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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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Exhibit 1014
IPR2024-00510
U.S. Patent 10,484,976

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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

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

PTO/AIA/14 (11-15)
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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		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

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 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

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 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Youngdae		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

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

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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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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)[i] 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).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (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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☐ 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.

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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	

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.

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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	

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

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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 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.**

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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 CooperationTreaty.

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

아래 제안 방식들은 복수개의 'SIDELINK (**SL**) 그리고/혹은 UPLINK (**UL**) SEMI-PERSISTENT SCHEDULING (**SPS**) PROCESS(S)(/CONFIGURATION(S))'가 설정된 경우 (예를 들어, 'MULTIPLE SPS CONFIGURATION(S)(/PROCESS(S)) FOR UL (UL + SL), EX) ONE FOR VOIP, ONE FOR ITS'), 이를 효율적으로 운영 (예를 들어, SPS PROCESS(/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATIN, HARQ RETRANSMISSION)하기 위한 방법을 제시한다. 여기서, 일례로, 'SL SPS PROCESS(/CONFIGURATION)'와 'UL SPS PROCESS(/CONFIGURATION)'의 워딩은 각각 'PC5 LINK 기반의 V2X 메시지 전송'을 지원하기 위한 SPS PROCESS(/CONFIGURATION), 'UU LINK 기반의 V2X 메시지 전송'을 지원하기 위한 SPS PROCESS(/CONFIGURATION)으로 해석될 수 있다.

[제안 방법#1] 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 별로 (일부) 상이한 (새로운) 'V2X_SPS-RNTI'을 설정(/시그널링)해줌으로써, 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 별로 독립적인 운영 및 제어 (예들 들어, SPS PROCESS(/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATIN, HARQ RETRANSMISSION)를 할 수 있다. 여기서, 일례로, 해당 규칙이 적용될 경우, 복수개의 SL SPS PROCESS(/CONFIGURATION) (혹은 UL SPS PROCESS(/CONFIGURATION)) 간에 (일부) 상이한 'RNTI' 값이 설정(/시그널링)되는 것 그리고/혹은 SL SPS PROCESS(/CONFIGURATION)와 UL SPS PROCESS(/CONFIGURATION) 간에 (일부) 상이한 'RNTI' 값이 설정(/시그널링)되는 것으로 해석될 수 있다. 여기서, 또 다른 일례로, 기존 WAN (VOIP(/UL)) 통신 관련 SPS PROCESS(/CONFIGURATION) (예를 들어, 'SPS C-RNTI')와 (V2X) UL SPS PROCESS(/CONFIGURATION) (그리고/혹은 SL SPS PROCESS(/CONFIGURATION)) 간에 (일부) 상이한 (혹은 공통적인) 'RNTI' 값이 설정(/시그널링)될 수 도 있다.

[제안 방법#2] 복수개의 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S))'에 공통된 (하나의) 'V2X_SPS-RNTI'을 설정(/시그널링)해주고, 해당 RNTI로 디코딩되는 '(SL (그리고/혹은 UL)-SPS) (ACTIVATION/RELEASE) DCI' 상의 사전에 정의(/시그널링)된 (새로운) 특정 필드 (예를 들어, 'SL (그리고/혹은 UL) SPS PROCESS(/CONFIGURATION) INDEX(/ID)' 필드 그리고/혹은 (사전에 정의된 시그널링을 통해서 설정(/시그널링)된) 'SL (그리고/혹은 UL) SPS PROCESS(/CONFIGURATION) INDEX(/ID)'와 링크(/연동)된 'LCID'를 알려주는 필드)를 통해서, 해당 제어 정보가 어떠한 'SL (그리고/혹은 UL) SPS PROCESS(/CONFIGURATION)'와 관련된 것인지를 구분해줄 수 있다. 여기서, 일례로, 해당 용도의 필드로 'DM-RS CS (3비트) 필드' (예를 들어, (기존) 'DCI FORMAT 0' 형태의 '(UL (그리고/혹은 SL)-SPS) (ACTIVATION/RELEASE) DCI'가 ('(SL (그리고/혹은 UL)-SPS) (ACTIVATION/RELEASE) DCI' 용도로) (재)사용될 경우 (표 3.3 참조)) 그리고/혹은 'HARQ ID (3/4 비트)/RV (2 비트) 필드' (예를 들어, (기존) 'DCI FORMAT 1/1A/2/2A/2B/2C/2D' 형태의 '(UL (그리고/혹은 SL)-SPS) (ACTIVATION/RELEASE) DCI'가 ('(SL (그리고/혹은 UL)-SPS) (ACTIVATION/RELEASE) DCI' 용도로) (재)사용될 경우 (표 3.3 참조))가 (재)사용될 수 도 있다. 여기서, 일례로, 해당 용도의 필드 크기 (**X_SIZE**)는 사전에 설정(/시그널링)된 값 (예를 들어, '3 비트')으로 고정되고, 네트워크 (혹은 (서빙) 셀)로부터 ('CARRIER(/CELL)-SPECIFIC (PRE)CONFIGURATION' 형태로) 설정(/시그널링)되는 (최대) 'SL (그리고/혹은 UL) SPS PROCESS(/CONFIGURATION)' 개수 (**SPS_NUM**)는 변경될 수 있는 경우, '(X_SIZE – CEILING(LOG_2(SPS_NUM)))' (그리고/혹은 '(X_SIZE – FLOOR(LOG_2(SPS_NUM)))') 비트 (여기서, 일례로, 'CEILING(X)'와 'FLOOR(X)'는 'X 보다 크거나 같은 최소 정수값', 'X 보다 작거나 같은 최대 정수값'을 도출하는 함수를 나타냄)는 제로 (혹은 사전에 설정(/시그널링)된 특정 값) 패딩 (예를 들어, 'VIRTUAL CRC' 용도로 사용될 수 있음) 될 수 있다. 여기서, 일례로, 기존 WAN (VOIP(/UL)) 통신 관련 SPS PROCESS(/CONFIGURATION)와 (V2X) UL SPS PROCESS(/CONFIGURATION) 간에 공통적인 'RNTI' 값이 설정(/시그널링)될 경우 (그리고/혹은 동일한 (패이로드) 크기의 '(ACTIVATION/RELEASE) DCI'가 사용될 경우), 해당 공통 RNTI로 디코딩되는 '(ACTIVATION/RELEASE) DCI' (**C_V2XARDCI**) 상의 (A) 사전에 정의(/시그널링)된 새로운 필드 (예를 들어, '1 비트') 그리고/혹은 (B) 사전에 지정(/시그널링)된 기존 필드 (재이용) (예를 들어, (기존) 'DCI FORMAT 0' 형태의 '(ACTIVATION/RELEASE) DCI'가 (해당 용도로) (재)사용될 경우 (표 3.3 참조), 'MCS/RV (5비트) 필드 (MSB (1비트))' 그리고/혹은 'TPC (2비트) 필드 (MSB (1비트))' 그리고/혹은 'CS DM RS (3비트) 필드 (MSB (1비트))'가 (재)이용될 수 있음)를 통해서, 해당 제어 정보가 기존 WAN (VOIP(/UL)) 통신 관련 SPS PROCESS(/CONFIGURATION)와 (V2X) UL SPS PROCESS(/CONFIGURATION) 중에 어떤 것과 관련된 것인지를 구분해줄 수 있다. 여기서, 일례로, 만약 C_V2XARDCI 상에 새로운 필드가 정의됨으로써, (동일 USS(/CSS) 상에 전송되는) 기존 WAN (VOIP(/UL)) 통신 관련 SPS PROCESS(/CONFIGURATION) 관련 '(ACTIVATION/RELEASE) DCI' (**WANARDCI**) 보다 (패이로드) 크기가 커질 경우, 단말의 블라인드 디코딩 횟수 증가 방지를 위해서, WANARDCI (패이로드) 크기를 C_V2XARDCI의 것과 동일해질 때까지 제로 (혹은 사전에 설정(/시그널링)된 특정 값) 패딩 (예를 들어, 'VIRTUAL CRC' 용도로 사용될 수 있음) 할 수 있다.

표 3.3: 기존 LTE 시스템 하에서, (WAN (VOIP(/UL)) 통신 관련) SPS ACTIVATION/RELEASE 동작에 대한 예시

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'	$n_{\mathrm{PUCCH}}^{(1,p)}$
'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'	$n_{PUCCH}^{(1,p)}$
'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

[제안 방법#3] (일례로, 복수개의 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))' 운영을 위해서 공통된 (하나의) 'V2X_SPS-RNTI' 및 '(ACTIVATION/RELEASE) DCI FORMAT'이 사용될 경우) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 별로 관련 '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI'가 수신되는 SUBFRAME (**SF**) SET(/CELL SET) (그리고/혹은 SEARCH SPACE (**SS**) 타입 (CSS/USS) 그리고/혹은 제어 채널 (PDCCH/EPDCCH SET) 타입)이 상이하게 (혹은 독립적으로) 설정(/시그널링)될 수 있다. 여기서, 일례로, 이러한 동작은 복수개의 SL 그리고/혹은 UL SPS 전송들이 하나의 SF 상에서 수행되지 않는 상황에서만 (한정적으로) 적용될 수 도 있다.

일례로, 상기 (일부) 제안 방법들 (예를 들어, [제안 방법#1], [제안 방법#2], [제안 방법#3])이 적용될 경우, (A) 복수개의 'SL SPS PROCESS(S)(/CONFIGURATION(S))' (혹은 'UL SPS PROCESS(S)(/CONFIGURATION(S))') 간에 (SPS PROCESS(/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATIN, HARQ RETRANSMISSION 동작(/지시) 관련) 구분 그리고/혹은 (B) 'SL SPS PROCESS(/CONFIGURATION)'와 'UL SPS PROCESS(/CONFIGURATION)' 간에 (SPS PROCESS(/CONFIGURATION) ACTIVATION/RELEASE, FREQUENCY RESOURCE REALLOCATIN, HARQ RETRANSMISSION 동작(/지시) 관련) 구분을 해줄 수 있다.

일례로, 복수개의 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))'에 공통된 (하나의) 'V2X_SPS-RNTI'을 설정(/시그널링)해주고, 해당 RNTI로 디코딩되는 '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI' 상의 사전에 정의(/시그널링)된 (새로운) 특정 필드(들)을 통해서, 복수개의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 관련 'ACTIVATION/RELEASE'(/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION) 지시를 동시에 해줄 수 도 있다. 여기서, 일례로, 해당 (새로운) 특정 필드(들)은 (A) 비트맵

형태로 구현 (예를 들어, (최대) '4' 개의 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))'가 동시에 'ACTIVATION/RELEASE'(/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION) 될 수 있는 경우, 해당 필드는 '4 BIT(S)' 길이의 비트맵 형태 ('WXYZ')로 구현 (예를 들어, 'W = 1/0' → 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#0 ACTIVATION/RELEASE', 'X = 1/0' → 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#1 ACTIVATION/RELEASE', 'Y = 1/0' → 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#2 ACTIVATION/RELEASE', 'Z = 1/0' → 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#3 ACTIVATION/RELEASE'을 각각 의미함. 여기서, 일례로, 이것은 특정 필드값에 링크(/연동)된 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) INDEX(/ID)' (정보)가 사전에 설정(/시그널링)된 것으로도 볼 수 있음) 될 수 있음) 되거나 혹은 (B) 동시에 'ACTIVATION/RELEASE'(/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION) 될 수 있는 (최대) 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))' 개수와 동일한 개수의 필드(들)로 구현 (예를 들어, (최대) '4' 개의 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))'가 동시에 'ACTIVATION/RELEASE' 될 수 있고 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) INDEX(/ID)'가 '3 BIT(S)'로 표현될 경우, 해당 필드(들)은 '3 BIT(S)' 길이의 필드 '4' 개로 구현될 수 있음) 될 수 있다. 여기서, 일례로, (상기 제안 방식에 따라, 복수개의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 관련 'ACTIVATION'(/RELEASE/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION)이 동시에 지시될 경우, 해당 (동시에 지시된) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 중에 동일 '주기 값' 그리고/혹은 '주파수(/시간) 자원 위치 값'을 가지는 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))' 간의 충돌을 줄이기 위해서) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 별 'SF OFFSET' 정보가 (A) '상위 계층 시그널링 (예를 들어, 'RRC')' 혹은 (B) '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI' 상에 (새롭게) 정의된 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 별 'SF OFFSET' 정보 필드를 통해서 설정될 수 있다. 여기서, 일례로, (동시에 지시된) 복수개의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 간에 적용되는 'SF GAP' 정보가 설정(/시그널링) (예를 들어, 동일한 '주기 값 (P)'과 '주파수(/시간) 자원 위치 값'을 가지는 '2' 개의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)'가 동시에 'ACTIVATION' 된 경우, ('SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) INDEX(/ID)의 오름차순 (혹은 내림차순)에 따라) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#1' 관련 (주기적) 자원은 'SF#0, SF#P,..., SF#(N·P)' (혹은 'SF#(0+SF GAP), SF#(P+SF GAP),..., SF#(N·P+SF GAP)') 상에 나타나고, 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#2' 관련 (주기적) 자원은 'SF#(0+SF GAP), SF#(P+SF GAP),..., SF#(N·P+SF GAP)' (혹은 'SF#0, SF#P,..., SF#(N·P)') 상에 나타나게 됨) 될 수 도 있다. 여기서, 추가적인 일례로, 동시에 'ACTIVATION'(/RELEASE/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION)되는 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION)(S)'는 상이한 '주기 값' 그리고/혹은 '주파수(/시간) 자원 위치 값'을 가지는 것들로 한정될 수 도 있다. 일례로, (A) (상기 제안 방식에 따라) 동일 '주기 값' 그리고/혹은 '주파수(/시간) 자원 위치 값'을 가지는 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))'가 동시에 'ACTIVATION'(/RELEASE/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION)된 경우 그리고/혹은 (B) 'RB SIZE/LOCATION' 그리고/혹은 '주기 값' 그리고/혹은 'MCS 값' 등이 (일부) 상이한 복수개의 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))'이 설정(/시그널링)된

경우, 현재의 SF (SET) 상에서 어떤 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)'가 유효한지를 사전에 정의된 (상위계층/물리계층) 시그널링 (예를 들어서, '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI')을 통해서 알려줄 수 도 있다. 여기서, 추가적인 일례로, 사전에 설정(/시그널링)된 SF SET 별로 (일부) 상이한 파라미터 (집합) (예를 들어, 'RB SIZE/LOCATION', 'MCS 값')를 맵핑(/시그널링)해놓고, 특정 SF SET 상에서 유효(/'ON')한 (혹은 사용되는) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)'에 해당 파라미터 (집합)가 적용되도록 할 수 도 있다.

일례로, (상기 제안 방식과 다르게) '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI' 상에 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) INDEX(/ID)' 필드(들)가 정의되지 않고 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#X' 관련 주기적 자원이 'SF#N' 시점에서 나타날 경우, 'SF#(N-K)' 시점 (예를 들어, 'K = 4')에 수신되는 '(SL 그리고/혹은 UL-SPS) RELEASE(/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION) DCI'는 해당 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)#X'의 'RELEASE(/FREQUENCY RESOURCE REALLOCATIN/HARQ RETRANSMISSION)'를 (암묵적으로) 가리키는 것으로 간주(/가정)될 수 있다.

일례로, (A) SL (그리고/혹은 UL) SPS 관련 (PSCCH 그리고/혹은 PSSCH) 스케줄링 정보를 알려주는 'MODE 1 DCI'는 아래의 (일부) 필드들로 구성되도록 정의되거나 그리고/혹은 (B) 동일 TB 관련 'K' 번의 (반복) 재전송 동작은 아래 (일부) 규칙에 따라 수행되도록 정의될 수 있다. 여기서, 일례로, 해당 'MODE 1 DCI'는 (상기 설명한) '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI'와 (추가적으로 설정(/시그널링)된) 상이한 (혹은 동일한) 'RNTI'로 디코딩 시도될 수 있다. 여기서, 일례로, 'MODE 1 DCI' 상의 (일부) 필드(들) (예를 들어, (예시#1-1) 그리고/혹은 (예시#1-2) 그리고/혹은 (예시#1-3) 그리고/혹은 (예시#1-5) (그리고/혹은 (예시#1-6)) 등)은 'SA(/PSCCH)'의 필드(들)로 재구성(/사용)될 수 있다.

- 'MODE 1 DCI'를 구성하는 필드 종류
  - (예시#1-1) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) INDEX(/ID)' 필드.
  - (예시#1-2) 'SA(/PSCCH)'와 연동된 'DATA(/PSSCH)' 간의 'TIMING GAP' (지시) 필드 (그리고/혹은 'RESOURCE (RE)SELECTION TRIGGERING TIMING'과 'SA(/PSCCH) TX TIMING' 간의 간격 (지시) 필드). 여기서, 일례로, 'MODE 1' 동작 하에서 해당 필드 값이 사전에 정의(/시그널링)된 특정 값 (예를 들어, 'TIMING GAP = 0')으로 고정될 수 될 수 있으며, 이와 같은 경우, 해당 필드가 생략될 수 도 있음.
  - (예시#1-3) '(동일 TB 관련) RE-TRANSMISSION NUMNER COUNTER(/INDICATOR)' 필드 (그리고/혹은 '(동일 TB 관련) RV' 필드). 여기서, 일례로, 해당 필드는 특히, 동일 TB 관련 재전송 마다 'MODE 1 DCI' (그리고/혹은 'SA(/PSCCH)')가 함께 (혹은 같이) 전송될 때에(만) 유용할 수 있음.
  - (예시#1-4) 'SA(/PSCCH)' 관련 주파수(/시간) 자원 정보 필드.

- (예시#1-5) 'DATA(/PSSCH)' 관련 주파수(/시간) 자원 정보 필드.
- (예시#1-6) 'SA(/PSCCH)' 그리고/혹은 'DATA(/PSSCH)' 관련 'TPC COMMAND' 필드 (예를 들어, 해당 'TPC COMMAND' 필드 크기가 '1 BIT'인 경우, '0' → '사전에 설정(/시그널링)된 (최대) 전송 전력 값 (즉, 'NO OPEN-LOOP POWER CONTROL') 적용', '1' → '사전에 정의된 'OPEN-LOOP POWER CONTROL' 수식에 따라 전송 전력 값 결정'을 각각 의미함) 그리고/혹은 'DATA(/PSSCH)' 관련 'FREQUENCY HOPPING' 적용 여부를 알려주는 필드 그리고/혹은 'DATA(/PSSCH)' 관련 'TIME RESOURCE PATTERN (**T-RPT**)' 필드.
- (예시#1-7) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) ACTIVATION(/RELEASE)' 관련 지시자 필드.
- (예시#1-8) 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 관련 자원이 어느 정도 길이(/크기)의 시간 (예를 들어, 'SF' 단위) 동안에 유지 (혹은 몇 개의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION)' 주기 동안에 유지) 되는지에 대한 정보 필드. 여기서, 일례로, 해당 필드는 일종의 'ACTIVATION DURATION TIMER' 정보로 해석될 수 있음.

- (상기 설명한 'MODE 1 DCI'가 수신될 경우) 동일 TB 관련 'K' 번의 (반복) 재전송 동작 규칙
  - (예시#2-1) 동일 TB 관련 재전송(/초기전송) 마다 'MODE 1 DCI' (그리고/혹은 'SA(/PSCCH)')가 함께 (혹은 같이) 전송될 경우, 해당 'MODE 1 DCI' 상의 상기 설명한 필드들 (예를 들어, (예시#1-1)(/(예시#1-2)), (예시#1-3), (예시#1-4), (예시#1-5) 등)이 알려주는(/지시하는) ('SA(/PSCCH)' 그리고/혹은 'DATA(/PSSCH)') 스케줄링 정보들에 따라 재전송(/초기전송)이 수행될 수 있음.
  - (예시#2-2) 동일 TB 관련 'K' 번의 (반복) 재전송을 위해, 초기 전송 스케줄링 관련 하나의 'MODE 1 DCI' (그리고/혹은 'SA(/PSCCH)')만이 전송될 경우, (A) 재전송은 초기 전송과 동일한 주파수 자원으로 연속된 SF(S) 상에서 ('DATA(/PSSCH)'이) 수행된다고 가정되거나 혹은 (B) 초기 전송 스케줄링 관련 (하나의) 'MODE 1 DCI' (그리고/혹은 'SA(/PSCCH)') 상에서 ('DATA(/PSSCH)') 재전송(/초기전송) 관련 T-RPT 정보를 알려줄 수 있음 (예를 들어, (B)의 경우, 재전송 관련 주파수 자원은 초기 전송의 것과 동일하게 가정될 수 있음).

일례로, 복수개의 'SL 그리고/혹은 UL SPS PROCESS(S)(/CONFIGURATION(S))'이 설정(/시그널링)된 경우, 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) (SET)' 별로 'SA(/PSCCH)'와 연동된 'DATA(/PSSCH)' 간의 'TIMING GAP' 값 (그리고/혹은 'RESOURCE (RE)SELECTION TRIGGERING TIMING'과 'SA(/PSCCH) TX TIMING' 간의 간격 그리고/혹은 '(SA DECODING/ENERGY MEASUREMENT-BASED) SENSING WINDOW SIZE' 그리고/혹은 '(OPEN-LOOP) TX POWER PARAMETER(S)')을 상이하게 설정(/시그널링)해줌으로써, 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) (SET)' 간의 우선 순위를 (암묵적으로) 다르게 지정해줄 수 도 있다. 여기서, 일례로, 상대적으로 높은 우선 순위의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) (SET)' 상에는 상대적으로 큰 값 (혹은 작은 값)의 'TIMING GAP' (그리고/혹은 'RESOURCE (RE)SELECTION TRIGGERING TIMING'과 'SA(/PSCCH) TX TIMING' 간의 간격 그리고/혹은 '(SA DECODING/ENERGY MEASUREMENT-BASED) SENSING WINDOW SIZE')을

설정(/시그널링)해줌으로써, 상대적으로 낮은 우선 순위의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) (SET)' (즉, 상대적으로 작은 값 (혹은 큰 값)의 'TIMING GAP' (그리고/혹은 'RESOURCE (RE)SELECTION TRIGGERING TIMING'과 'SA(/PSCCH) TX TIMING' 간의 간격 그리고/혹은 '(SA DECODING/ENERGY MEASUREMENT-BASED) SENSING WINDOW SIZE')이 설정(/시그널링)됨)을 통해 V2X 통신을 수행하는 V2X UE(S)로 하여금, 상대적으로 높은 우선 순위의 'SA(/PSCCH)'을 (높은 확률로) 검출(/센싱)하고 해당 'SA(/PSCCH)'가 스케줄링하는 'DATA(/PSSCH)' 자원을 (최대한) 피해서 자신의 'DATA(/PSSCH)' 자원을 선택(/스케줄링)하도록 할 수 있다. 여기서, 일례로, 상대적으로 높은 우선 순위의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) (SET)' 상에는 상대적으로 큰 값의 '(OPEN-LOOP) TX POWER PARAMETER(S)' (예를 들어, 'P_O' 그리고/혹은 'ALPHA' 등)가 설정(/시그널링)될 수 있다. 여기서, 일례로, 상대적으로 높은 우선 순위의 'SL 그리고/혹은 UL SPS PROCESS(/CONFIGURATION) (SET)'는 'EVENT-TRIGGERED V2X MESSAGE TX(/SERVICE TYPE)' 그리고/혹은 '상대적으로 높은 'RELIABILITY'를 요구하는 SERVICE TYPE' 등을 위해 사용(/할당)될 수 있다.

일례로, 사전에 정의된 이벤트가 발생될 경우 (예를 들어, ('V2X MESSAGE TX'가 수행된 이전 시점에 비해) 사전에 정의(/시그널링)된 임계값 이상의 속도/진행방향/위치 변화 등이 발생될 경우), 'V2X MESSAGE (예를 들어, 'CAM') GENERATION(/TX)'가 (즉시) 트리거링될 수 있다. 따라서, 'V2X MESSAGE GENERATION(/TX)' 관련 '주기' 그리고/혹은 '사이즈 변화 패턴' (그리고/혹은 연속된 'V2X MESSAGE GENERATION(/TX)' 간의 간격) 등이 (시간 영역 상에서) 변경될 수 있다. 여기서, 일례로, 이러한 문제(/현상)을 고려할 때, V2X UE가 (기지국으로부터 설정(/시그널링) 받은) 특정 주기 그리고/혹은 (시간/주파수) 자원 크기 (그리고/혹은 MCS)의 'SINGLE SPS CONFIGURATION(/PROCESS)'을 통해서, 높은 '신뢰도' (그리고/혹은 'LATENCY REQUIREMENT' 만족)의 'V2X MESSAGE TX'를 수행하기는 어렵다. 여기서, 일례로, 해당 문제를 해결하기 위해서, 'SINGLE SPS CONFIGURATION(/PROCESS)' 관련 주기를 (매우) 짧게 설정하고 큰 크기의 (시간/주파수) 자원을 할당해줄 수 도 있겠지만, 이는 효율적인 자원 운영 측면에서 바람직하지 않다. 한가지 대안으로 기지국이 V2X UE에게 (상이한 주기 그리고/혹은 (시간/주파수) 자원 크기 (그리고/혹은 MCS)를 가지는) 'MULTIPLE SPS CONFIGURATION(/PROCESS)'을 설정(/시그널링)해주고, V2X UE로 하여금, 아래 (일부) 정보를 보고하도록 정의될 수 도 있다. 여기서, 일례로, 해당 정보 보고는 사전에 정의(/시그널링)된 채널 (예를 들어, 'PUSCH(/PUCCH)', 'SR')을 통해서 수행될 수 있다. 여기서, 일례로, 이러한 정보를 수신한(/보고받은) 기지국은 해당 V2X UE가 사용하지 않는 (혹은 해당 V2X UE에게 (가장) 부적합한) 'SPS CONFIGURATION(/PROCESS)'을 'RELEASE'(/'DEACTIVATION') 해주거나, 혹은 해당 V2X UE에게 (가장) 적합한 'SPS CONFIGURATION(/PROCESS)' (혹은 (기존의) 'SPS CONFIGURATION(/PROCESS)' 관련 주기 그리고/혹은 (시간/주파수) 자원 크기 (그리고/혹은 MCS))을 새롭게 설정(/시그널링)해줄 수 도 있다. 또 다른 일례로, 이러한 정보를 수신한(/보고받은) 기지국은 (최종적으로) 해당 V2X UE에게 'MULTIPLE SPS CONFIGURATION(/PROCESS)' 중에 (가장) 적합한 특정 'SPS CONFIGURATION(/PROCESS)'로의 스위칭을 지시할 수 도 있다. 여기서, 일례로, 해당 스위칭 지시는 사전에 정의(/시그널링)된 채널 (예를 들어, '(E)PDCCH(/PDSCH)')을 통해서 수행될 수 있다. 여기서, 일례로, 이러한 규칙은 'MODE 1 (예를 들어, 'V2X MESSAGE TX' 관련 스케줄링 정보를 기지국이 제어(/시그널링)하는 방식)' 기반의 V2X 통신 그리고/혹은 'RRC_CONNECTED(/IN-COVERAGE) V2X UE'에만 한정적으로 적용될 수 도 있다.

(예시#A) 설정(/시그널링)받은 'MULTIPLE SPS CONFIGURATION(/PROCESS)' 중에 자신이 사용하는 (혹은 자신에게 (가장) 적합한) (그리고/혹은 자신이 사용하지 않는 (혹은 자신에게 (가장) 부적합한)) 'SPS CONFIGURATION(/PROCESS) (인덱스/식별자) 정보'.

(예시#B) 설정(/시그널링)받은 'MULTIPLE SPS CONFIGURATION(/PROCESS)' 별 'UTILIZATION 정보' 그리고/혹은 '(다른 V2 UE와의) COLLISION DETECTION 정보' 그리고/혹은 '간섭(/에너지) 측정 정보' 그리고/혹은 '자신의 (현재) 'V2X MESSAGE TX(/GENERATION)' 시점(/주기)과의 'TIMING MISALIGNMENT' 정보.

또 다른 일례로, 기지국으로부터 (상이한 주기 그리고/혹은 (시간/주파수) 자원 크기 (그리고/혹은 MCS)를 가지는) 'MULTIPLE SPS CONFIGURATION(/PROCESS)'을 설정(/시그널링) 받은 V2X UE는 자신에게 가장 적합한 'SPS CONFIGURATION(/PROCESS)'을 선택/사용하고, 해당 결과 (예를 들어, V2X UE가 선택/사용하는 'SPS CONFIGURATION(/PROCESS) (인덱스/식별자) 정보')를 기지국에게 보고할 수 도 있다.

또 다른 일례로, 표 3.1과 표 3.2는 각각 (V2X 통신 관련) SL SPS 동작, UL SPS 동작을 효율적으로 지원하기 위한 방법 (예를 들어, DCI FORMAT 필드 구성)을 나타낸다.

표 3.1: (V2X 통신 관련) SL SPS 동작을 효율적으로 지원하기 위한 방법에 대한 일례

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 sidelink 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 sidelink SPS should be compatible with sidelink 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 (여기서, 일례로, SPS CONFIGURATION(/PROCESS) (INDEX(/ID)) 필드의 어떤 VALUE(/STATE)가 DYNAMIC SCHEDULING 모드 (그리고/혹은 SPS SCHEDULING 모드)를 지시할지는 사전에 기지국으로부터 (상위 계층 시그널링을 통해서) 시그널링되거나 혹은 스펙 상에 고정될 수 도 있음).

Validation (whether it is a DCI format for sidelink 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).

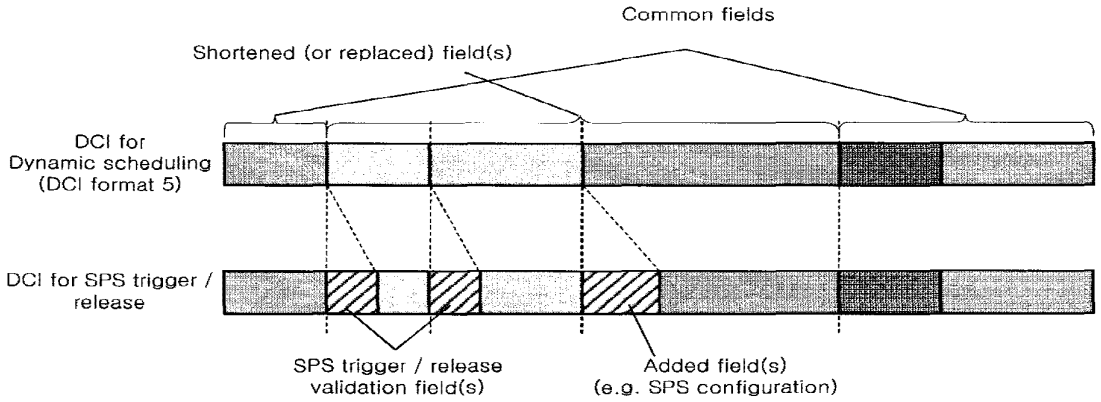

Figure 1. Common DCI format for dynamic scheduling and SPS (with special fields for SPS trigger / release validation and SPS configuration field)

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".

표 3.2: (V2X 통신 관련) UL SPS 동작을 효율적으로 지원하기 위한 방법에 대한 일례

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

'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.

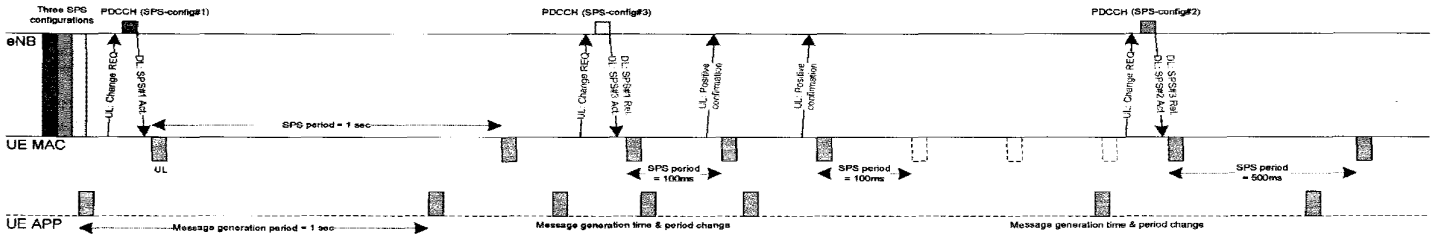

Figure 1. An example of using UE report in adaptation to the message arrival pattern change.

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.

일례로, V2X MODE 1 통신 수행시, V2X TX UE(S)로 하여금, (V2X 데이터 전송 관련) MCS 값을 단말 구현으로 (혹은 독자적으로) 결정하도록 하는 방법이 지원될 필요가 있다. 여기서, 일례로, "DYNAMIC 형태" 그리고/혹은 "SPS 형태" 기반의 V2X MODE 1 통신 스케줄링에 동일한 (구성의) DCI FORMAT (예를 들어, (기존) "DCI FORMAT 5"과 유사한 역할) (**MODE1_DCI**)이 사용될 경우, MCS 필드가 정의될 수 있다. 여기서, 일례로, V2X UE(S)로 하여금, (서빙) 기지국으로부터 수신된 MODE1_DCI 상의 MCS 필드 값이 사전에 설정(/시그널링)된 특정 값 (혹은 "RESERVED STATE")을 가리키면, 단말 구현으로 (혹은 독자적으로) (V2X 데이터 전송 관련) MCS 값을 결정 (예를 들어, MODE1_DCI 상의 MCS 필드 값이 (그 외에) 다른 값을 가리키면, 해당 MCS 값에 따라 V2X 데이터 전송을 수행함) 하도록 할 수 있다. 일례로, V2X MODE 1 통신 스케줄링 관련 DCI FORMAT 상에 PSSCH(/PSCCH) DM-RS (SEQUENCE) 관련 "CYCLIC SHIFT (**CS**) INDEX" 값 (그리고/혹은 시퀀스 생성 관련 시드값 (예를 들어, SEQUENCE GROUP NUMBER (U), BASE SEQUENCE NUMBER (V)))을 알려주는 필드 (**MODE1_CSFD**)가 (추가적으로) 정의될 수 있다. 여기서, 일례로, V2X MODE 1 통신 스케줄링 관련 DCI FORMAT 상에 MODE1_CSFD를 (추가적으로) 정의하지 않고, V2X TX UE(S)로 하여금, (A) (서빙) 기지국으로부터 PSSCH(/PSCCH) DM-RS (SEQUENCE) 관련 "CS INDEX" 값 (그리고/혹은 시퀀스 생성 관련 시드값)을 RRC 시그널링을 통해서 수신하면, 해당 값에 따라 PSSCH(/PSCCH) DM-RS (SEQUENCE)를 생성하고, 반면에 (B) (서빙) 기지국으로부터 PSSCH(/PSCCH) DM-RS (SEQUENCE) 관련 "CS INDEX" 값 (그리고/혹은 시퀀스 생성 관련 시드값)을 (RRC 시그널링을 통해서) 수신하지 않으면, PSSCH(/PSCCH) DM-RS (SEQUENCE) 관련 "CS INDEX" 값 (그리고/혹은 시퀀스 생성 관련 시드값)을 단말 구현으로 (혹은 독자적으로) 결정하도록 할 수 있다. 여기서, 일례로, 단말 구현으로 (혹은 독자적으로) 결정할 수

있는 "CS INDEX" 값 (그리고/혹은 시퀀스 생성 관련 시드값)의 종류(/범위)가 사전에 설정(/시그널링) 될 수 도 있다. 여기서, 일례로, 상기 규칙에 따라 결정된 PSSCH DM-RS (SEQUENCE) 관련 "CS INDEX" 값 (그리고/혹은 시퀀스 생성 관련 시드값)은 SA (예를 들어, (기존) "SCI FORMAT 0"와 유사한 역할) 상의 (특정) 필드를 통해서도 시그널링될 수 있다. 여기서, 일례로, 사전에 설정(/시그널링)된 "SPS 형태" 기반의 V2X MODE 1 통신 관련 RNTI (**SPS-RNTI**) 값 (그리고/혹은 "DYNAMIC 형태" 기반의 V2X MODE 1 통신 관련 RNTI (**DYM-RNTI**) 값)이 입력 파라미터로 정의된 함수 (예를 들어서, "FLOOR (SPS-RNTI/2) MOD 8" (여기서, 일례로, "FLOOR (X)", "A MOD B"는 각각 X 보다 작거나 같은 정수를 도출하는 함수, A 나누기 B의 나머지 값을 도출하는 함수임))를 통해서, (MODE 1) PSSCH(/PSCCH) DM-RS (SEQUENCE) ("CS INDEX" 값)가 생성(/결정)될 수 도 있다.

일례로, "SPS 형태" 기반의 V2X MODE 1 통신을 수행하는 V2X UE(S)가 (특정) TB에 대해서, PSCCH와 PSSCH를 각각 W, Q 번씩 (TDM) 전송하도록 (시간/주파수) 자원을 설정(/시그널링) 받았는데, (A) 만약 사전에 설정(/시그널링)된 S (예를 들어, "S = 1") 번째 PSCCH 전송을 수행하고 연동된 PSSCH 전송 전에 (사전에 정의된) SPS RELEASE DCI FORMAT (**SPS_RELFMT**)를 수신 (SF#N) 하였다면 (그리고/혹은 (특정) TB 관련 (PSCCH/PSSCH) 전송 동작 수행 중에 SPS_RELFMT을 수신 (SF#N) 하였다면), ((SF#(N+4) 시점을 포함하여 (혹은 포함하지 않고) 이후부터) SPS 자원이 RELEASE 되었다고 가정하고) 이후의 송신 동작은 (해당 SPS 자원을 통해서) 수행하지 않도록 (혹은 진행 중이었던 (특정) TB 관련 전송들만은 수행(/마무리)하도록) 할 수 있다. 여기서, 일례로, 사전에 설정(/시그널링)된 (MODE 1) SPS 자원의 RELEASE 그리고/혹은 해당 (SPS) 자원 기반의 (PSCCH/PSSCH) 전송 동작 중지를 위해서는 (특정) TB 관련 첫번째 PSCCH 전송 시점으로부터 (최소한) 사전에 설정(/시그널링)된 값 (예를 들어, "4MS") 이전에 SPS_RELFMT가 수신되도록 할 수 있다. 여기서, 일례로, "DYNAMIC 형태" 기반의 V2X MODE 1 통신을 수행하는 V2X UE(S)가 (특정) TB 전송을 위해서, 복수개의 서브프레임 상에서의 (시간/주파수) 자원을 설정(/시그널링) 받았는데, 만약 (특정) TB 관련 (PSCCH/PSSCH) 전송 동작 수행 중에 (사전에 정의된) DYNAMIC TX 중지를 지시하는 DCI FORMAT (**DYN_RELFMT**)을 수신 (SF#J) 하였다면, ((SF#(J+4) 시점을 포함하여 (혹은 포함하지 않고) 이후부터) DYNAMIC 자원이 유효하지 않다고 가정하고) 이후의 송신 동작은 수행하지 않도록 (혹은 진행 중이었던 (특정) TB 관련 전송들만은 수행(/마무리)하도록) 할 수 있다. 여기서, 일례로, 사전에 설정(/시그널링)된 (MODE 1) DYNAMIC 자원의 무효화 (RELEASE) 그리고/혹은 해당 (DYNAMIC) 자원 기반의 (PSCCH/PSSCH) 전송 동작 중지를 위해서는 (특정) TB 관련 첫번째 PSCCH 전송 시점으로부터 (최소한) 사전에 설정(/시그널링)된 값 (예를 들어, "4MS") 이전에 DYN_RELFMT가 수신되도록 할 수 있다.

일례로, V2X UE(S)로 하여금, 자신의 캠핑 (CAMPING) 기지국(/셀)로부터 특정 케리어 상에서 (기지국 타이밍(/동기) 보다) GNSS 타이밍(/동기)을 우선시하라고 설정(/시그널링) 받은 경우, 만약 해당 (특정) 케리어 상에서 (다른) 기지국(/셀)이 검출 (예를 들어, V2X UE(S)가 검출된 (다른) 기지국(/셀)의 커버리지 안에 위치한 것으로 볼 수 도 있음) 되고, 해당 (다른) 기지국(셀)이 기지국 타이밍(/동기)을 우선시하라고 설정(/시그널링)하고 있다면, ((적어도) 검출된 (다른) 기지국(/셀)의 커버리지 안에 위치한다면) 기지국 타이밍(/동기)을 우선시하도록 할 수 있다. 여기서, 일례로, V2X UE(S)는 자신의 캠핑 기지국(/셀)로부터 특정 케리어 상의 어떤 기지국(/셀)에 대해서 기지국 타이밍(/동기) 혹은 GNSS 타이밍(/동기)이 우선시될지가 설정(/시그널링)될 수 도 있다.

일례로, 'SL (그리고/혹은 UL)-SPS (ACTIVATION/RELEASE) DCI' 수신에 대한 HARQ-ACK 피드백이 정의될 경우, V2X UE(S)로 하여금, 'NACK' 일때, (사전에 설정(/시그널링)된 일정 시간 동안에) ((예외) 풀 기반의) MODE 2 (폴백) 동작을 수행하도록 할 수 도 있다.

일례로, 복수개의 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S))'가 설정(/시그널링)된 경우, 사전에 정의된 DCI 포맷 (예를 들어, "DCI 3(/3A)" 형태) (**SPS_TPCDCI**)을 통해서, 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S)) (SET)' 별 (독립적인) ("OPEN-LOOP" (그리고/혹은 "CLOSED-LOOP" (예를 들어, "SEPARATE TPC ACCUMULATION"))) 전력 제어가 운영될 수 있다. 여기서, 일례로, (해당) SPS_TPCDCI 상에는 (사전에 설정(/시그널링)된 크기의) 복수개의 (TPC) 필드들이 존재할 수 있으며, 특정 (인덱스의) 필드와 (특정) 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S))' 간의 연동(/링키지) 정보는 사전에 정의된 (상위 계층(/물리 계층)) 시그널링을 통해서 설정될 수 있다. 여기서, 일례로, (해당) SPS_TPCDCI는 (PCELL (그리고/혹은 SPS_TPCDCI가 수신 (예를 들어, (PCELL) CSS)되는 CELL)이 아닌) 다른 CELL (예를 들어, SCELL)에 대한 전력 제어 정보를 ("CROSS-CARRIER(/CELL) SCHEDULING" 형태로) (예외적으로) 지시해 줄 수 도 있다. 여기서, 일례로, 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S)) (SET)' 별 (독립적인) ("OPEN-LOOP" (그리고/혹은 "CLOSED-LOOP" (예를 들어, "SEPARATE TPC ACCUMULATION"))) 전력 제어는 사전에 정의된 (상위 계층(/물리 계층)) 시그널링을 통해서 (일부 (혹은 모든)) 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S)) (SET)' 상에 "파워 오프셋 값"을 지정해줌으로써 구현될 수 도 있다. 또 다른 일례로, 복수개의 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S))'가 설정(/시그널링)된 경우, "OPEN-LOOP" (그리고/혹은 "CLOSED-LOOP" (예를 들어, "SEPARATE TPC ACCUMULATION")) 전력 제어 동작(/파라미터)은 복수개의 'SL (그리고/혹은 UL) SPS PROCESS(S)(/CONFIGURATION(S))' 간에 공통적으로 적용(/운영)될 수 도 있다.

상기 설명한 제안 방식에 대한 일례들 또한 본 발명의 구현 방법들 중 하나로 포함될 수 있으므로, 일종의 제안 방식들로 간주될 수 있음은 명백한 사실이다. 또한, 상기 설명한 제안 방식들은 독립적으로 구현될 수 도 있지만, 일부 제안 방식들의 조합 (혹은 병합) 형태로 구현될 수 도 있다. 일례로, 본 발명에서는 설명의 편의를 위해 3GPP LTE 시스템을 기반으로 제안 방식을 설명하였지만, 제안 방식이 적용되는 시스템의 범위는 3GPP LTE 시스템 외에 다른 시스템으로도 확장 가능하다. 일례로, 본 발명의 제안 방식들은 D2D 통신을 위해서도 확장 적용 가능하다. 여기서, 일례로, D2D 통신은 UE가 다른 UE와 직접 무선 채널을 이용하여 통신하는 것을 의미하며, 여기서, 일례로 UE는 사용자의 단말을 의미하지만, 기지국과 같은 네트워크 장비가 UE 사이의 통신 방식에 따라서 신호를 송/수신하는 경우에는 역시 일종의 UE로 간주될 수 있다. 또한, 일례로, 본 발명의 제안 방식들은 MODE 2 V2X 동작 (그리고/혹은 MODE 1 V2X 동작)에만 한정적으로 적용될 수 도 있다. 또한, 일례로, 본 발명의 제안 방식들에서 '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI'는 '(PDCCH 혹은 EPDCCH) USS' (혹은 'PDCCH CSS')를 통해서만 한정적으로 전송될 수 도 있다. 또한, 일례로, 본 발명의 제안 방식들에서 '(SL 그리고/혹은 UL-SPS) (ACTIVATION/RELEASE) DCI'의 워딩은 (기지국으로부터 수신되는) (PC5 (V2V) SPS 관련 스케줄링 정보를 알려주는) 'MODE 1 DCI'로 (동일하게) 해석될 수 도 있다.

4. Reference

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

Electronic Acknowledgement Receipt

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1	Application Data Sheet	UT16-1424_ADS.pdf	1825851 c55a26a49875c7095793dc244fbe49b43f615d5b	no	10
Warnings:					
Information:					
2	Specification - Not in English	UT161424_SPEC.pdf	2688255 6621cffb02ce29f2284b545ebafba57067e98af2	no	23
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	29690 6b5fdac9536406285eac453770688e9184d3ad7f	no	2
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