**3GPP TSG RAN WG1 #117 R1-24xxxxx**

**Fukuoka City, Fukuoka, Japan, May 20th – 24th, 2024**

**Source:** **Moderator (MediaTek)**

**Title:** **FL summary 1 for** **on-demand SIB1 in idle/inactive mode**

**Agenda item: 9.5.2**

**Document for:** **Discussion and Decision**

Introduction

This document is used to assist the discussions for “9.5.2 On-demand SIB1 for idle/inactive mode UEs” study item of the Rel-19 working item on “Enhancements of network energy savings for NR” based on proposals from companies.

This contribution provides discussion points in Section 2, resulted RAN1 conclusion/agreement in Section 3 (TBD), reference (companies tdoc list) in Section 4, and companies’ NES gain simulation results in Section 5.

Discussion points

This section is used to discuss the critical factors that are brought up by multiple companies’ contributions. For each issue, a brief background is provided, and then proposals are bought up to collect company views.

## Issue 1: Cell Scenarios to be discussed for on-demand SIB1

**Background**

The following is agreed in RAN1 #116b:

**Agreement**

For the further study of on-demand SIB1 for idle/inactive mode UE, RAN1 focuses its studies on the following cases:

* Case 1: Option 1+A+X
* Case 2: Option 1+B+X
* Case 3: Option 2+B+Y

Where the options 1/2/A/B/X/Y are defined below:

* On target cell of UL WUS transmission:
  + Option 1: UE transmits UL WUS to NES Cell
  + Option 2: UE transmits UL WUS to Cell A
* On configuration provision for UL WUS transmission
  + Option A: UE obtains the UL WUS configuration from NES Cell
  + Option B: UE obtains the UL WUS configuration from Cell A
* On receiving of SIB1
  + Option X: UE receives on-demand SIB1 from NES Cell
  + Option Y: UE receives on-demand SIB1 from Cell A

Most companies further discussed the cell scenarios to apply on-demand SIB1.

* Exemplary figure form Qualcomm is shown below (while many companies also draw gorgeous figures)

[30, Qualcomm]

******

**For the 3 cases, companies’ views in RAN1 #117 can summarized as the table below:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Support** | **Not prefer** | **Comment** |
| Case 1 (1+A+X) | DOCOMO  Lenovo  [NEC]  KT  CEWiT  Futurewei  Intel  InterDigital  CMCC  Xiaomi  Google  Panasonic  ASUSTek  Frauhnofer  Vodafone | LG  MTK  Qualcomm  Huawei  Spreadtrum  Samsung  vivo  Nokia  CATT | DOCOMO: Most flexible NES cell deployment  Lenovo:   * Case 1 is applicable for the scenarios e.g., UE camping on a single NES cell without the overlayed Cell A * For Case 1, UL WUS ime domain resource can be fixed and frequency resource can be derived from the RBs of SSB   NEC: RAN1 should discuss if isolated cell is applicable for the scenario of on-demand SIB1 for further study.  MTK:   * Reserved PBCH payload not enough to provide UL WUS configuration to UE. * NES gain may not be evident as the NES cell needs to periodically provide UL WUS configuration similar as SIB1.   Qualcomm:   * minimum set of configurable parameters required by the UL-WUS configuration cannot be fit into the limited PBCH payload   Huawei:   * defining a new MIB or pre-SIB1 for WUS configuration provisioning from NES Cell is not beneficial in terms of NES gains and its specification impact is expected to be large   Nokia:   * Case 1 standalone should be ruled out because it would require MIB change to provide the WUS configuration   CATT:   * the specification impact of a new MIB design is large since the reserved bits or states in MIB are limited |
| Case 2 (1+B+X) | Fujitsu  Transsion  LG  Sharp  Ericsson  MTK  III  Futurewei  Huawei  Spreadtrum  [Samsung]  vivo  Nokia  Apple  InterDigital  CATT  China Telecom  CMCC  ZTE  Xiaomi  Google  Lenovo  ETRI  ASUSTek |  | Futitsu: RAN1 to focus on the deployment scenario where Cell A and NES Cell are fully overlapping, as a baseline.  Sharp: RAN2#125bis Agreement   * **At least RAN2 starts scenario 1a (Cell A SIB assisted intra-cell WUS. And WUS and SIB1 is sent to/from NES cell). Other scenarios are not excluded.**   Samsung: From network energy saving perspective, Case 2 can be considered as a candidate for RAN to further decide  CMCC: The study of on-demand SIB1 should be discussed separately according to the following coverage scenario   * Scenario 1: The coverage of the NES cell is fully contained in the coverage of one or multiple Cell A. * Scenario 2: The coverage of the NES cell is partially or not overlapped with the coverage of one or multiple Cell A.   Lenovo: RAN2 has agreed to start with Case 2 (i.e., scenario 1a in RAN2) and other cases are not precluded.  ETRI: RAN1 study focuses on Case 2, i.e., Option 1+B+X, in accordance with the RAN2 agreement |
| Case 3 (2+B+Y) | LG  DOCOMO  Panasonic  Qualcomm  III  [Futurewei]  Huawei  Apple  China Telecom  [CMCC]  Google  ASUSTek [Frauhnofer] | Spreadtrum  [Samsung]  vivo  CATT | DOCOMO: smaller specification impact than Case 2 by reusing legacy on-demand OSI request procedure  Panasonic: Case 3 leads to more NES gain with more stringent constraints on backhaul coordination  Qualcomm: Case 3 is better than Case 2 with higher network energy saving gain (25%/4% v.s. 23%/2%) and minimal spec change   * However, Case 3 design may require higher signaling overhead at backhaul F1-AP and/or Xn interface   Futurewei: The reference SSB for UL-WUS should be discussed  Samsung: Whether to support Case 3 or not is up to RAN2  vivo: Large impacts in RAN2  CATT:   * For case 3, coordination between cell A and NES cell, e.g. exchange information to determine detailed SIB1 of NES cell, results large latency in obtaining on-demand SIB 1. |

**From moderator’s perspective, the pros and cons of the 3 cases can be categorized as:**

**Case 1 (****Options 1+A+X):**

* **Pros:**
  + - **Most flexible NES cell deployment (standalone)**
  + **Cons:**
    - **Reserved PBCH payload not enough to provide UL WUS configuration to UE**
    - **Defining a new MIB or pre-SIB1 for WUS configuration provisioning from NES Cell may not have evident NES gain and may have large spec impact**

**Case 2** **(Options 1+B+X):**

* **Pros:**
  + - **Does not required backhaul information exchange between NES cell and Cell A**
  + **Cons:**
    - **Less NES gain than Case 3**

**Case 3 (Options 2+B+Y):**

* **Pros:**
  + - **Better NES gain than Case 2**
    - **Can reuse legacy on-demand OSI request procedure**
  + **Cons:**
    - **May have large RAN2 impact**
    - **May require higher signaling overhead at backhaul F1-AP and/or Xn interface, and may results in large latency in obtaining on-demand SIB 1**

**As Case 2 is supported by the most companies, and RAN2 had agreed to adopt Case 2 as a starting point (mentioned by Sharp/Lenovo/ETRI) in RAN2 #125bis, moderator hence has the following proposal:**

RAN2#125bis Agreement

* **At least RAN2 starts scenario 1a (Cell A SIB assisted intra-cell WUS. And WUS and SIB1 is sent to/from NES cell). Other scenarios are not excluded.**

### FL Proposal 1-1

**For further study of on-demand SIB1 in idle/inactive mode, RAN1 assumes Case 2 as a starting point while other cases are not excluded.**

* **Case 2: Option 1+B+X**

**where the options 1/B/X are defined below:**

* **On target cell of UL WUS transmission:**
  + **Option 1: UE transmits UL WUS to NES Cell**
* **On configuration provision for UL WUS transmission**
  + **Option B: UE obtains the UL WUS configuration from Cell A**
* **On receiving of SIB1** 
  + **Option X: UE receives on-demand SIB1 from NES Cell**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes |  |
| III | Yes |  |
| Xiaomi | Support |  |
| Fraunhofer | Not support | We do not support the case 1+B+X. Here is why: in our understanding any case which includes option “B” leads to a more complex procedure (switching back and forth in different frequencies), more complex UE implementation and harder test. We can also not understand why “Does not required backhaul information exchange between NES cell and Cell A” . How then the WUS configuration would be exchanged? This would need to be done at least when NES cell changes state and when SIB-1 is updated. Please add “Fraunhofer” , on the table as “Not Prefer” for case 2.  The case “1+A+X” is the most general one, applicable to any thinkable scenario. It also leads to a self-contained OD-SIB-1 procedure, in a single frequency, leading to simpler specification as other procedures need not be touched. Last, but not least this the one where the pro “Does not required backhaul information exchange between NES cell and Cell A” should really be listed. For all these advantages it is our preferred. The companies which have been against are suggesting that “1+A+X” implies a MIB redesign. This is completely not true. As it is clear from the discussion in issue 6, “1+A+X” can be implemented e.g. by having pre-SIB information on DCI (new DCI format or reuse DCI\_1\_0). That still provides significant gain as our contribution to RAN1#116-bis showed. And the gain can be even larger by more efficient multiplexing pattern, pre-defining some configurations and low-overhead efficient design.  Case “2+B+Y” could be a “secondary” optimization for the case the UE accesses Cell A first. But this should be solely discussed in RAN2  In understanding RAN1 should focus simply on studying what is needed to implement “1+X” and let RAN2 look at “2”, “B” and “Y” |
| CMCC | Support | Generally fine with the proposal |
| CATT | Support |  |
| Ericsson |  | Generally fine with proposal, prefer FL Proposal 1-1-2 |
| InterDigital | Support | Fine to consider Case 2 as baseline |

### FL Proposal 1-1-2

**For further study of on-demand SIB1 in idle/inactive mode, RAN1 prioritizes Case 2 for further design details. Other cases are not excluded.**

* **Case 2:** **Option 1+B+X**

**where the options 1/B/X are defined below:**

* **On target cell of UL WUS transmission:**
  + **Option 1: UE transmits UL WUS to NES Cell**
* **On configuration provision for UL WUS transmission**
  + **Option B: UE obtains the UL WUS configuration from Cell A**
* **On receiving of SIB1** 
  + **Option X: UE receives on-demand SIB1 from NES Cell**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Samsung |  | OK |
| Ericsson |  | OK |
| III | Yes |  |
| InterDigital |  | Fine with the wording to ‘prioritize’ Case 2 |

### FL Proposal 1-1-3

**For SIB1 in idle/inactive mode,**

* **Support of Case 2 (Option 1+B+X) is feasible [and beneficial] from RAN1 perspective.**
  + **FFS design details**
* **Further study Case 3, focusing on** **whether/how to transmit SIB1 from cell A.**
  + **Further study Case 1, focusing on whether/how to transmit UL WUS configuration from the NES cell.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| III | Yes |  |
|  |  |  |
|  |  |  |

### FL Proposal 1-1-4

**RAN1 leaves “which cell would provide the WUS configuration” to RAN2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
|  |  |  |
|  |  |  |
|  |  |  |

## Issue 2: UL WUS signal structure and PRACH resources

**Background**

In RAN1 #116b, the following is agreed:

**Agreement**

For UL WUS design for SIB1 request, at least dedicated PRACH resource is the assumption for further study in RAN1

* FFS: Details on time, frequency, and/or PRACH preamble resources for UL WUS
* FFS: whether RACH resource for SIB1 request could be used for an initial access procedure and/or an on-demand SI procedure

Companies’ views are collected below from RAN1 #117:

* Denso: For WUS resource design, reuses or extends the RACH resource design in the legacy on-demand SI procedure.
* Fujitsu: For UL WUS transmission based on PRACH, at least TPC should be applied in the same manner as the legacy PRACH transmission.
* LG: Consider using the existing PRACH as uplink wake-up-signal to trigger SIB1 transmission
* DOCOMO: Study the UE’s assumption of spatial relationships among On-demand SIB1 PDCCH/PDSCH, SSB, and UL WUS
* Xiaomi: Either Msg1-based request or Msg3-based request can be used for requesting on-demand SIB1.
* Panasonic: It is possible to use Msg3 and/or Msg5 for on-demand SIB1 request.
* Huawei: For Case 3 (Option 2+B+Y), RAN1 further study whether the PRACH configuration for UL WUS (e.g. prach-ConfigurationIndex) can reuse the legacy PRACH configuration in cell A’s SIB1.
* Transsion: RACH resource for SIB1 request could not be used for an initial access procedure and/or an

on-demand SI procedure.

* Spreadtrum: A dedicated part of preambles can be used for UL WUS for on-demand SIB1.
* vivo: Dedicated PRACH resources including separate preambles or separate RO with SSB mapping can be used for UL-WUS to request OD-SIB, and the dedicated PRACH resources are different from legacy RACH resources used for random access and OSI.
* CATT: Considering the following options to configure dedicated PRACH resource for UL WUS transmission
  + Option 1: The RO for UL WUS transmission is shared with the RO configured to legacy UE and dedicated preamble is configured.
  + Option 2: The RO for UL WUS transmission is dedicated RO resource configured by:
    - Option 2\_1: One single RACH configuration with possible enhancement.
    - Option 2\_2: Separate RACH configuration for UL WUS.
* ASUSTek:
  + PRACH is used as wake up signal for requesting on-demand SIB1.
  + RAN1 further discusses whether contention based random access procedure or non-contention based random access procedure is supported for requesting on-demand SIB1.
* CMCC: Support the following
  + Opt 1 (shared RO): The dedicated WUS resource shares the same PRACH resource pool with PRACH resource for other usages. IEs like ra-ssb-OccasionMaskIndex and ra-PreambleIndex can be reused to select the dedicated RO and/or preamble for WUS.
  + Opt 2 (separated RO): The dedicated WUS resource uses an independent RACH resource pool with PRACH resource for other usages.

If WUS transmission for camping and WUS transmission for RRC establishment are both supported, the corresponding dedicated WUS resource can be configured respectively.

* ZTE: The dedicated RACH resources for UL WUS should not be used for an initial access procedure neither an on-demand SI (other than the SI in SIB1) procedure.
* Panasonic:
  + The assumption on PRACH resource can be different based on if UL-WUS is sent to Cell A or NES cell.
* ETRI:
  + For UL WUS configuration, up to two separate sets of preambles can be configured:
    - Set of preambles for camping only (e.g., for Scenario 1, Mode 1)
    - Set of preambles for subsequent random access procedure (e.g., for Scenario 2, Mode 2)
  + Set of preambles for camping consists of only one preamble per SSB

**Based on the proposals above, moderator thinks the following proposals may worth a try first.**

### FL Proposal 2-1

**For further study of on-demand SIB1 in idle/inactive mode, it is assumed that the transmit power control of UL WUS transmission based on PRACH is applied in the same manner as the legacy PRACH transmission.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes |  |
| Xiaomi | Support. |  |
| Fraunhofer | Not support | While the general procedure of ramping up should be adopted, we think that the power ramp-up for PRACH is “too flexible”, meaning that the ramp-up parameters are at a fine granularity which is ok for SIB-1 signalling but it would be too much unneeded overhead for WUS configuration. We kindly suggest instead that the ramp-up procedure is studied and optimized. |
| CMCC | Yes | Since in WID it is agreed that no modification of SSB, the UE can directly obtain the RSRP of the corresponding cell via SSB. Therefore, the legacy mechanism for PRACH power control may not need to modify. |
| CATT | OK |  |
| Samsung |  | In our view, UL WUS can follow the same manner as the legacy but separate parameters can be considered for UL WUS. |
| Ericsson | Support |  |
| InterDigital | Support |  |

### FL Proposal 2-2

**For further study of on-demand SIB1 in idle/inactive mode, RAN1 to study UE’s assumption of spatial relationships among PDCCH/PDSCH of on-demand SIB1, SSB, and UL WUS.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes | UL WUS is PRACH. No change is expected. |
| Xiaomi | Not | Not sure why we need to consider UE’s assumption of spatial relationships among PDCCH/PDSCH of on-demand SIB1, SSB and UL WUS.  For the spatial relationship between PDCCH/PDSCH of on-demand SIB1 and SSB, legacy behaviour is sufficient. For UL WUS, it is already covered by pervious proposal. |
| Fraunhofer | Support | The beam selection for UL WUS is yet another point which makes 1+A+X preferred. There this relationship is straightforward. For 1+B+X and 2+B+Y this needs to be reformulated: which SIB1? Which SSB? |
| CMCC | Yes, but | Legacy mechanism may sufficient |
| CATT |  | Agree with cmcc that legacy mechanism should be the baseline and FFS the necessity for any change. |
| Samsung |  | Given UL WUS is assumed as dedicated PRACH resource, it is our understanding that spatial relationships among PDCCH/PDSCH of on-demand SIB1, SSB and UL WUS can follow legacy mechanism. |
| Ericsson | OK | Agree with CMCC, CATT |
| InterDigital |  | In our view, the scope of this proposal can be refined based on the progress made in for Issue 1. Nevertheless, fine with the proposal to study the spatial relation assumptions for now although legacy approach is sufficient. |

### FL Proposal 2-3

**For further study of on-demand SIB1 in idle/inactive mode, RAN1 to study whether contention based random access procedure or contention-free random access procedure is supported for requesting on-demand SIB1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes | CBRA is only choice for idle/inactive UEs. |
| Xiaomi | Support |  |
| Fraunhofer | Not support | If two UEs request SIB-1 at the same time, then SIB-1 is transmitted. Both can read. So, it differs from a random access procedure. |
| CMCC | [Yes] | Is CBRA/CFRA means whether WUS resource is the common PRACH resource or the dedicated WUS resource?  If so, we support contention-free random access procedure for requesting on-demand SIB1 (dedicated PRACH resource for OD-SIB1) as baseline.  For contention based random access procedure (common PRACH resource for OD-SIB1), it can be further studied if there is a significant benefit. |
| CATT | OK |  |
| Samsung |  | Contention based random access procedure would be a starting point for UE will initially connect to NES cell. But, we are OK with studying contention free random access procedure. |
| Ericsson |  | We support that UL WUS resource is dedicated PRACH resource (corresponds to contention free random access). |
| InterDigital |  | Ok with CBRA as starting point.  Not clear how contention-free RA procedure is applicable for OD-SIB1 for idle mode UEs. |

### FL Proposal 2-4

**For further study of on-demand SIB1 in idle/inactive mode, it is assumed** **the dedicated RACH resources for UL WUS can be used for neither initial access procedure nor on-demand SI (other than the SI in SIB1) procedure.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Xiaomi | Support. |  |
| Fraunhofer | Not support | In our understanding the case 2+B+Y fully relies on on-demand SI. Thus the formulation of the proposal is not general enough. Is a specific case implied on the proposal? |
| CMCC | Yes | Support |
| CATT | NO | Since PRACH is used for UL WUS, it is very likely that UE can also utilize this for initial access. No need to preclude this for now. |
| Samsung |  | We see a benefit if UL WUS can be used for initial access at least for Case 2. In addition, given there is a limitation for PRACH resource, it would be better to reuse the UL WUS for initial access which may reduce PRACH collision with other UEs accessing to NES cell. |
| Ericsson |  | “Dedicated RACH resource” means that the RACH resources cannot be used for anything else. So, dedicated RACH resource for SIB1 request is only for that etc. |
| InterDigital | Support | To avoid ambiguity at NW, the PRACH resources for UL WUS are dedicated only for the purpose of requesting OD-SIB1. |

### FL Proposal 2-5

**For further study of on-demand SIB1 in idle/inactive mode related to dedicated PRACH resource usage, RAN1 to study the following options:**

* **Option 1 (shared RO): The dedicated WUS resource shares the same PRACH resource pool with PRACH resource for other usages.** 
  + **E.g. IEs like *ra-ssb-OccasionMaskIndex* and *ra-PreambleIndex* can be reused to select the dedicated RO and/or preamble for WUS.**
* **Option 2 (separated RO): The dedicated WUS resource uses an independent RACH resource pool with PRACH resource for other usages.**

**FFS: Whether the corresponding dedicated WUS resource can be configured respectively if WUS transmission for camping and WUS transmission for RRC establishment are both supported.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Xiaomi | Support. |  |
| CMCC | Yes | Support |
| Samsung |  | Option 1  Regarding the FFS, it seems duplicated with previous FL’s proposal 2-4. |
| Ericsson |  | Pro to option 1 for the case that the UL WUS transmission is for SIB1 request. |
| InterDigital |  | Fine with the proposal in principle.  Not sure on the intent of the FFS. Is the FFS intended to consider further splitting of the dedicated UL WUS resources for the purposes of camping and RRC establishment? |

## Issue 3: Achievable NES gain with on-demand SIB1 and baseline system settings

**@ Intel Corporation**

**@ Apple**

**@ CATT**

**@ China Telecom**

**@ CMCC**

**@ Xiaomi**

**@ Frauhnofer**

**As I am trying to parse companies’ results with the excel file, please assist to fill in your simulation results to the excel file “NES\_gain\_results\_RAN1\_117\_v0\_Mod.xlsx” in the draft folder.**

**Background**

In RAN1 #116b, the following is agreed:

**Agreement**

Companies to report at least the following key settings used in the evaluation/simulation of achievable NES gain with on-demand SIB1 in idle/inactive mode

1. Setting A: SIB1 period (20ms/40ms/160ms)
2. Setting B1: Cell load (Empty/low/medium)
3. Setting B2: Traffic model
4. Setting C: SIB1 PDSCH time domain resource index in 38.214 Table 5.1.2.1.1-2
5. Setting D: CORESET0/SSB multiplexing pattern including *controlResourceSetZero* (index) in 38.213 Table 13-6, and *searchSpaceZero* (index) in 38.213 Table 13-11
6. Setting E: PRACH configurations (including PRACH configuration index in 38.211 Table 6.3.3.2-3) for WUS and initial/random access
7. Setting F: Cat1/Cat2 BS
8. Setting G: Number of SSB beams
9. Setting H: NES gain/loss on Cell A
10. Setting I: On-demand SIB1 transmission rate (how often UE requests on-demand SIB1)

**Agreement**

For further study of the NES gain/loss evaluation assumption on Cell A with on-demand SIB1 on NES cell for idle/inactive mode UE,

* Assume the following for network energy evaluation of Cell A in FR1:
  + Company to report among empty/low/medium cell load as defined in 38.864
  + Same Cat BS as the Non-NES cell
  + 30kHz SCS, DDDSU TDD pattern
    - Same SSB period as the Non-NES cell and company to report SIB1 period
  + Same number of SSBs in a SSB burst as the Non-NES cell with SSB pattern case C
  + 20ms PRACH configuration periodicity for WUS and/or initial access RACH and company to report RACH configuration index in 38.211 Table 6.3.3.2-3
  + Same SSB/CORESET0 multiplexing pattern and same SIB1 PDSCH time domain resource allocation as the Non-NES cell
  + Same traffic model as the Non-NES cell
  + Companies to report the assumption of WUS configuration provision or UL WUS monitoring or on-demand SIB1 transmission on Cell A if Case 2 (Option 1+B+X) or Case 3 (Option 2+B+Y) is considered

**Moderator tried to use some script to parse simulation results in excel file from companies in RAN1 #117 to create some visualization on the NES gains distribution and draw some observations.**





### FL Proposal 3-1

**Observation 1**

**For the evaluation of achievable NES gain on NES cell with on-demand SIB1 in idle/inactive mode, the following is observed with 20ms SSB period and 20ms SIB1 period (Case A)**

* **For FR1, empty load, Cat 1 BS, 4/8 beams, 0% on-demand SIB1 transmission rate, the NES gain is 22.1% - 47.69% from the following sources**
  + **CEWiT, vivo, OPPO, MTK, Panasonic, Qualcomm**
    - **22.1% NES gain is obtained with 4 PRACH slots per PRACH period and PRACH configuration index 17 (Panasonic)**
    - **47.22% NES gain is obtained with 1 PRACH slot per PRACH period (OPPO)**
  + **One source (Samsung) reports the following with FDMed SSB and SIB1**
    - **9.27%~18.94%** **NES gain with UL WUS configuration transmitted in legacy SIB**
      * **Accompanied with -3.62% NES gain on Cell A**
    - **0% NES gain with** **UL WUS configuration transmitted in separated SIB** 
      * **Accompanied with -15.49% NES gain on Cell A**
  + **One source (Nokia) observed that A NES gain varying between a minimum of ~15% and a maximum of ~20% is achieved with OD-SIB1 based on the request rate of OD-SIB1**
* **For FR1, empty load, Cat 1 BS, 4/8 beams, 0% < on-demand SIB1 transmission rate < 25%, the NES gain is 22.6% - 45.79% from the following sources**
  + **vivo, OPPO**
* **For FR1, empty load, Cat 2 BS, 4/8 beams, 0% on-demand SIB1 transmission rate, the NES gain is 11.9% - 39.34% from the following sources**
  + **Nokia, ZTE, OPPO, MTK, Huawei,**
* **For FR1, empty load, Cat 2 BS, 8 beams, 0% < on-demand SIB1 transmission rate < 25%, the NES gain is 15.87% - 36.87% from the following sources**
  + **ZTE, OPPO, Huawei**

**Observation 2**

**For the evaluation of achievable NES gain on NES cell with on-demand SIB1 in idle/inactive mode, the following is observed with 20ms SSB period and 160ms SIB1 period (Case C)**

* **For FR1, empty load, Cat 1 BS, 4/8 beams, 0% on-demand SIB1 transmission rate, the NES gain is 2.21% - 6.33% from the following sources**
  + **Samsung, Qualcomm, OPPO, MTK, vivo**
  + **One source (Panasonic) reports 28.9% NES gain**
* **For FR1, empty load, Cat 1 BS, 4/8 beams, 0% < on-demand SIB1 transmission rate < 25%, the NES gain is 1.01% – 8.48% from the following sources**
  + **Samsung, ZTE, vivo, OPPO, Ericsson**
* **For FR1, empty load, Cat 2 BS, 4/8 beams, 0% on-demand SIB1 transmission rate, the NES gain is 2.96% - 7.76% from the following sources**
  + **ZTE, MTK, Spreadtrum, OPPO**
* **For FR1, empty load, Cat 2 BS, 8 beams, 0% < on-demand SIB1 transmission rate < 25%, the NES gain is 2.5% - 7.44% from the following sources**
  + **ZTE, OPPO, Huawei**

**Observation 3**

**For the evaluation of NES gain/loss on cell A with on-demand SIB1 in idle/inactive mode, if UL WUS configuration is transmitted in separated SIB on cell A, the NES loss is up to 15.69%. If UL WUS configuration is transmitted in legacy SIB on cell A, the NES loss is up to 3.62%.**

**As moderator are still collecting companies’ input into the excel file, the gain values and companies would be further updated later. Also the observations for other cell loads would updated later. Companies are welcomed to suggest revision on the structure of the observations.**

|  |  |
| --- | --- |
| **Company** | **Comment/suggestion on the structure of the observations** |
| Fraunhofer | We suggest also to capture the case with 160 ms SSB period and 160 ms SIB-1 period. Our results are now uploaded on the provided excel template |
| CATT | Please add our evaluation result in observation 1:   * **For FR1, empty load, Cat 1 BS, 4/8 beams, 4% < on-demand SIB1 transmission rate < 24%, the NES gain is 17.98%~24.48%.(CATT)** |
| Ericsson | The result of 4 and 8 beams should be captured separately. |
| Samsung | Our updated input was already shared to FL. We’ll check whether current figure will capture our results correctly. |

## Issue 4: Supported operation for the NES cell with on-demand SIB1

**Background**

Which operations (Ex. SSB, paging, RACH receiving, OSI request …) should be supported for the on-demand SIB1 NES cell is widely discussed. Companies’ view in RAN1 #117 are collected below.

* Transsion: NES cells to support UL WUS reception, RACH and paging transmissions
* OPPO: Support to avoid legacy UE to attempt to access/camp on a NES cell
* Futurewei: Scenarios for UE requesting SIB1 (e.g., to camp on NES Cell, to RACH and connect to NES Cell) can be discussed by RAN2
  + NES cell’s MIB to indicate the cell as barred and/or SIB1 absent to avoid backward compatibility issue
  + Clarify if the following scenario should be assumed:
    - NES Cell does not transmit always-on SSB and transmits on-demand SSB and SIB1, and one of SSB/SIB1 is transmitted only when the other is transmitted
* Nokia: Enabling or disabling specific operations of the NES cell with on-demand SIB1 is a RAN2 aspect
* Apple: NES cell does not support initial cell selection
* ZTE: MES cell should support RACH procedure, paging, and OSI procedures
* ASUSTek: Existing procedures for on-demand OSI could be reuse for on-demand SIB1 as much as
* possible
* Xiaomi: UE can camp on NES cell following current cell selection/reselection procedure. For NES cell, at least following operations should be supported:
  + RACH procedure (random access)
  + OSI transmission
  + Paging
* Ericsson: A UE requesting SIB1 can camp on NES cell
  + Supporting this for NES cells (Scenario 1) requires no/minimal modification of the standard
* KT: UE can request SIB1 to camp on NES cell

### FL Proposal 4-1

**For further study of on-demand SIB1 in idle/inactive mode, enabling or disabling specific operations (e.g. paging, RACH receiving, OSI request …) of the NES cell with on-demand SIB1 is up to RAN2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes | NES cell is a new type of cell. It can compatible for R19 eNES capable UEs in idle/inactive state, but it may not compatible for legacy UEs. RAN2 should be main WG for discussing it. |
| Xiaomi | Not | It may be not RAN2 related only. For example, RAN1 has clear definition on the reception/transmission procedure on RACH, paging (i.e., CSS configuration and short message transmission). Furthermore, we are unclear the reasoning of supporting on-demand SIB1 for NES cell if camping on this cell is not allowed. |
| Fraunhofer | Support |  |
| CMCC | Yes | Support |
| CATT | OK |  |
| Samsung |  | OK |
| Ericsson | Support | To minimize standardization impact, we should avoid special solutions/behaviour that only applies to NES cells. That is, aside from providing SIB1 on demand, baseline is that NES cells should behave as other cells. |
| InterDigital |  | Fine |

### FL Proposal 4-2

**For further study of on-demand SIB1 in idle/inactive mode, it is assumed that NES cell’s PBCH payload is used to indicate the cell as barred or SIB1 absent to avoid backward compatibility issue.**

|  |  |  |
| --- | --- | --- |
| * **Company** | **Support or not** | **Comment** |
| Xiaomi | support |  |
| Fraunhofer | Support | As Cell DTX/DRX already make MIB barring to block legacy UEs, we should instead use a k\_ssb value to say SIB1 is absent (which will be treated as barred by the UE). Unless MIB barring for Cell DTX/DRX would be reversed (there is ongoing discussion on RAN 2 due to emergency calls) |
| CMCC | Yes | Support |
| Samsung |  | OK |
| Ericsson |  | OK. |
| InterDigital |  | OK |

### FL Proposal 4-3

**For further study of on-demand SIB1 in idle/inactive mode, it is assumed that always-on SSB is transmitted on the NES cell with on-demand SIB1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes, but | It is up to RAN2 discussion.  NES cell can be detected by UEs, so always-on SSB in SMTC can be supported for NES cell. |
| III | Yes | Always-on SSB transmitted on the NES cell with on-demand SIB1 is preferable. |
| Xiaomi | Support. |  |
| Fraunhofer | Support | But we should note that this always-on SSB can be adapted, as discussed in the subtopic 9.5.3 – common signals adaptation. Therefore, the period of SSB should not be taken for granted. |
| CMCC | Yes | Support at least for case 2 |
| CATT | OK |  |
| Samsung |  | It is already in WID, i.e., “No modification of SSB will be discussed under this objective” and then no need to agree on it. |
| Ericsson |  | Agree with Samsung, it is clear from the WID. Release 18 is baseline and there is no SSB-less for IDLE/INACTIVE UEs. |
| InterDigital | OK |  |

## Issue 5: UE operation scenarios in the UL WUS design and potential enhancements

**Background**

In RAN1 #116b, the following is agreed:

**Agreement**

**RAN1 to further study the following** **UE operation scenarios in the UL WUS design:**

* **Scenario 1: UE requests SIB1 to camp on NES cell**
* **Scenario 2: UE request SIB1 to perform random access procedure to make RRC connection to NES cell**

For this topic, Companies’ view in RAN1 #117 are collected below.

* Denso: Support performing wake-up and random access in a single procedure
* LG: Study combining the on-demand SIB1 procedure with the initial access procedure and/or an on-demand SI procedure
* DOCOMO:
  + Study whether the wake-up procedure can be part of random-access procedure to reduce the initial access delay.
    - in which condition that wake-up procedure can be part of random-access procedure.
* Ericsson: A new procedure to support UE request SIB1 to perform random access procedure to make RRC connection to NES cell (Scenario 2) requires significant standardization effort and makes the standard more complex, while the gains are not clear.
* Huawei:
  + At least, Scenario 1 is the assumption in RAN1 for further study for case 2 (Option 1+B+X).
  + Scenario 2 is the assumption in RAN1 for further study for case 3 (Option 2+B+Y)**.**
* Spreadtrum: Scenario 1 and Scenario 2 can be combined
* vivo: At least support scenario1, i.e., UE requests SIB1 to camp on NES cell.
* Nokia: UE operation scenarios are RAN2 aspects.
* Apple:
  + For Scenario 1, Case 2 could be considered as the baseline UE behavior
  + For Scenario 2, Case 3 could be considered as the baseline UE behavior
* CATT: If on-demand SIB1 is supported, UL WUS for SIB1 request could be used for an initial access procedure. Dedicated PRACH resource should be configured to distinguish scenario 1 and scenario 2 when considering UL WUS design
* China Telecom
  + Scenario 1 should be supported and studied for on-demand SSB, especially when the on-demand SIB1 is transmitted in Cell A.
  + Observation 3: Scenario 2 is not needed if on-demand SIB1 is transmitted on Cell A.
* Lenovo
  + **RAN2 has agreed to support UE operation Scenario 1, i.e., UE requests SIB1 to camp on NES cell.**
  + Support UE operation Scenario 2 for more gNB power saving, i.e., UE requests SIB1 to perform random access procedure to make RRC connection to NES cell.
  + **RAN2 has agreed to reuse existing Msg1 based on-demand procedure for on-demand SIB1 procedure.**
  + Support to use a combined PRACH procedure for initial access and on-demand SIB1, i.e., RACH resource for SIB1 request could be used for an initial access procedure.
  + Support to use a combined PRACH procedure for on-demand SI and on-demand SIB1, i.e., RACH resource for SIB1 request could be used for an on-demand SI procedure.
* CMCC
  + WUS transmission for camping can be supported in potential case 1 and potential case 2.
  + WUS transmission for RRC establishment can be supported in potential case 1-3.
* ZTE:
  + Using UL WUS to initiate random access procedure will result in great impact on the protocol and has no benefit.
  + The UL WUS is used for triggering on-demand SIB1 only.
* Panasonic: At least support Scenario 2 that UE requests on-demand SIB1 to perform random access procedure to NES cell.
* ETRI:
  + Both the SIB1 request/reception procedures combined and not combined with the RACH procedure are useful for different scenarios.
  + Support the following two procedures for on-demand SIB1 for idle/inactive mode UEs.
    - Mode 1: SIB1 request/reception not combined with RACH procedure
      * UE transmits UL WUS and receives SIB1/RAR
      * If triggered, UE performs the individual RACH procedure as legacy
    - Mode 2: SIB1 request/reception combined with RACH procedure
      * UE transmits UL WUS (msg1) and receives SIB1/RAR (msg2)
      * Subsequently, UE performs remaining steps for 4-step RACH to make RRC connection to NES cell

**It can be seen that**

* **Huawei/Apple/CMCC think the scenarios (1/2) here are related to the cell combination cases (1/2/3)**
* **Denso/LG/DOCOMO/Spreadtrum support to further study potential enhancement of Scenario 2 while Ericsson/ZTE thinks Scenario 2 is not preferred due to large spec impact and not evident gain.**
* **Vivo/China Telecom thinks at least Scenario 1 should be supported**
* **CATT thinks dedicated PRACH resource should be configured to distinguish scenario 1 and scenario 2**
* **Nokia thinks the 2 scenarios are RAN2 topic**
* **Lenovo mentions Scenario 1 is agreed to be supported in RAN2 and RAN1 can further discuss the support of Scenario 2**
* **Panasonic prefers to support Scenario 2 first**
* **ETRI prefers to support both Scenario 1 and Scenario 2 and clarify the UE procedure**

### FL Proposal 5-1

**For further study of on-demand SIB1 in idle/inactive mode about UE operation scenarios, it is assumed:**

* **Scenario 1 is supported with case 2 (Option 1+B+X).**

**Send an LS to RAN2 to check whether they have the intention to support the following:**

* **Scenario 2 with case 3** **(Option 2+B+Y) with potential enhancement to combine wake-up procedure as part of random-access procedure to reduce the initial access delay**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes |  |
| III | Yes |  |
| Xiaomi | Not | Scenario 2 should be the direct consequence of scenario 1. We are wondering why scenario 2 is precluded and what is the mentioned complexity. Further clarification is appreciated. |
| Fraunhofer | Not support | As Nokia we think that this scenario discussion belongs to RAN2.  And we think that 1+A+X should not be excluded (exclusion implicit in current proposal) |
| Samsung |  | We are fine with checking Scenario 2 with RAN2. But, it is unclear why Scenario 2 should be associated with Case 3. If our understanding is correct, it should be Case 2 for “**wake-up procedure as part of random-access procedure to reduce the initial access delay”.** |
| Ericsson |  | We assume that RAN2 is already studying both Scenario 1 and Scenario 2. (In RAN2#125bis, Scenario 1 was already agreed.) |
| InterDigital |  | Fine with the first bullet. Not clear on the need to check with RAN2 on supporting Scenario 2 with Case 3 at this stage. |

## Issue 6: Using which signal/channel to transmit the UL WUS configuration to the UE

**Background**

About using which signal/channel to transmit the UL WUS configuration to the UE the following company views are collected in RAN1 #117:

* **Option 1: SIBx of Cell A**
  + Ericsson, CMCC, ZTE, Nokia, MTK, Apple, Sony, Xiaomi, ETRI (according to RAN2 agreement)
    - **UL WUS configuration can be provided from different cell A.** (ZTE, Ericsson, Huawei, MTK)
* **Option 2**: **SIBx of NES cell (assume long period SIB1/SIBx on NES cell)**
  + CMCC, Xiaomi
* **Option 3: RRC (release) signaling of the cell UE used to connect to (say Cell A)**
  + CMCC, Nokia, Sony
* **Option 4: PDCCH/PDSCH based on Type 0-PDCCH CSS set, e.x. DCI 1\_0**
  + KT, Xiaomi, NEC
* **Option 5**: **Predefined configuration**
  + KT, Sony, Xiaomi, NEC
* **Option 6: PBCH payload from the NES cell**
  + Denso, Sony, NEC
* **Option 7: *pdcch-ConfigSIB1***
  + NEC
* **Option 8: Paging information on Cell A**
  + NEC

**As Option 1 is supported by most companies, and RAN2 had agreed to adopt Option 1 for Case 2 (mentioned by ETRI) in RAN2 #125bis, moderator hence has the following proposal:**

RAN2#125bis Agreement

* **At least RAN2 starts scenario 1a (Cell A SIB assisted intra-cell WUS. And WUS and SIB1 is sent to/from NES cell). Other scenarios are not excluded.**

### FL Proposal 6-1

**For further study of on-demand SIB1 in idle/inactive mode, RAN1 to adopt at least Option 1 for UL WUS configuration provision to the UE for Case 2**

* **Option 1: SIBx of Cell A**
  + - **FFS: Whether/how UL WUS configuration can be provided from different/multiple cell A.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes |  |
| III | Yes |  |
| Xiaomi | Support |  |
| Fraunhofer | Not support | The current proposal only works for cases 1+B+X and 2+B+Y. The case 1+A+X should not be excluded, so at least one option (e.g. option 4) which can be implemented for 1+A+X needs to be further studied.  Please also add “Fraunhofer” to option 4 and option 5. We have discussed the merit of each option in our contribution, and 4 is the strongest while 5 or combination of 4/5 could allow to work with low overhead and therefore higher NES gain. |
| CMCC | Yes | Support |
| Samsung |  | OK |
| Ericsson | Support |  |
| InterDigital | Support |  |

About the contents to be carried in the UL WUS configuration, the following company views are collected in RAN1 #117:

**UL WUS configuration for on-demand SIB1 request includes at least the following:**

1. **Identification of cell(s) that the configuration applies to** (Ericsson, Huawei)
2. **indication of nearby NES cells to the UE** (Ericsson, Huawei, Interdigital)
   * **E.g. NES cell(s) ID, or implicitly indicated by a)**
3. **RACH procedure specification similar to legacy MSG-1-based on-demand SI** (Ericsson, Huawei, vivo, Interdigital)
   * **Time domain PRACH resources e.g. *prach-ConfigurationIndex***
   * **Frequency domain PRACH resources e.g. *msg1-FDM and msg1-FrequencyStart***
   * **PRACH preamble resources e.g. *ra-PreambleStartIndex***
4. **time/frequency resources for SIB1 acquisition** (Ericsson, Huawei, NEC, vivo, Google)
5. **Starting point and length of the time window of on-demand SIB1 reception** (NEC)
6. **resources for random access response** (Ericsson)
7. **UL BWP 0** (Huawei)
8. **SSB pattern** (Huawei, Google (1-1 mapping between RO and SSB))
9. **SSB power** (Huawei, Google)

Nokia**: For time, frequency and/or PRACH preamble resources, RAN1 to consider the dedicated RA resources configuration as part of the WUS configuration content.**

China Telecom**: The configuration of on-demand SIB1 request can reuse the existing IEs in SIB1 with necessary modification.**

Frauhnofer**: RAN1 to study solutions where time and PRACH preamble for UL-WUS is different for each neighbor cell. For example, these resources are mapped from PCI.**

ZTE**: Send LS to RAN2 to handle details on time, frequency, and/or PRACH preamble resources for UL WUS.**

Panasonic**: On the details on time, frequency, and/or PRACH preamble resources for UL-WUS, it is feasible to choose from the current table for PRACH resource mapping.**

### FL Proposal 6-2

**For further study of on-demand SIB1 in idle/inactive mode, it is assumed UL WUS configuration for on-demand SIB1 request includes at least the following:**

1. **Identification of cell(s) that the configuration applies to**
2. **indication of nearby NES cells to the UE**
   * **E.g. NES cell(s) ID, or implicitly indicated by a)**
3. **RACH procedure specification similar to legacy MSG-1-based on-demand SI**
   * **Time domain PRACH resources e.g. *prach-ConfigurationIndex***
   * **Frequency domain PRACH resources e.g. *msg1-FDM and msg1-FrequencyStart***
   * **PRACH preamble resources e.g. *ra-PreambleStartIndex***
4. **time/frequency resources for SIB1 acquisition**
5. **Starting point and length of the time window of on-demand SIB1 reception**
6. **resources for random access response**
7. **UL BWP 0**
8. **SSB pattern**
9. **SSB power**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum |  | Narrow down the configurations, which is too complicated |
| III |  | Detail is to be discussed. |
| xiaomi |  | It is too premature to have this combo proposal at this stage. To be safe, we suggest to make the following modification for the main bullet:  “**For further study of on-demand SIB1 in idle/inactive mode, it is assumed UL WUS configuration for on-demand SIB1 request includes at least a subset of the following:**” |
| Fraunhofer | Not support | The proposal is listing many items, with a “at least”. Not all the features which are listed may be needed. For example, “f – resources for random access response” are only needed if we agree on explicit feedback (to which we currently see no need). Identification (a) is not needed in case 1+A+X. Other fields do not need to be signalled in exactly the same way as in SIB, e.g. SSB pattern and power could be more efficiently signaled.  To have a working proposal we should reduce a lot and come to the bare minimum number of features |
| CMCC |  | Fine to discuss this as a starting point. |
| Samsung |  | In our understanding, all of these parameters are ones used for NES cell not Cell A. It can be clarified at least for c) ~ i). |
| Ericsson |  | Good starting point.  Given a), we don’t need b). |
| InterDigital |  | Fine with at least (a) and (c). |

### FL Proposal 6-3

**For further study of on-demand SIB1 in idle/inactive mode, use the following Table I (from R1-2405106, Ericsson) as a starting point to discuss the required parameters/contents inside the UL WUS configuration.**

**Table I.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Purpose** | **Parameters** | | |
| **To which cell does the config applies** | **NES-CellId** | PhysCellId | |
| ARFCN-ValueNR | |
| **WUS transmission** | **SIB1-RequestConfig** | ss-PBCH-BlockPower | |
| rach-OccasionsSIB1 | Prach-ConfigurationIndex |
| msg1-FDM |
| msg1-FrequencyStart |
| zeroCorrelationZoneConfig |
| preambleReceivedTargetPower |
| preambleTransMax |
| powerRampingStep |
| ra-ResponseWindow |
| ssb-perRACH-Occasion |
| sib1-RequestPeriod | |
| sib1-RequestResource | ra-PreambleStartIndex |
| ra-AssociationPeriodIndex |
| ra-ssb-OccasionMaskIndex |
| rsrp-ThresholdSSB | |
| prach-RootSequenceIndex | |
| msg1-SubcarrierSpacing | |
| restrictedSetConfig | |
| tdd-UL-DL-ConfigurationCommon | |
| **frequencyInfoUL** | frequencyBandList | |
| absoluteFrequencyPointA | |
| offsetToCarrier | |
| p-Max | |
| frequencyShift7p5khz | |
| **SIB1 reception** | **pdcch-ConfigSIB1** | ssb-SubcarrierOffset | |
| controlResourceSetZero | |
| searchSpaceZero | |
| **RAR Reception** | **pdcch-ConfigOD-SIB1-RAR** | controlResourceSet | |
| monitoringSlotPeriodicityAndOffset | |
| Duration | |
| monitoringSymbolsWithinSlot | |
| aggregationLevels | |

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Fraunhofer | support | That is a good starting point. We believe ssbPositionsInBurst should also be added there. |
| Samsung |  | The details can be further discussed later, after discussion on FL’s proposal 6-3. |
| Ericsson | Support | It is good to start thinking about parameters early on. The configuration cannot be too thin (there are probably many other parameters that need to be added), which will have implications for e.g. the feasibility of standalone NES cell solutions. |

About the update of UL WUS configuration, the following company views are collected in RAN1 #117:

* **RAN1 to study provision of** **update of UL WUS configuration on the cell UE is camping on**
  + Denso, Ericsson

### FL Proposal 6-4

**For further study of on-demand SIB1 in idle/inactive mode, RAN1 to study provision of update of UL WUS configuration on the cell UE is camping on.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes |  |
| III | Yes |  |
| Xiaomi | Support. |  |
| Fraunhofer | Support | WUS configuration on camping cell would simplify UE behavior and testing. Yet another reason to consider the multiple cases |
| CMCC | Yes | Support |
| Samsung |  | It can be discussed later after discussing whether NES cell allows UE camping. |
| Ericsson | Support | In the rare event that the UL WUS configuration is updated, a UE camping on the NES cell should not have to go back to Cell A to retrieve the updated UL WUS configuration. |
| InterDigital |  | Same view as Samsung |

## Issue 7: How UE identifies a NES cell is with on-demand SIB1

**Background**

In RAN1 #116b, the following is agreed:

**Agreement**

**RAN1 to further study UE identification of NES cell with on-demand SIB1 based on one, both, or combination of the following options:**

* **Option 1: By WUS configuration**
* **Option 2:** **By PBCH payload of NES cell**

About how UE identifies a NES cell is with on-demand SIB1, the following company views in RAN1 #117 are collected:

* **Option 1: By WUS configuration**: Denso, Fujitsu (Cases 1/2/3), III, LG, MTK, Ericsson, Qualcomm, III, Futurewei, Xiaomi, Huawei, HiSilicon, Nokia, Apple, InterDigital, [Sony], ZTE, Sanechips, Panasonic, ETRI
* **Option 2: By PBCH payload of NES cell**: Fujitsu (Cases 1/3), LG, DOCOMO, Sharp, Ericsson, Qualcomm, KT, CEWiT, Spreadtrum, vivo, Nokia, Apple, InterDigital, CATT, China Telecom, Sony, ZTE, Sanechips, Lenovo, ETRI, Frauhnofer, Vodafone

**As both options are supported by lots of companies, and many companies think both can be supported, the following moderator proposal is drawn.**

### FL Proposal 7-1

**RAN1 to further study UE identification of NES cell with on-demand SIB1 based on both of the following options:**

* **Option 1: By WUS configuration**
  + - **Cell(s) that the UL WUS configuration(s) applies to are NES cell(s)**
* **Option 2: By PBCH payload of NES cell** 
  + - **FFS: How to use the (reserved)** **k\_SSB values to indicate a NES cell with on-demand SIB1**
      * **E.g. k\_SSB for FR1 and k\_SSB =14 for FR2**
    - **FFS: Whether to introduce a new parameter to distinguish Case 1/2 (on-demand SIB1 from NES cell) and Case 3 (on-demand SIB1 from Cell A)**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes |  |
| III | Yes |  |
| Xiaomi | Support. | A minor modification for the sub-bullet of Option 2:   * **Option 2: By PBCH payload of NES cell**    + - **FFS: How to use the (reserved) k\_SSB values to indicate a NES cell with on-demand SIB1**       * **E.g. k\_SSB =30 for FR1 and k\_SSB =14 for FR2**   **FFS: Whether to introduce a new parameter to distinguish Case 1/2 (on-demand SIB1 from NES cell) and Case 3 (on-demand SIB1 from Cell A)** |
| Fraunhofer | support | We agree with the correction from Xiaomi |
| CMCC | Yes | Support. |
| Samsung |  | OK with following updates, and we support Option 2. FL Proposal 7-1 **RAN1 to further study UE identification of NES cell with on-demand SIB1 based on both of the following options:**   * **Option 1: By WUS configuration**   + - **Cell(s) that the UL WUS configuration(s) applies to are NES cell(s)** * **Option 2: By PBCH payload of NES cell**    + - **FFS: How to use the (reserved) k\_SSB values to indicate a ~~NES cell~~ Cell A with WUS configuration corresponding to NES cell**       * **~~E.g. k\_SSB for FR1 and k\_SSB =14 for FR2~~**     - **~~FFS: Whether to introduce a new parameter to distinguish Case 1/2 (on-demand SIB1 from NES cell) and Case 3 (on-demand SIB1 from Cell A)~~**   Regarding the last FFS, it can be revisited later, after we determine the case for on-demand SIB1. |
| Ericsson |  | We are positive to both Option 1 and Option 2.  We don’t see that two different cases should be supported (the evaluations hardly justifies it). Regardless, the second FFS, that could be handled separately, it is not needed at this point. |
| InterDigital |  | Fine with both Option 1 and Option 2. |

## Issue 8: UL WUS is cell-specific or shared among multiple cells

**Background**

In RAN1 #116, the following is agreed:

**Agreement**

For the further study on UL WUS configuration among the following options:

* Option 1: Pre-defined UL WUS configuration
* Option 2: UL WUS configuration that applies to multiple NES cell
* Option 3: UL WUS configuration that applies to a single NES cell

About UL WUS is cell-specific or shared among multiple cells, the following company views in RAN1 #117 are collected:

* **Option 1: Pre-defined UL WUS configuration**
  + CEWiT, Xiaomi
* **Option 2: UL WUS configuration applies to multiple NES cells**
  + LG, Qualcomm, Futurewei, MTK, Ericsson, InterDigital, [CMCC]
* **Option 3: UL WUS configuration applies to a single NES cell**
  + LG, Qualcomm, Ericsson, vivo, Nokia, CMCC, ZTE, Xiaomi

Considering that most companies support Option 2 or 3, the following proposal from Qualcomm seems like a good way forward from moderator’s perspective.

* For Case 2 (Option 1+B+X) design, support a unified configuration format that can support both Option 2 (i.e. a UL-WUS configuration applies to multiple NES cells) and Option 3 (i.e. a UL-WUS configuration applies to a single NES cell).

### FL Proposal 8-1

**At least for Case 2 (Option 1+B+X) design, RAN1 to study a unified configuration format that can support both Option 2 (i.e. a UL-WUS configuration applies to multiple NES cells) and Option 3 (i.e. a UL-WUS configuration applies to a single NES cell).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes, but | it can be up to RAN2 design, since it seems a semi-static signalling design issue. |
| III | Yes |  |
| Fraunhofer | support |  |
| CMCC | Yes | We generally fine with the proposal. |
| Samsung |  | OK |
| Ericsson | Support | Although we prefer Option 3, it will be easy to extend the solution to support also Option 2 (e.g. just add another cell ID to a list of NES cells to which the configuration applies) |
| InterDigital | Support |  |

## Issue 9: Confirmation of reception of UL WUS transmission

**Background**

In RAN1 #116, the following is agreed:

**Agreement**

For the study of on-demand SIB1 for idle/inactive mode UE, RAN1 to further study whether feedback from gNB in response to the SIB1 request is supported including associated details.

About confirmation of reception of UL WUS transmission, the following company views in RAN1 #117 are collected:

* **Option 1: Do not support additional feedback to SIB1 request on top of legacy SIB1 reception procedure. UE starts to monitor type0-PDCCH after sending UL WUS.**
  + OPPO, DOCOMO, Futurewei, vivo
* **Option 2: Support** **additional feedback to SIB1 request on top of legacy SIB1 monitoring procedure**
  + DOCOMO, Qualcomm (explicit-ACK via RAR), Xiaomi (Msg2 or Msg4), Nokia, CATT, CMCC, ZTE, Sanechips,
* **Left to RAN2**
  + Spreadtrum

### FL Proposal 9-1

**For further study of on-demand SIB1 in idle/inactive mode, RAN1 to study additional feedback to SIB1 request on top of legacy SIB1 monitoring procedure**

* **E.g. explicit-ACK via RAR for UL-WUS using PRACH**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Xiaomi | Support |  |
| Fraunhofer | Not support | At the moment we do not see the need for explicit ACK. |
| CMCC | Yes | Support to introduce an explicit feedback. Detail design can be further discussed |
| Samsung |  | We don’t see a need to introduce additional feedback. |
| Ericsson | Support | RAR feedback is used for OD-OSI (other system information). Prefer to follow that pattern. Moreover, it can reduce the delay in case of retransmissions etc. |
| InterDigital | Support |  |

## Issue 10: How long on-demand SIB1 is transmitted after BS receives a UL WUS

**Background**

In RAN1 #116-bis, the following are discussed during online session of AI 9.5.2, but not agreed yet. It may serve as a starting point for further discussions in future RAN1 meetings:

**Companies to consider the following for future meetings**

* **Option 1: SIB1 monitoring occasions within a time window**
  + **FFS: The starting time and duration of the time window**
  + **FFS: Interval between two SIB1 monitoring occasions in the time window**
  + **FFS: How gNB informs UE the details related to the time window**
* **Option 2: Periodic SIB1 monitoring occasions until gNB turns off the SIB1 transmission**
  + **FFS: The staring time of the SIB1 monitoring occasions**
  + **FFS: How gNB informs UE the SIB1 transmission is turned off**
  + **FFS: How gNB informs the UE the details related to periodicity**
* **Other options are not precluded**
* **FFS: Further details on SIB1 monitoring occasions**

In RAN1 #117, companies’ views are collected below:

* Fujitsu: Window based transmission scheme should be studied for on-demand SIB1 transmission. (Option 1)
* LG:
  + UE can assume that periodic SIB1 is transmitted during a time window starting from the first time the UE expects to receive SIB1 after the WUS transmission
  + The timer (or duration of time window) or a value of SIB1 transmission cycle N can be pre-defined/configured, or indicated via the gNB's response (e.g., RAR) to the UL WUS. (Option 1)
* DOCOMO:
  + For Case 1 and Case 2 where UE obtains SIB1 via NES cell, support Option 1
  + For Case 3 where UE obtains SIB1 via cell A, UE follows the legacy specification of PDCCH monitoring procedure for receiving system information
* Ericsson: There should be no explicit signaling to inform the UE that SIB1 transmission is turned off. (Option 1)
* Qualcomm: The UE is expected to monitor PDCCH for on-demand SIB1 within a time window (Option 1).
  + FFS: whether UE determines PDCCH monitoring occasions from searchSpaceZero in MIB or from a new search space that is indicated by UL-WUS configuration.
  + FFS: details on the time window
  + Support transmission of on-demand SIB1 with the association with a subset of SSB(s) based on a received UL-WUS.
* MTK: Support SIB1 reception scheduled by the DCI (as in legacy procedure) within a time window. (Option 1)
* CEWiT: Support SIB1 monitoring occasions within a time window with a predefined starting time and duration of the time window. (Option 1)
* Huawei: For case 2 and case 3, option 1(i.e., SIB1 monitoring occasions within a time window) is the assumption for SIB1 monitoring in RAN1 for further study.
* vivo: Support option1 for SIB1 PDCCH monitoring after UL WUS
* Nokia: RAN1 to consider Option 1. FFS Option 2.
  + FFS: how the information about SIB1 monitoring and OD-SIB1 transmission scheduling is informed to UE (e.g. part of WUS configuration)
* Apple: Support SIB1 PDCCH monitoring occasion within a window (Option 1)
  + FFS: where the search space zero configuration is provided.
  + Support indication of the SIB1 monitoring window in the gNB feedback
* InterDigital: Support periodic SIB1 monitoring occasions until gNB turns off the SIB1 transmission. (Option 2)
* CATT: The SIB1 monitoring occasions are within a time window (Option 1)
  + Alt 1: The staring time window is associated with the UL WUS occasion/window
  + Alt 2: The staring time window is associated with the feedback of UL WUS
  + Alt 3: Periodic candidate time windows for transmitting SIB1 are configured and UE assumes the first candidate time window after UL WUS occasion/window
* China Telecom: How the on-demand SIB1 be terminated is related to the reason why on-demand SIB1 is requested.
* CMCC: Support to introduce a time window for SIB1 reception as baseline. (Option 1)
* Sony: The starting time for SIB1 monitoring is determined based on the response with on-demand SIB1 request
* ZTE: Support on-demand **periodic** SIB1 transmission within a time window. (Option 1)
* Panasonic: The behavior of NES cell and scenarios after SIB1 is triggered are to be discussed and clarified.
* ETRI: For transmission of on-demand SIB1, at least support Option 1, i.e., SIB1 monitoring occasions within a time window.
* NEC: Upon SIB1 on-demand request, SIB1 may be monitored for a specified duration (i.e. Option 1: SIB1 monitoring occasions within a time window), from the first period after WUS acknowledgement from gNB.
  + The length of the time window can be implicitly or via DCI format 1\_0.
* Frauhnofer: A time window is defined for SIB-1 transmission after WUS. (Option 1)
* Vodafone: The time-domain behavior of on-demand SIB1 is based on periodic SIB1 monitoring occasions until gNB turns off the SIB1 transmission. (Option 2)

**The above views can summarized as:**

* **Option 1: SIB1** **monitoring occasions within a time window**
  + Fujitsu, LG (add periodic), DOCOMO, Ericsson, Qualcomm, MTK, CEWiT, Huawei, vivo, Nokia, Apple, CATT, China Telecom, CMCC, ZTE (add periodic), ETRI, NEC, Frauhnofer
* **Option 2: Periodic SIB1 monitoring occasions until gNB turns off the SIB1 transmission**
  + InterDigital, Frauhnofer

### FL Proposal 10-1

**For further study of on-demand SIB1 monitoring occasions after UE transmits the UL WUS in idle/inactive mode, RAN1 assumes following as a starting point:**

* **Option 1: Periodic SIB1 monitoring occasions within a time window**
  + **FFS: where the search space zero configuration is provided (e.g. from *searchSpaceZero* in MIB or from a new search space that is indicated by UL-WUS configuration)**
  + **FFS: Details of the time window, including at least the starting time and duration**
  + **FFS: Whether/how to support transmission of on-demand SIB1 with the association with a subset of SSB(s) based on a received UL-WUS**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Spreadtrum | Yes, but | SIB1 monitoring occasion is confusing. If it means searchSpace for SIB1, it should be SIB1 PDCCH monitoring occasion. |
| III | Yes |  |
| Fraunhofer | support | We are supporting Option 1, but we were listed also in option 2. Maybe Vodafone was intended instead? |
| CMCC | Yes | Support |
| Samsung |  | OK |
| Ericsson |  | OK |
| InterDigital |  | OK |

## Issue 11: Whether to covert on-demand SIB1 from study into normative work (collection of views only)

**Background**

About whether to on-demand SIB1 from study into normative work, this would be checked in RAN1 #105 while companies’ views are collected below:

* LG: Consider the trade-off between energy saving gain and initial access latency, in order to decide whether to proceed on-demand SIB1 procedure as normative work in Release 19.
* Samsung: From network energy saving perspective, Case 2 can be considered as a candidate for on-demand SIB1 operation in multi-cell scenario, and RAN can further decide whether to convert the study objective into a normative work objective.
* InterDigital: Support on-demand SIB1 for UEs in idle/inactive mode for normative work
* ZTE: If the solution to on-demand SIB1 for UEs in idle/inactive mode is significantly beneficial for network energy savings, the normative work can be considered.
* vivo: Support to specify on-demand SIB1 by UL WUS for UEs in idle/inactive mode
* Sony: Support on-demand SIB1 for UEs in idle/inactive mode in Release 19
* Lenovo: Sparse SIB1 transmission leads to higher latency of cell access and more power consumption on SIB1 detection in the UE side. This is likely to affect legacy UEs more than Rel-19 UEs. Support to specify on-demand SIB1 in Rel-19 as a solution to achieve network energy saving.

**A brief summary below**

* **Support to covert on-demand SIB1 from study into normative work**: Samsung (Case 2), InterDigital, ZTE (if significantly beneficial), vivo, Sony, Lenovo
* **Need more check**: LG

## Issue 12: UL WUS transmission failure handling and retransmission procedure

**Background**

In RAN1 #117, LG has the following proposal:

* RAN1 to discuss UL WUS transmission failure criterion and retransmission procedure when a UE does not receive SIB1 after transmitting UL WUS.
* Consider introducing a prohibit timer for UL WUS transmission such that the signalling overhead caused by excessive UL WUS transmission by UEs can be reduced.

### FL Proposal 12-1

**RAN1 to discuss UL WUS transmission failure criterion and retransmission procedure when a UE does not receive SIB1 after transmitting UL WUS.**

* + **FFS: whether/how to introduce a prohibit timer to reduce the signalling overhead caused by excessive UL WUS transmission**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support or not** | **Comment** |
| Xiaomi | Support |  |
| Fraunhofer | Support (issue 11) | We support to convert this to normative work, as proposed in our contribution.  Issue 12 can be left for later |
| CMCC | Yes | Support  The legacy PRACH retransmission mechanism can be reused as a starting point. |
| Samsung |  | It seems too early to discuss it.  From our initial point of view, UE will request on-demand SIB1 to NES cell, since NES cell provides better channel quality. In this sense, we don’t see the strong motivation on FL Proposal 12-1. |
| III |  | This issue has some connection with Issue 2: UL WUS signal structure and PRACH resources (i.e., UL WUS retransmission procedure) and Issue 9: Confirmation of reception of UL WUS transmission (i.e., UL WUS transmission failure), and should be considered as a whole. |

Resulted RAN1 conclusion/agreement

4 References (all from RAN1 #117)

1. R1-2403870 Discussion of on-demand SIB1 for idle/inactive mode UEs FUTUREWEI
2. R1-2403942 Discussion on on-demand SIB1 for eNES Huawei, HiSilicon
3. R1-2403979 Study on on demand SIB1 for Idle/inactive mode Ues Intel Corporation
4. R1-2404033 Discussion on on-demand SIB1 for idle/inactive mode UEs Spreadtrum Communications
5. R1-2404122 On-demand SIB1 for idle/inactive mode UEs Samsung
6. R1-2404184 Discussions on on-demand SIB1 for idle/inactive mode UEs vivo
7. R1-2404224 On-demand SIB1 for Idle/Inactive mode UEs Nokia, Nokia Shanghai Bell
8. R1-2404294 On on-demand SIB1 for IDLE/INACTIVE mode UE Apple
9. R1-2404333 Discussion on on-demand SIB1 for idle/inactive mode UEs InterDigital, Inc.
10. R1-2404408 Discussion on on-demand SIB1 CATT
11. R1-2404434 Discussion on on-demand SIB1 for idle/inactive mode UEs China Telecom
12. R1-2404463 Discussion on on-demand SIB1 for UEs in idle/inactive mode CMCC
13. R1-2404507 On-demand SIB1 for idle/inactive mode UEs Sony
14. R1-2404561 Discussion on on-demand SIB1 for UEs ZTE, Sanechips
15. R1-2404625 Discussion on on-demand SIB1 for idle/inactive mode UEs Xiaomi
16. R1-2404690 On-demand SIB1 for Idle/Inactive Mode UE Google
17. R1-2404698 On-demand SIB1 for idle/inactive mode UEs Lenovo
18. R1-2404758 Discussion on on-demand SIB1 for idle/inactive mode UEs Panasonic
19. R1-2404780 On-demand SIB1 for idle/inactive mode UEs for NES ETRI
20. R1-2404796 Discussion on on-demand SIB1 for UEs in idle/inactive mode NEC
21. R1-2404800 Discussion on on-demand SIB1 for idle/inactive mode UEs DENSO CORPORATION
22. R1-2404808 Discussion on on-demand SIB1 transmission for idle/inactive mode UEs Fujitsu
23. R1-2404820 Discussion on on-demand SIB1 transmission for idle/inactive mode UEs Transsion Holdings
24. R1-2404859 Discussion on the enhancement to support on demand SIB1 for idle/inactive mode UE OPPO
25. R1-2404895 On-demand SIB1 for idle/inactive mode UEs LG Electronics
26. R1-2405049 Discussion on on-demand SIB1 for idle/inactive mode UEs NTT DOCOMO, INC.
27. R1-2405071 Discussion on on-demand SIB1 transmission for idle UEs Sharp
28. R1-2405085 On-demand SIB1 for idle or inactive mode UEs MediaTek Inc.
29. R1-2405106 Study of on-demand SIB1 for UEs in idle/inactive mode for NES Ericsson
30. R1-2405162 On-demand SIB1 procedure Qualcomm Incorporated
31. R1-2405177 Discussion on on-demand SIB1 for idle/inactive mode UEs KT Corp.
32. R1-2405182 On-demand SIB1 for Idle/Inactive mode UEs III
33. R1-2405202 Triggering of on-demand SIB1 ASUSTeK
34. R1-2405207 On-demand SIB1 for NES Fraunhofer IIS, Fraunhofer HHI
35. R1-2405213 Views on On-demand SIB1 operation for idle/inactive UEs Vodafone
36. R1-2405247 Discussion on on-demand SIB1 CEWiT