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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
62/294,095	02/11/2016		260	111027-IDF132916		

CONFIRMATION NO. 8297

FILING RECEIPT

31817
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Date Mailed: 03/01/2016

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Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

Title

SCHEDULING REQUEST DESIGN FOR STANDALONE DEPLOYMENT IN MMWAVE SYSTEM

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Title of Invention		SCHEDULING REQUEST DESIGN FOR STANDALONE DEPLOYMENT IN MMWAVE SYSTEM				
Attorney Docket Number (if applicable)		111027-IDF132916				
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• No.

Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:

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Signature	Michael S. Moore/			Date (YYYY-MM-DD)	2016-02-11
First Name	Michael S.	Last Name	Moore	Registration Number (If appropriate)	64003

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UNITED STATES PROVISIONAL APPLICATION
For
**SCHEDULING REQUEST DESIGN FOR STANDALONE DEPLOYMENT IN
MMWAVE SYSTEM**

Inventors:

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Wenting Chang
Huaning Niu
Yushu Zhang
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Prepared by:
Michael S. Moore
Reg. No. 64,003

SCHEDULING REQUEST DESIGN FOR STANDALONE DEPLOYMENT IN MMWAVE SYSTEM

BACKGROUND

Various embodiments generally may relate to the field of wireless communications.

DETAILED DESCRIPTION

The following detailed description refers to the accompanying drawings. The same reference numbers may be used in different drawings to identify the same or similar elements. In the following description, for purposes of explanation and not limitation, specific details are set forth such as particular structures, architectures, interfaces, techniques, etc. in order to provide a thorough understanding of the various aspects of various embodiments. However, it will be apparent to those skilled in the art having the benefit of the present disclosure that the various aspects of the various embodiments may be practiced in other examples that depart from these specific details. In certain instances, descriptions of well-known devices, circuits, and methods are omitted so as not to obscure the description of the various embodiments with unnecessary detail.

Embodiments may be related to RAN1 and 5G

Mobile communication has evolved significantly from early voice systems to today's highly sophisticated integrated communication platform. The next generation wireless communication system, 5G, will provide access to information and sharing of data anywhere, anytime by various users and applications. 5G is expected to be a unified network/system that target to meet vastly different and sometime conflicting performance dimensions and services. Such diverse multi-dimensional requirements are driven by different services and applications. In general, 5G will evolve based on 3GPP LTE-Advanced with additional potential new Radio Access Technologies (RATs) to enrich people lives with better, simple and seamless wireless connectivity solutions. 5G will enable everything connected by wireless and deliver fast, rich contents and services.

Figure 1 illustrates the procedure for uplink data transmission in the existing LTE specification. When UE intends to transmit the data in the uplink, it will request the resource using physical uplink control channel (PUCCH) format 1 for scheduling request (SR). After successful detection of SR, eNB transmits the physical downlink control channel (PDCCH) with downlink control information (DCI) format containing uplink grant to allocate the uplink resource. Subsequently, UE sends the buffer status report (BSR) on physical uplink shared channel (PUSCH) in the allocated uplink resource. BSR is carried in a Medium Access Control (MAC) Protocol Data Unit (PDU), which is used to inform eNB on the amount of the data in UE's buffer to be transmitted. Based on the BSR information, eNB allocates the appropriate resource and modulation and coding scheme (MCS) which is included in the uplink grant. After receiving the uplink grant, UE transmits the uplink data on PUSCH.

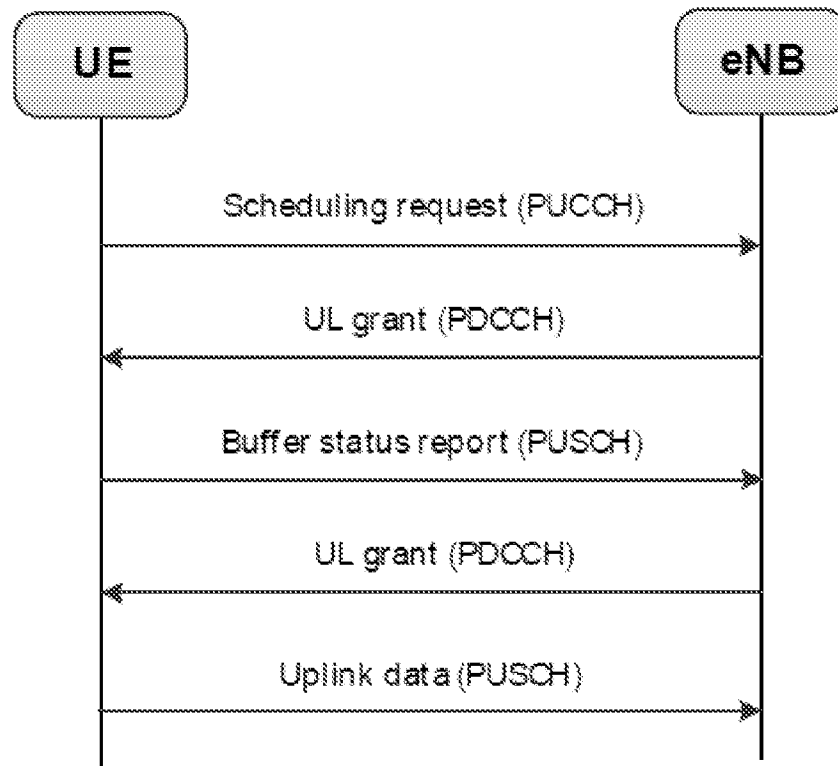


Figure 1: Procedure for uplink data transmission in LTE

For 5G system, high frequency band communication has attracted significantly attention from the industry, since it can provide wider bandwidth to support the future integrated communication system. The beam forming is a critical technology for the implementation of

high frequency band system due to the fact that the beam forming gain can compensate the severe path loss caused by atmospheric attenuation, improve the SNR, and enlarge the coverage area. By aligning the transmission beam to the target UE, the radiated energy is focused for higher energy efficiency, and the mutual UE interference is suppressed.

For cmWave and mmWave system, when UE intends to request the resource for uplink data transmission, eNB may not know the exact Rx beam for scheduling request reception. For standalone deployment scenario, certain design is needed to ensure robust reception of scheduling request. Further, scheduling request may carry certain eNB Tx beam information to allow eNB to subsequently transmit the 5G physical downlink control channel (xPDCCH) using the appropriate beams.

Embodiments relate to scheduling request design for standalone deployment in mmWave system. In particular, embodiments include

- Scheduling request procedure for standalone deployment scenario
- Resource allocation of SR transmission, which includes one to one association between beamforming reference signal (BRS) antenna port (AP) and SR transmission resource.

Scheduling request procedure for standalone deployment scenario

For standalone deployment scenario, Tx and Rx beam direction should be aligned between eNodeB and UE to allow reliable communication in mmWave band. Compared to conventional SR procedure in LTE, beam reference signal (BRS) is transmitted from eNodeB to allow UE to measure BRS received power (BRS-RP) and obtain the best eNodeB Tx beam and UE Rx beam. Figure 2 illustrates the SR procedure for standalone deployment scenario for mmWave system.

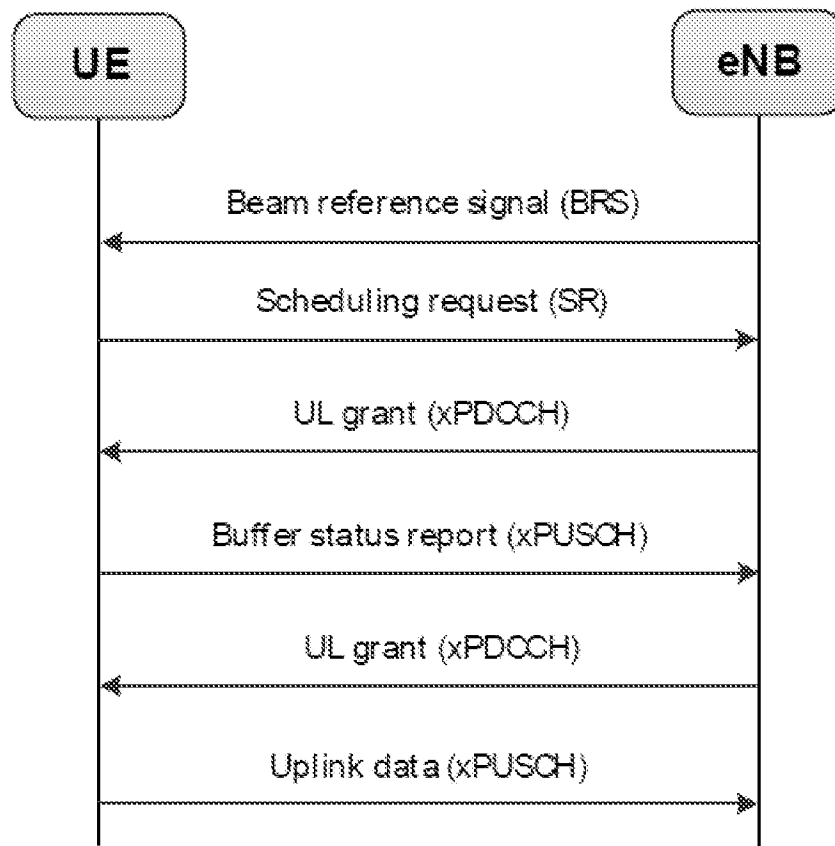


Figure 2: SR procedure for standalone deployment

The detailed procedure for the transmission of SR in standalone deployment scenario is illustrated in Figure 3. In particular,

- Element 1: UE performs beam acquisition from beamforming reference signal (BRS) to obtain best eNB Tx beam and UE Rx beam;
- Element 2: UE transmits scheduling request using best UE Rx beam acquired from BRS-RP measurement on the resource based on time and frequency location of best eNB Tx beam. Note that one to one association rule may need to be defined between SR transmission resource and BRS antenna port (AP). Under the assumption of channel reciprocity in TDD system, when eNodeB successfully detects the SR transmission on certain resource, it can determine the best eNodeB Tx beam for this particular UE for subsequent control and data transmission and reception.

- Element 3: UE receives 5G physical downlink control channel (xPDCCH) from eNodeB for uplink grant using UE Rx beam acquired in the element 1. Note that in this element, eNodeB transmits the xPDCCH using the best Tx beam acquired in the element 2 upon successful SR detection.

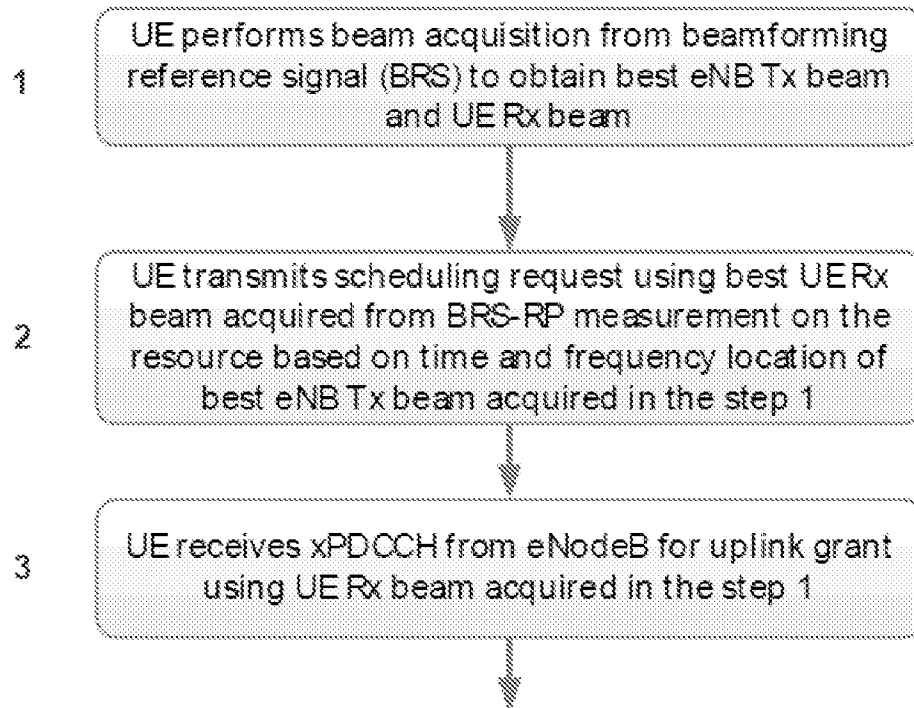


Figure 3: Detailed procedure for SR transmission

Resource allocation of SR transmission

Subframe structure for SR transmission can be based on a self-contained subframe structure, wherein xPDCCH can be transmitted at the beginning of the subframe and 5G physical uplink control channel (xPUCCH) can be transmitted at the last part of the subframe. As shown in Figure 4, a guard period can be inserted after xPDCCH in order to accommodate the DL to UL and UL to DL switching time and round-trip propagation delay. Further, 5G physical uplink shared channel (xPUSCH), SR and/or 5G physical random access channel (xPRACH) can be multiplexed in a frequency division multiplexing (FDM) manner within the same subframe.

Note that the number of SR resources in the frequency domain can be configured in a cell specific manner by higher layers via 5G master information block (xMIB), 5G system information block (xSIB) and RRC signalling.

Figure 4 illustrates the SR resource for self-contained subframe structure in option 1. In the figure, 4 SR resources are configured within the UL subframe. In addition, xPDCCH, GP and xPUCCH are also included in this subframe. In this example, one SR resource spans 11 OFDM symbols.

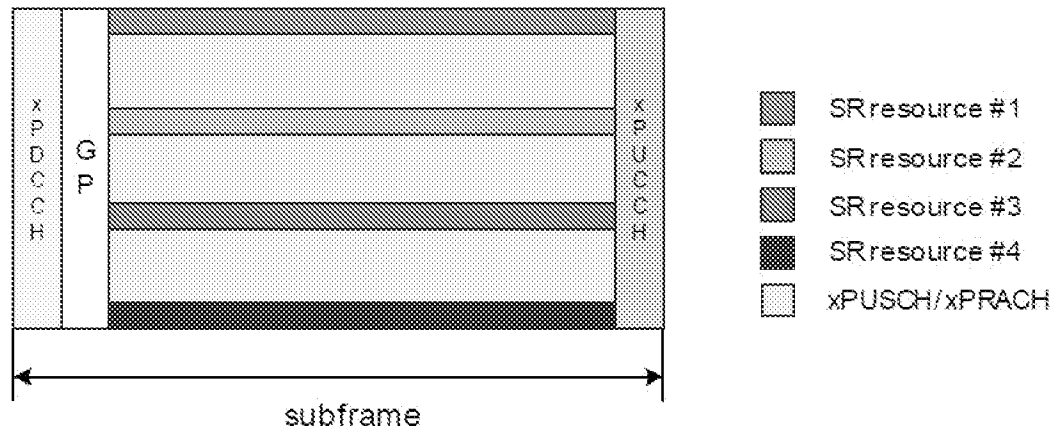


Figure 4: SR resources for self-contained subframe structure: option 1

Figure 5 illustrates the SR resource for self-contained subframe structure in option 2. In the figure, xPDCCH and GP are included in this subframe. In addition, one SR resource spans 12 OFDM symbols.

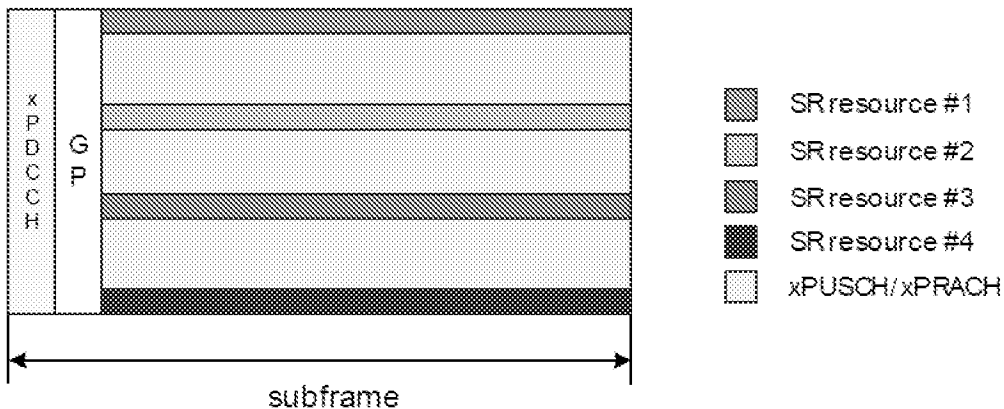


Figure 5: SR resources for self-contained subframe structure: option 2

Figure 6 illustrates the SR resource for self-contained subframe structure in option 3. In the figure, one SR resource spans whole subframe, i.e., 14 OFDM symbols.

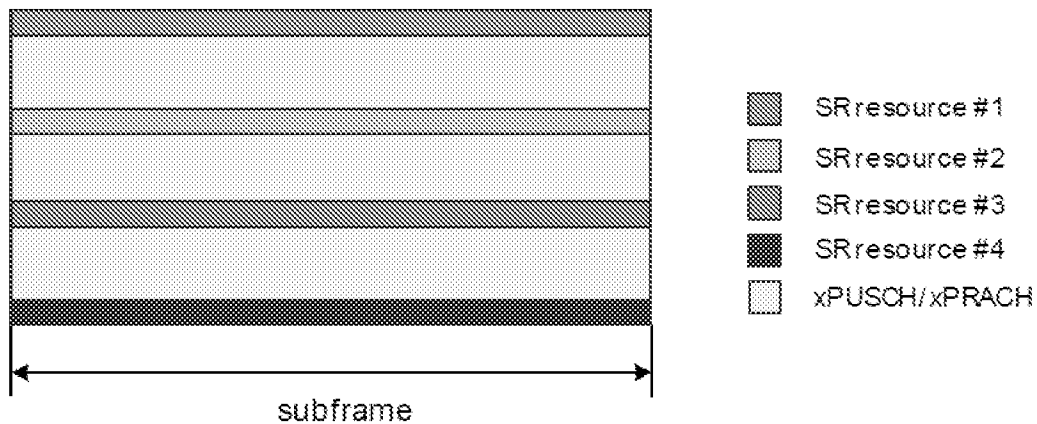


Figure 6: SR resources for self-contained subframe structure: option 3

SR transmission for multiple users can be multiplexed in a code division multiplexing (CDM) or frequency division multiplexing (FDM) manner or a combination thereof. Further, in the case when CDM based multiplexing and when Zadoff-Chu (ZC) sequence is adopted for SR transmission, different users may be configured with dedicated cyclic shift value for SR transmission. The root index for ZC based SR transmission can be defined as a function of physical cell ID and subframe/symbol index.

In order to allow UE to utilize SR to carry eNB Tx beam information, one to one resource association between BRS antenna port and SR resource needs to be defined. Further, the subframe gap between the BRS transmission and corresponding SR transmission can be predefined in the specification or configured by higher layers via xMIB, xSIB or RRC signalling.

In one example, subframe 0 in one radio frame can be defined for BRS transmission, while the corresponding SR transmission can be allocated in subframe 5. It can be also allocated within the same subframe when xPRACH is configured.

Given the periodicity of eNB Tx beam sweeping, certain alignment between BRS and SR transmission needs to be defined to ensure eNB to detect SR transmission using proper Rx beam. In one example, SR may be transmitted in the next opportunity after BRS transmission.

Embodiments for the resource allocation of SR transmission can be provided as follows:

In one embodiment, one to one resource association between BRS antenna port and SR resource in time and frequency domain can be defined. Further, UE transmits the SR using dedicated resource index which is configured by higher layers via UE specific RRC signalling. In addition, UE selects the time and frequency resource for SR transmission which has one to one association on the time and frequency resource where the eNB best Tx beam is located.

According to this transmission scheme, eNB may use the same Tx beam for BRS transmission to apply on the SR reception on the same time and frequency position. Under the assumption of channel reciprocity, eNB best Tx beam information can be carried by the SR resource index in time and frequency domain.

Figure 7 illustrates one example of one to one association between BRS AP and SR resource in time and frequency domain. In this example, in subframe #0, UE measures BRS received power and determines the eNB best Tx beam. As shown in the figure, for UE #1, eNB best Tx beam is located at BRS beam group #0 and 3rd OFDM symbol; and for UE #2, eNB best Tx beam is located at BRS beam group #2 and 8th OFDM symbol. Let us define the one to one association between BRS AP and SR resource, i.e., BRS AP #0 is associated with SR frequency resource #0, BRS AP #1 is associated with SR frequency resource #1, etc.

Based on the mapping rule, UE #1 transmits SR in the subframe #5 in SR frequency resource #0 and 3rd OFDM symbol using configured SR resource index. Similarly, UE #2 transmits SR in the subframe #5 in SR frequency resource #2 in 8th OFDM symbol.

Note that although shown in this figure, each BRS AP is transmitted using localized transmission, i.e. one BRS AP spans contiguous N subcarriers in the frequency domain, BRS AP can also be transmitted in a distributed manner.

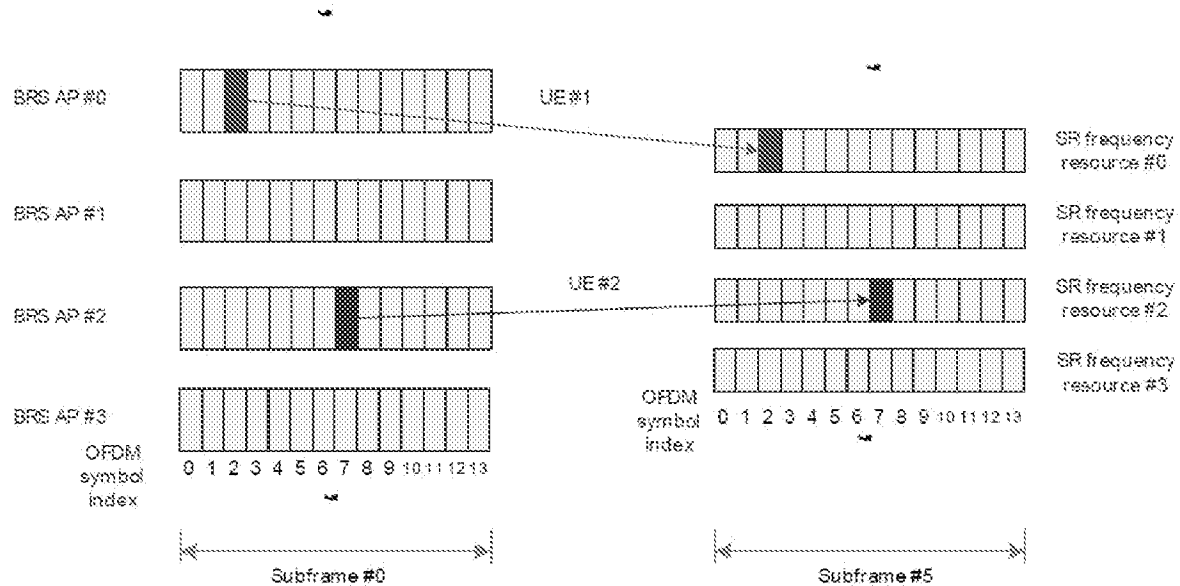


Figure 7: One to one association between BRS AP and SR resource in time and frequency domain

In another embodiment, one to one resource association between BRS antenna port and SR resource in time and code domain can be defined. In particular, one UE may be configured with K SR resource index, where K is the number of BRS APs. In this case, UE selects the time and code resource for SR transmission which has one to one association on the time and frequency resource where the eNB best Tx beam is located.

Figure 8 illustrates one example of one to one association between BRS AP and SR resource in time and frequency domain. In this example, one SR frequency resource is configured in a cell specific manner. Within each resource, one UE is configured with 4 code indexes which have one to one association with BRS AP. In one example, in the case 8 cyclic shift (CS) values are defined for SR transmission, UE #1 may be configured with CS value {0, 2, 4, 6} and UE #2 may be configured with CS value {1, 3, 5, 7}.

Let us define the one to one association between BRS AP and SR code index, i.e., BRS AP #0 is associated with SR code index #0, BRS AP #1 is associated with SR code index #1, etc. Based on the mapping rule, UE #1 transmits SR in the subframe #5 using configured SR codex index #0 in 3rd OFDM symbol. Similarly, UE #2 transmits SR in the subframe #5 using configured SR codex index #2 in 8th OFDM symbol.

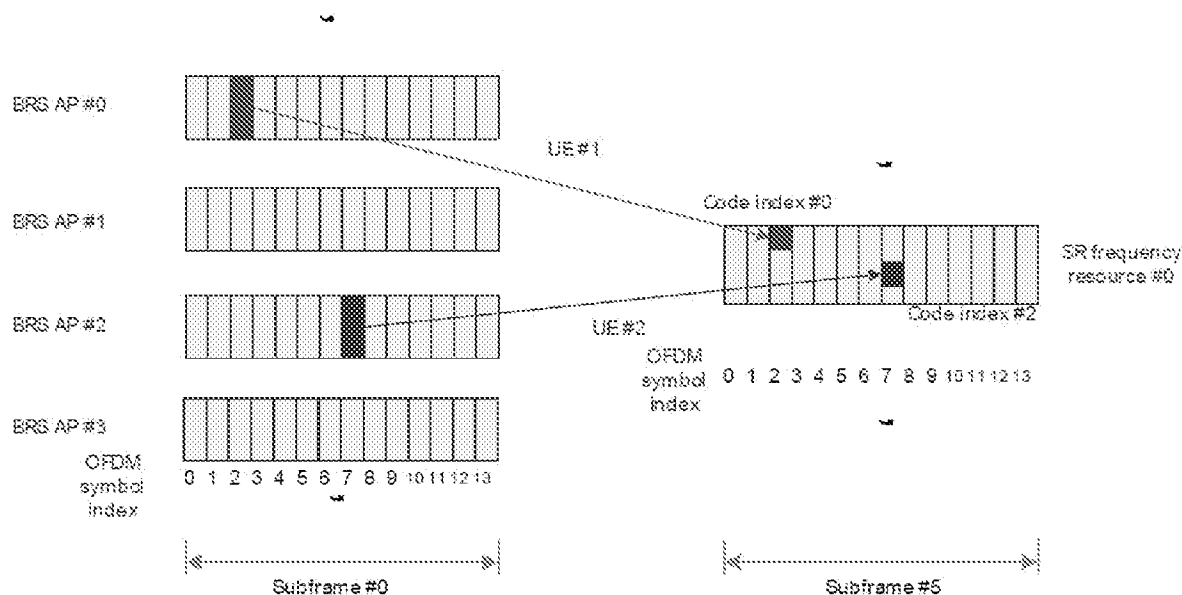


Figure 8: One to one association between BRS AP and SR resource in time and code domain

In another embodiment, one to one resource association between BRS antenna port and SR resource in time/code/frequency domain can be defined. In particular, UE may be configured with M_0 SR resource indexes, where $M_0 < K$. Further, M_1 SR frequency resources can be configured by higher layers in a cell specific manner, where $M_0 \cdot M_1 = K$. In this case, UE selects the time/frequency/code resource for SR transmission which has one to one association on the time and frequency resource where the eNB best Tx beam is located.

In another embodiment, L SR resource can be define, where $L > K$, where K is the number of BRS APs. In this case, one to many resource association between BRS AP and SR resource in the time and frequency domain can be defined. UE may randomly choose one SR frequency resource to transmit the SR according to the one to many resource association rule.

Figure 9 illustrates one example of one to many association between BRS AP and SR resource in time and frequency domain. In this example, two BRS APs and 4 SR frequency resources can be configured. Further, BRS AP #0 is associated with SR frequency resource #0 and #1; while BRS AP #1 is associated with SR frequency resource #2 and #3.

Based on the mapping rule, UE #1 randomly choose one SR frequency resource from SR frequency resource #0 and #1. In the figure, UE transmits SR in the subframe #5 in SR frequency resource #0 and 3rd OFDM symbol using configured SR resource index. Similarly, UE #2 transmits SR in the subframe #5 in SR frequency resource #3 in 8th OFDM symbol.

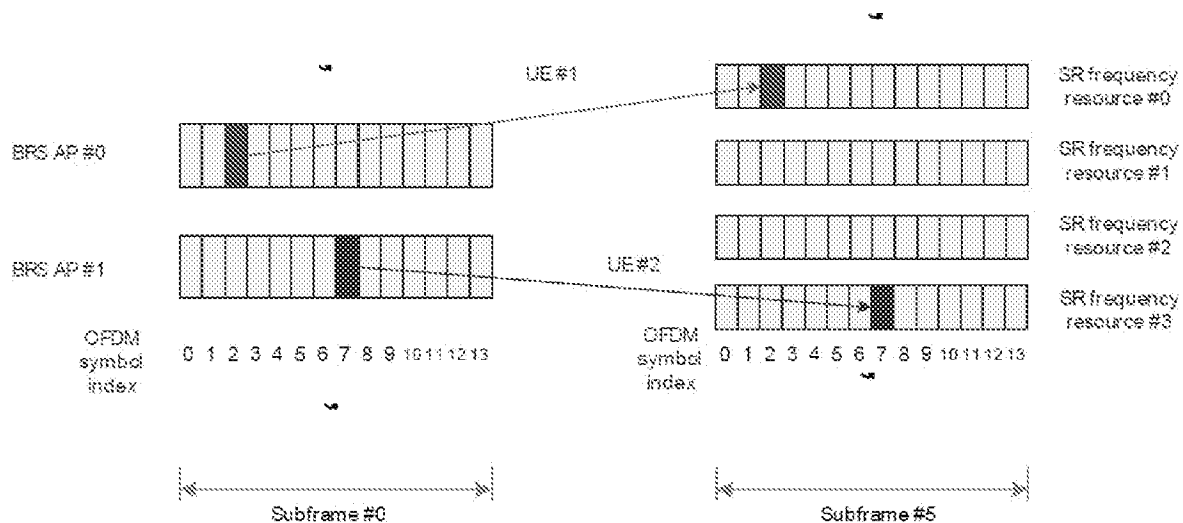


Figure 9: One to many association between BRS AP and SR resource in time and frequency domain

In another embodiment, to improve the SR detection performance, UE may transmit the SR on N SR resources simultaneously, where N can be predefined or configured by higher layers via xMIB, xSIB or RRC signalling. Note that N SR transmissions may correspond to N best eNB Tx beams.

Figure 10 illustrates one example of SR transmission in four SR resources. In this example, UE transmits SR in 3rd OFDM symbol in SR frequency resource #0; in 5th OFDM symbol in SR frequency resource #1; in 8th OFDM symbol in SR frequency resource #2 and in 10th OFDM symbol in SR frequency resource #3.

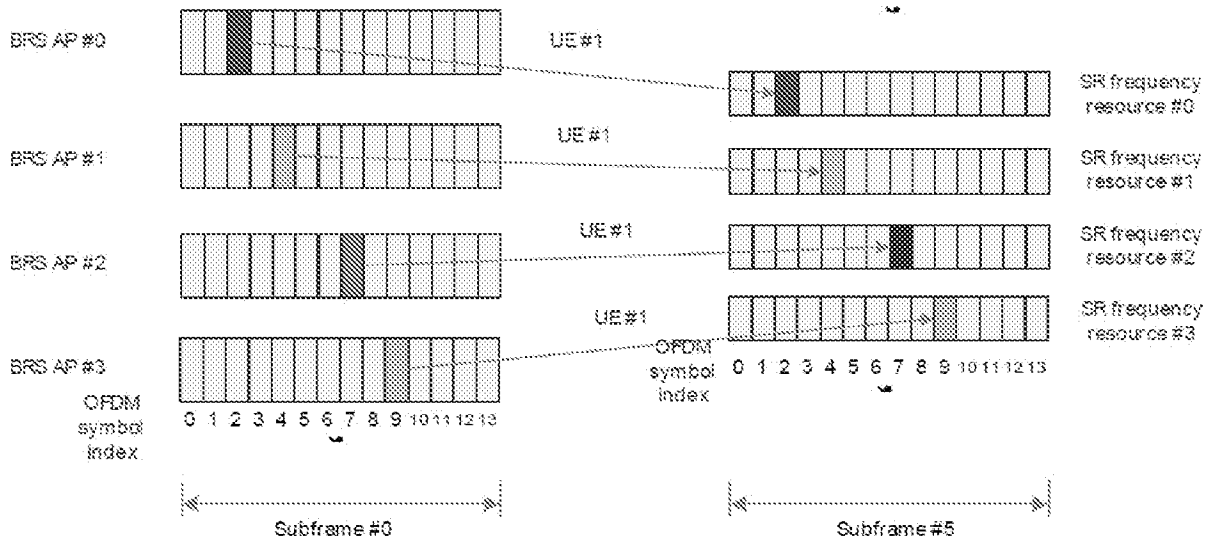


Figure 10: SR transmission in N SR resources

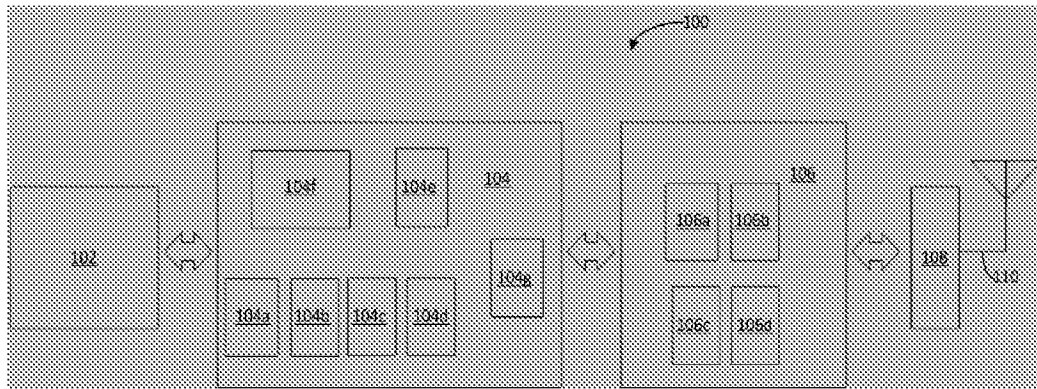


Figure X-1

As used herein, the term "circuitry" may refer to, be part of, or include an Application Specific Integrated Circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group), and/or memory (shared, dedicated, or group) that execute one or more software or firmware programs, a combinational logic circuit, and/or other suitable hardware components that provide the described functionality. In some embodiments, the circuitry may be implemented in, or functions associated with the circuitry may be implemented by, one or more

software or firmware modules. In some embodiments, circuitry may include logic, at least partially operable in hardware.

Embodiments described herein may be implemented into a system using any suitably configured hardware and/or software. Figure X-1 illustrates, for one embodiment, example components of an electronic device 100. In embodiments, the electronic device 100 may be, implement, be incorporated into, or otherwise be a part of a user equipment (UE), an evolved NodeB (eNB), or some other electronic device. In some embodiments, the electronic device 100 may include application circuitry 102, baseband circuitry 104, Radio Frequency (RF) circuitry 106, front-end module (FEM) circuitry 108 and one or more antennas 110, coupled together at least as shown.

The application circuitry 102 may include one or more application processors. For example, the application circuitry 102 may include circuitry such as, but not limited to, one or more single-core or multi-core processors. The processor(s) may include any combination of general-purpose processors and dedicated processors (e.g., graphics processors, application processors, etc.). The processors may be coupled with and/or may include memory/storage and may be configured to execute instructions stored in the memory/storage to enable various applications and/or operating systems to run on the system.

The baseband circuitry 104 may include circuitry such as, but not limited to, one or more single-core or multi-core processors. The baseband circuitry 104 may include one or more baseband processors and/or control logic to process baseband signals received from a receive signal path of the RF circuitry 106 and to generate baseband signals for a transmit signal path of the RF circuitry 106. Baseband processing circuitry 104 may interface with the application circuitry 102 for generation and processing of the baseband signals and for controlling operations of the RF circuitry 106. For example, in some embodiments, the baseband circuitry 104 may include a second generation (2G) baseband processor 104a, third generation (3G) baseband processor 104b, fourth generation (4G) baseband processor 104c, and/or other baseband processor(s) 104d for other existing generations, generations in development or to be developed in the future (e.g., fifth generation (5G), 6G, etc.). The baseband circuitry 104 (e.g., one or more of baseband processors 104a-d) may handle various radio control functions that enable communication with one or more radio networks via the RF circuitry 106. The radio control functions may include, but are not limited to, signal modulation/demodulation,

encoding/decoding, radio frequency shifting, etc. In some embodiments, modulation/demodulation circuitry of the baseband circuitry 104 may include Fast-Fourier Transform (FFT), precoding, and/or constellation mapping/demapping functionality. In some embodiments, encoding/decoding circuitry of the baseband circuitry 104 may include convolution, tail-biting convolution, turbo, Viterbi, and/or Low Density Parity Check (LDPC) encoder/decoder functionality. Embodiments of modulation/demodulation and encoder/decoder functionality are not limited to these examples and may include other suitable functionality in other embodiments.

In some embodiments, the baseband circuitry 104 may include elements of a protocol stack such as, for example, elements of an evolved universal terrestrial radio access network (EUTRAN) protocol including, for example, physical (PHY), media access control (MAC), radio link control (RLC), packet data convergence protocol (PDCP), and/or radio resource control (RRC) elements. A central processing unit (CPU) 104e of the baseband circuitry 104 may be configured to run elements of the protocol stack for signaling of the PHY, MAC, RLC, PDCP and/or RRC layers. In some embodiments, the baseband circuitry may include one or more audio digital signal processor(s) (DSP) 104f. The audio DSP(s) 104f may include elements for compression/decompression and echo cancellation and may include other suitable processing elements in other embodiments.

The baseband circuitry 104 may further include memory/storage 104g. The memory/storage 104g may be used to load and store data and/or instructions for operations performed by the processors of the baseband circuitry 104. Memory/storage for one embodiment may include any combination of suitable volatile memory and/or non-volatile memory. The memory/storage 104g may include any combination of various levels of memory/storage including, but not limited to, read-only memory (ROM) having embedded software instructions (e.g., firmware), random access memory (e.g., dynamic random access memory (DRAM)), cache, buffers, etc. The memory/storage 104g may be shared among the various processors or dedicated to particular processors.

Components of the baseband circuitry may be suitably combined in a single chip, a single chipset, or disposed on a same circuit board in some embodiments. In some embodiments, some or all of the constituent components of the baseband circuitry 104 and the application circuitry 102 may be implemented together such as, for example, on a system on a chip (SOC).

In some embodiments, the baseband circuitry 104 may provide for communication compatible with one or more radio technologies. For example, in some embodiments, the baseband circuitry 104 may support communication with an evolved universal terrestrial radio access network (EUTRAN) and/or other wireless metropolitan area networks (WMAN), a wireless local area network (WLAN), a wireless personal area network (WPAN). Embodiments in which the baseband circuitry 104 is configured to support radio communications of more than one wireless protocol may be referred to as multi-mode baseband circuitry.

RF circuitry 106 may enable communication with wireless networks using modulated electromagnetic radiation through a non-solid medium. In various embodiments, the RF circuitry 106 may include switches, filters, amplifiers, etc. to facilitate the communication with the wireless network. RF circuitry 106 may include a receive signal path which may include circuitry to down-convert RF signals received from the FEM circuitry 108 and provide baseband signals to the baseband circuitry 104. RF circuitry 106 may also include a transmit signal path which may include circuitry to up-convert baseband signals provided by the baseband circuitry 104 and provide RF output signals to the FEM circuitry 108 for transmission.

In some embodiments, the RF circuitry 106 may include a receive signal path and a transmit signal path. The receive signal path of the RF circuitry 106 may include mixer circuitry 106a, amplifier circuitry 106b and filter circuitry 106c. The transmit signal path of the RF circuitry 106 may include filter circuitry 106c and mixer circuitry 106a. RF circuitry 106 may also include synthesizer circuitry 106d for synthesizing a frequency for use by the mixer circuitry 106a of the receive signal path and the transmit signal path. In some embodiments, the mixer circuitry 106a of the receive signal path may be configured to down-convert RF signals received from the FEM circuitry 108 based on the synthesized frequency provided by synthesizer circuitry 106d. The amplifier circuitry 106b may be configured to amplify the down-converted signals and the filter circuitry 106c may be a low-pass filter (LPF) or band-pass filter (BPF) configured to remove unwanted signals from the down-converted signals to generate output baseband signals. Output baseband signals may be provided to the baseband circuitry 104 for further processing. In some embodiments, the output baseband signals may be zero-frequency baseband signals, although this is not a requirement. In some embodiments, mixer circuitry 106a of the receive signal path may comprise passive mixers, although the scope of the embodiments is not limited in this respect.

In some embodiments, the mixer circuitry 106a of the transmit signal path may be configured to up-convert input baseband signals based on the synthesized frequency provided by the synthesizer circuitry 106d to generate RF output signals for the FEM circuitry 108. The baseband signals may be provided by the baseband circuitry 104 and may be filtered by filter circuitry 106c. The filter circuitry 106c may include a low-pass filter (LPF), although the scope of the embodiments is not limited in this respect.

In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a of the transmit signal path may include two or more mixers and may be arranged for quadrature downconversion and/or upconversion respectively. In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a of the transmit signal path may include two or more mixers and may be arranged for image rejection (e.g., Hartley image rejection). In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a may be arranged for direct downconversion and/or direct upconversion, respectively. In some embodiments, the mixer circuitry 106a of the receive signal path and the mixer circuitry 106a of the transmit signal path may be configured for super-heterodyne operation.

In some embodiments, the output baseband signals and the input baseband signals may be analog baseband signals, although the scope of the embodiments is not limited in this respect. In some alternate embodiments, the output baseband signals and the input baseband signals may be digital baseband signals. In these alternate embodiments, the RF circuitry 106 may include analog-to-digital converter (ADC) and digital-to-analog converter (DAC) circuitry and the baseband circuitry 104 may include a digital baseband interface to communicate with the RF circuitry 106.

In some dual-mode embodiments, a separate radio IC circuitry may be provided for processing signals for each spectrum, although the scope of the embodiments is not limited in this respect.

In some embodiments, the synthesizer circuitry 106d may be a fractional-N synthesizer or a fractional N/N+1 synthesizer, although the scope of the embodiments is not limited in this respect as other types of frequency synthesizers may be suitable. For example, synthesizer circuitry 106d may be a delta-sigma synthesizer, a frequency multiplier, or a synthesizer comprising a phase-locked loop with a frequency divider.

The synthesizer circuitry 106d may be configured to synthesize an output frequency for use by the mixer circuitry 106a of the RF circuitry 106 based on a frequency input and a divider control input. In some embodiments, the synthesizer circuitry 106d may be a fractional $N/N+1$ synthesizer.

In some embodiments, frequency input may be provided by a voltage controlled oscillator (VCO), although that is not a requirement. Divider control input may be provided by either the baseband circuitry 104 or the applications processor 102 depending on the desired output frequency. In some embodiments, a divider control input (e.g., N) may be determined from a look-up table based on a channel indicated by the applications processor 102.

Synthesizer circuitry 106d of the RF circuitry 106 may include a divider, a delay-locked loop (DLL), a multiplexer and a phase accumulator. In some embodiments, the divider may be a dual modulus divider (DMD) and the phase accumulator may be a digital phase accumulator (DPA). In some embodiments, the DMD may be configured to divide the input signal by either N or $N+1$ (e.g., based on a carry out) to provide a fractional division ratio. In some example embodiments, the DLL may include a set of cascaded, tunable, delay elements, a phase detector, a charge pump and a D-type flip-flop. In these embodiments, the delay elements may be configured to break a VCO period up into N_d equal packets of phase, where N_d is the number of delay elements in the delay line. In this way, the DLL provides negative feedback to help ensure that the total delay through the delay line is one VCO cycle.

In some embodiments, synthesizer circuitry 106d may be configured to generate a carrier frequency as the output frequency, while in other embodiments, the output frequency may be a multiple of the carrier frequency (e.g., twice the carrier frequency, four times the carrier frequency) and used in conjunction with quadrature generator and divider circuitry to generate multiple signals at the carrier frequency with multiple different phases with respect to each other. In some embodiments, the output frequency may be a LO frequency (f_{LO}). In some embodiments, the RF circuitry 106 may include an IQ/polar converter.

FEM circuitry 108 may include a receive signal path which may include circuitry configured to operate on RF signals received from one or more antennas 110, amplify the received signals and provide the amplified versions of the received signals to the RF circuitry 106 for further processing. FEM circuitry 108 may also include a transmit signal path which may

include circuitry configured to amplify signals for transmission provided by the RF circuitry 106 for transmission by one or more of the one or more antennas 110.

In some embodiments, the FEM circuitry 108 may include a TX/RX switch to switch between transmit mode and receive mode operation. The FEM circuitry may include a receive signal path and a transmit signal path. The receive signal path of the FEM circuitry may include a low-noise amplifier (LNA) to amplify received RF signals and provide the amplified received RF signals as an output (e.g., to the RF circuitry 106). The transmit signal path of the FEM circuitry 108 may include a power amplifier (PA) to amplify input RF signals (e.g., provided by RF circuitry 106), and one or more filters to generate RF signals for subsequent transmission (e.g., by one or more of the one or more antennas 110).

In some embodiments, the electronic device 100 may include additional elements such as, for example, memory/storage, display, camera, sensor, and/or input/output (I/O) interface.

In some embodiments, the electronic device of Figure X-1 may be configured to perform one or more processes, techniques, and/or methods as described herein, or portions thereof.

EXAMPLES

Example 1 may contain a system and/or method of wireless communication for a fifth generation (5G) system comprising: determining, by UE, best eNB Tx beam and UE Rx beam from beamforming reference signal (BRS); transmitting, by UE, scheduling request (SR) using the best UE Rx beam on the resource based on time and frequency location of the best eNB Tx beam; and receiving, by UE, 5G physical downlink control channel (xPDCCH) from eNodeB for uplink grant.

Example 2 may contain the system and/or method of example 1 and/or some other example herein, wherein number of SR resources in the frequency domain can be configured in a cell specific manner by higher layers via 5G master information block (xMIB), 5G system information block (xSIB) and RRC signalling.

Example 3 may contain the system and/or method of example 1 and/or some other example herein, wherein 5G physical downlink control channel (xPDCCH), Guard period (GP)

and 5G physical uplink control channel (xPUCCH) are allocated in the same subframe where SR is transmitted;

Example 4 may contain the system and/or method of example 1 and/or some other example herein, wherein xPDCCH and GP are included in the subframe where SR is transmitted.

Example 5 may contain the system and/or method of example 1 and/or some other example herein, wherein one SR resource spans one subframe.

Example 6 may contain the system and/or method of example 1 and/or some other example herein, wherein one to one resource association between BRS antenna port and SR resource can be defined; wherein subframe gap between the BRS transmission and corresponding SR transmission can be predefined in the specification or configured by higher layers via xMIB, xSIB or RRC signalling.

Example 7 may contain the system and/or method of example 6 and/or some other example herein, wherein one to one resource association between BRS antenna port and SR resource in time and frequency domain can be defined; wherein UE transmits the SR using dedicated resource index which is configured by higher layers via UE specific RRC signalling; wherein UE selects the time and frequency resource for SR transmission which has one to one association on the time and frequency resource where the eNB best Tx beam is located.

Example 8 may contain the system and/or method of example 7 and/or some other example herein, wherein the dedicated resource index for SR transmission can be cyclic shift index or comb index or a combination of thereof.

Example 9 may contain the system and/or method of example 6 and/or some other example herein, wherein one to one resource association between BRS antenna port and SR resource in time and code domain can be defined; wherein one UE may be configured with K SR resource index, where K is the number of BRS APs; wherein UE selects the time and code

resource for SR transmission which has one to one association on the time and frequency resource where the eNB best Tx beam is located.

Example 10 may contain the system and/or method of example 6 and/or some other example herein, wherein one to one resource association between BRS antenna port and SR resource in time/code/frequency domain can be defined; wherein UE may be configured with M_0 SR resource indexes, where $M_0 < K$; wherein M_1 SR frequency resources can be configured by higher layers in a cell specific manner, where $M_0 \cdot M_1 = K$; wherein UE selects the time/frequency/code resource for SR transmission which has one to one association on the time and frequency resource where the eNB best Tx beam is located.

Example 11 may contain the system and/or method of example 6 and/or some other example herein, wherein UE may transmit the SR on N SR resources simultaneously, where N can be predefined or configured by higher layers via xMIB, xSIB or RRC signalling; wherein N SR transmissions may correspond to N best eNB Tx beams.

Example 12 may contain the system and/or method of example 1 and/or some other example herein, wherein L SR resource can be define, where $L > K$, where K is the number of BRS APs; wherein one to many resource association between BRS AP and SR resource in the time and frequency domain can be defined; wherein UE may randomly choose one SR frequency resource to transmit the SR according to the one to many resource association rule.

Example 13 may include an apparatus comprising means to perform one or more elements of a method described in or related to any of examples 1-12, or any other method or process described herein.

Example 14 may include one or more non-transitory computer-readable media comprising instructions to cause an electronic device, upon execution of the instructions by one or more processors of the electronic device, to perform one or more elements of a method described in or related to any of examples 1-12, or any other method or process described herein.

Example 15 may include an apparatus comprising logic, modules, and/or circuitry to perform one or more elements of a method described in or related to any of examples 1-12, or any other method or process described herein.

Example 16 may include a method, technique, or process as described in or related to any of examples 1-12, or portions or parts thereof.

Example 17 may include an apparatus comprising: one or more processors and one or more computer readable media comprising instructions that, when executed by the one or more processors, cause the one or more processors to perform the method, techniques, or process as described in or related to any of examples 1-12, or portions thereof.

Example 18 may include a method of communicating in a wireless network as shown and described herein.

Example 19 may include a system for providing wireless communication as shown and described herein.

Example 20 may include a device for providing wireless communication as shown and described herein.

The foregoing description of one or more implementations provides illustration and description, but is not intended to be exhaustive or to limit the scope of embodiments to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of various embodiments.

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		SCHEDULING REQUEST DESIGN FOR STANDALONE DEPLOYMENT IN MMWAVE SYSTEM		
First Named Inventor/Applicant Name:		Gang Xiong		
Filer:		Michael Sean Moore/Aileen Lee		
Attorney Docket Number:				
Filed as Large Entity				
Filing Fees for Provisional				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional Application Filing	1005	1	260	260
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				260

Electronic Acknowledgement Receipt

EFS ID:	24893649
Application Number:	62294095
International Application Number:	
Confirmation Number:	8297
Title of Invention:	SCHEDULING REQUEST DESIGN FOR STANDALONE DEPLOYMENT IN MMWAVE SYSTEM
First Named Inventor/Applicant Name:	Gang Xiong
Customer Number:	31817
Filer:	Michael Sean Moore/Aileen Lee
Filer Authorized By:	Michael Sean Moore
Attorney Docket Number:	111027-IDF132916
Receipt Date:	11-FEB-2016
Filing Date:	
Time Stamp:	17:06:13
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$260
RAM confirmation Number	3813
Deposit Account	504238
Authorized User	MOORE, MICHAEL S.

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 CFR 1.17 (Patent application and reexamination processing fees)

Petitioners' Exhibit 1008, p. 32
AT&T et al v. ASUS Technology & Celerity
IPR2024-01142

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Provisional Cover Sheet (SB16)	IDF132916_Provisional_Cover_Sheet.pdf	1477423	no	4
			388b00a175dfbb83c161865af6d5c3c58f61c3b5		
Warnings:					
Information:					
2	Specification	132916_Provisional_Application.pdf	877241	no	22
			dbad217e1d3f5894dd31546ff34b0343b55c058c		
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	29712	no	2
			4d0f74985b67c41ce5ca02a33b0445ec22e3f2ac		
Warnings:					
Information:					
Total Files Size (in bytes):			2384376		
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