configuration #1. When the message generation period changes to 100 ms, the UE reports the "change request" so that the eNB can release SPS configuration #1 and activate SPS configuration #3. Then, the message generation period changes to 500 ms, the UE does not have data in some SPS opportunities, and neither positive confirmation nor the corresponding data is transmitted accordingly. When the UE recognizes this situation, the UE reports the "change request" again so that the eNB can activate SPS configuration #2.

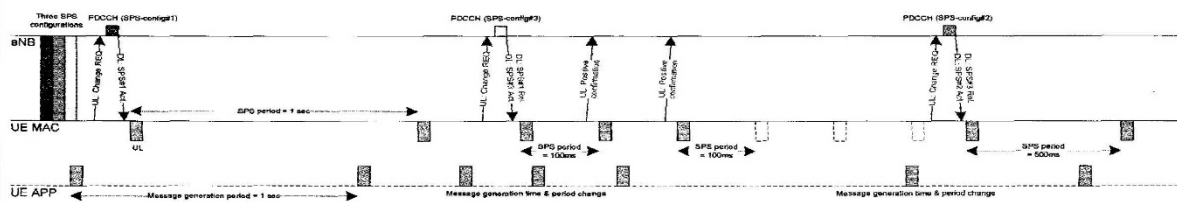


Figure 1. An example of using UE report in adaptation to the message arrival pattern change.

For the short-term intention report on the confirmation of SPS transmission, RAN1 needs to further consider how it is multiplexed with other UL transmissions. In order to simplify the specification impact, it is proposed that such report related to SL transmission has a lower priority than any other existing UL transmissions. For example,

when a UE is scheduled to transmit UL HARQ-ACK or PUSCH in a subframe, the confirmation of SPS transmission is dropped. As the eNB knows when a UE may transmit this confirmation, it can always avoid the dropping situation by its scheduling. When the confirmation transmission is dropped by eNB scheduling, a UE should be able to transmit data in the associated SPS opportunity not to violate the latency requirement. eNB will not use the SPS resource for the other purpose as it knows that the confirmation transmission is dropped.

3. Conclusion

This contribution discussed on the details of uplink SPS (E)PDCCH design and related uplink issues. Our observations and proposals can be summarized as follows:

Proposal: UL SPS design for V2X is based on the outcome on SL SPS in SL-based V2V WI.

Proposal: DCI format 0 can be reused for design of UL SPS (E)PDCCH for V2X.

Reference

- [1] Chairman's note, 3GPP RAN1 #84bis
- [2] R1-168830, "Remaining details of (E)PDCCH design of scheduling for sidelink resource," LG Electronics.
- [3] R1-164515, "Discussion on details of UE reporting," LG Electronics.

For example, when performing V2X Mode 1 communication, it is necessary to support a method allowing a V2X TX UE to determine a (V2X data transmission related) MCS value as a UE implementation (or independently). Herein, for example, in case the same DCI format (or DCI format having the same configuration) (e.g., a similar role as the (existing) "DCI Format 5") (this will be referred to as Mode 1_DCI) is used for a V2X Mode 1 communication scheduling that is based on a "dynamic format" and/or a "SPS format", an MCS field may be defined. Herein, for example, if an MCS field value within the Mode 1_DCI that is received from the (serving) base station indicates a pre-configured (/signaled) specific value (or a "reserved state"), a V2X UE may be capable of determining a (V2X data transmission related) MCS value as a UE implementation (or independently) (e.g., if the MCS field value within the Mode 1_DCI indicates another value (other than the above-mentioned value), V2X data transmission may be performed in accordance with the corresponding MCS value). For example, a field indicating a PSSCH (/PSCCH) DM-RS (sequence) related "CYCLIC SHIFT (CS) INDEX" value (and/or a sequence generation related seed value (e.g., SEQUENCE GROUP NUMBER (U), a BASE SEQUENCE NUMBER (V))) within the DCI format that is related to the V2X Mode 1 communication scheduling may be (additionally) defined. Herein, for example, instead of (additionally) defining a Mode 1_CSFD within the DCI format that is related to the V2X Mode 1 communication scheduling, (A) if a PSSCH (/PSCCH) DM-RS (sequence) related "CS index" value (and/or a sequence generation related seed value) is received from the (serving) base station via RRC signaling, the V2X TX UE may be capable of generating a PSSCH (/PSCCH) DM-RS (sequence) in accordance with the corresponding value; (B) Alternatively, if a PSSCH (/PSCCH) DM-RS (sequence) related "CS index" value (and/or a sequence generation related seed value) is not received from the (serving) base station (via RRC signaling), the V2X TX UE may be capable of determining the PSSCH (/PSCCH) DM-RS (sequence) related "CS index" value (and/or a sequence generation related seed value) as a UE implementation (or independently).

Herein, for example, a type (/range) of the “CS index” value (and/or a sequence generation related seed value) that can be determined as a UE implementation (or independently) may be pre-configured (/signaled). Herein, for example, the PSSCH DM-RS (sequence) related “CS index” value (and/or a sequence generation related seed value), which is determined in accordance with the above-described rule, may also be signaled through a (specific) field within the SA (e.g., a role that is similar to the (existing) “SCI Format 0”). Herein, for example, a (Mode 1) PSSCH (/PSCCH) DM-RS (sequence) (“CS index” value) may be generated (/determined) through a function in which a pre-configured (/signaled) a “SPS format” based V2X Mode 1 communication related RNTI (SPS-RNTI) value (and/or a “dynamic format” based V2X Mode 1 communication related RNTI (DYM-RNTI) value) is defined as an input parameter (e.g., “ $\text{FLOOR}(\text{SPS-RNTI}/2) \text{ MOD } 8$ ” (herein, for example, “ $\text{FLOOR}(X)$ ” and “ $A \text{ MOD } B$ ” respectively indicate a function drawing out an integer that is equal to or smaller than X and a function drawing out a remainder value from A divided by B)).

For example, in a case where a V2X UE performing the “SPS format” based V2X Mode 1 communication has received configuration (/signaling) of a (time/frequency) resource so that the corresponding V2X UE can respectively perform (TDM) transmission of the PSCCH and PSSCH over W and Q number of times, (A) if a pre-configured (/signaled) S^{th} (e.g., “ $S=1$ ”) PSCCH transmission is performed and a (pre-defined) SPS release DCI format (this will be referred to as SPS_RELFMT) is received before an interconnected PSSCH transmission (in SF #N) (and/or if the SPS_RELFMT is received (in SF #N) while performing a (PSCCH/PSSCH) transmission operation that is related to a (specific) TB), (based on an assumption that the SPS resource has been released (after a time point including (or not including) SF #(N+4)) settings may be made so that the subsequent transmission operations are not performed (through the corresponding SPS resource) (or settings may be made so that only the (specific) TB related transmission can be performed (/completed)). Herein, for example, for the release of the pre-configured (/signaled) (Mode 1) SPS resource and/or the suspension of the (PSCCH/PSSCH) transmission operation that is based on the corresponding (SPS) resource settings may be made so that SPS_RELFMT can be received before a pre-configured (/signaled) value (e.g., “4 MS”) from (at least) a first PSCCH transmission point that is related to a (specific) TB. Herein, for example, in a case where a V2X UE performing the “dynamic format” based V2X Mode 1 communication has received configuration (/signaling) of a (time/frequency) resource within a plurality of subframes for the transmission of the (specific) TB, if a DCI format (DYN_RELFMT) indicating the suspension of a (pre-defined) dynamic transmission is received (SF #J) while performing the (PSCCH/PSSCH) transmission operation that is related to the (specific) TB, (based on an assumption that the dynamic resource is not valid (or effective) (after a time point including (or not including) SF #(J+4)) settings may be made so that the subsequent transmission operations are not performed (or settings may be made so that only the (specific) TB related transmission can be performed (/completed)). Herein, for example, for the invalidation (release) of the pre-configured (/signaled) (Mode 1) dynamic resource and/or the suspension of the (PSCCH/PSSCH) transmission operation that is based on the corresponding (dynamic) resource settings may be made so that DYN_RELFMT can be received before a pre-configured (/signaled) value (e.g., “4 MS”) from (at least) a first PSCCH transmission point that is related to a (specific) TB.

For example, in case the V2X UE has received from its (camping) base station (/cell) a configuration (/signaling) instructing the V2X UE to prioritize the GNSS timing (/synchronization) (over the base station timing (/synchronization)) within a specific carrier, if a (other) base station (/cell) is detected within the corresponding (specific) carrier (e.g., this may be understood that the V2X UE is positioned within the coverage of the detected (other) base station (/cell)), and if the corresponding (other) base station (/cell) is sending a configuration (/signaling) instructing the UE to prioritize the base station timing (/synchronization), (if the V2X UE is positioned (at least) within the coverage of the (other) detected base station (cell)) the V2X UE may prioritize the base station timing (/synchronization). Herein, for example, the V2X UE may also receive configuration (/signaling) from its (camping) base station (/cell) indicating for which base station (/cell) within the specific carrier the base station timing (/synchronization) or the GNSS timing (synchronization) is to be prioritized.

For example, in case a HARQ-ACK feedback corresponding to a 'SL (and/or UL)-SPS (ACTIVATION/RELEASE) DCI' reception is defined, in case of a 'NACK', the V2X UE may be capable of performing a ((excluded) pool based) Mode 2 (fallback) operation (during a pre-configured (/signaled) period of time)).

For example, in case a plurality of 'SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S))' are configured (/signaled), a(n) (independent) ("open-loop" (and/or "closed-loop" (e.g., "separate TPC accumulation"))) power control may be managed and operated per 'SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S)) (SET)', through a pre-defined DCI format (e.g., "DCI 3 (/3A)" Format) (SPS_TPCDCI). Herein, for example, a plurality of (TPC) fields (having a pre-configured (/signaled) size) may exist within the (corresponding) SPS_TPCDCI, and an interconnection (/linkage) information between a specific field (in an index) and a '(specific) SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S))' may be configured through a pre-defined (higher layer (/physical layer)) signaling. Herein, for example, the (corresponding) SPS_TPCDCI may (exclusively) indicate (or instruct) power control information (in a "cross carrier (/cell) scheduling format) corresponding to another cell (e.g., a SCELL) (other than a primary cell (and/or a cell in which the SPS_TPCDCI is received (e.g., a (PCELL) CSS))). Herein, for example, the (independent) ("open-loop" (and/or "closed-loop" (e.g., "separate TPC accumulation"))) power control per 'SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S)) (SET)' may be implemented by designating a "power offset value" within (part (or all of)) the 'SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S)) (SET)' through a pre-defined (higher layer (/physical layer)) signaling. As another example, in case a plurality of 'SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S))' are configured (/signaled), the "open-loop" (and/or "closed-loop" (e.g., "separate TPC accumulation"))) power control operation (/parameter) may be commonly applied (/managed and operated) between the plurality of 'SL (and/or UL) SPS PROCESS(S) (/CONFIGURATION(S))'.

Since the examples of the above-described proposed methods may be included as one of the implementation methods of this invention, it will be apparent that the corresponding examples can be viewed (or considered) as a type of the proposed methods. Additionally, although the above-described proposed methods may be independently implemented, the above-described proposed methods may also be implemented in a combined (or integrated) form of parts of the proposed methods. For example, although this invention is described based on a 3GPP LTE system for simplicity in the description, the scope of systems in which the proposed methods can be applied may be extended to diverse systems other than the 3GPP LTE system. For example, the proposed methods according to this invention may also be extendedly applied to D2D communication. Herein, for example, D2D communication refers to performing communication between a UE and another UE by using a direct wireless channel. And, herein, for example, although the UE refers to a user device, in case a network equipment, such as a base station, transmits/receives signals according to a communication method performed between UEs, the corresponding network equipment may also be viewed as a type of UE. Additionally, for example, the proposed methods according to this invention may also be limitedly applied only in Mode 2 V2X operations (and/or Mode 1 V2X operations). Additionally, for example, in the proposed methods according to this invention, the '(SL- and/or UL-SPS) (ACTIVATION/RELEASE) DCI' may be limitedly transmitted only through a '(PDCCH or EPDCCH) USS' (or 'PDCCH CSS'). Additionally, for example, in the proposed methods according to this invention, the wording '(SL- and/or UL-SPS) (ACTIVATION/RELEASE) DCI' may also be interpreted as a 'Mode 1 DCI' (that is received from base station) (announcing PC5 (V2V) SPS related scheduling information).

4. Reference

[1] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

Electronic Acknowledgement Receipt	
EFS ID:	27097438
Application Number:	62403061
International Application Number:	
Confirmation Number:	9237
Title of Invention:	DCI DESIGN FOR MULTIPLE SL&UL SPS PROCESSES
First Named Inventor/Applicant Name:	Seungmin LEE
Customer Number:	67487
Filer:	Andrew S. Park
Filer Authorized By:	
Attorney Docket Number:	UT16-1424-US
Receipt Date:	01-OCT-2016
Filing Date:	
Time Stamp:	00:16:33
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$260
RAM confirmation Number	100316INTEFSW00011880504198
Deposit Account	504198
Authorized User	Andrew PARK
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37 CFR 1.19 (Document supply fees)
 37 CFR 1.20 (Post Issuance fees)
 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	UT16-1424_ADS.pdf	1825851	no	10
			c35a2ca49875c7095799dc244fac59a43615d5b		

Warnings:

Information:

2	Specification - Not in English	UT161424_SPEC.pdf	2688255	no	23
			6621c8b02ce20f228c4c545ebaf3a57067e98af2		

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3	Fee Worksheet (SB06)	fee-info.pdf	29690	no	2
			6b5fdac9536406285ccc453770588e9184d3ad7f		

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Information:

Total Files Size (in bytes):	4543796
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Date: November 27, 2023

Donald W. Hanley, CEO