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# 1 Introduction

This document summarizes the contributions submitted to AI 8.3.3 for NW energy savings. Proposals from companies may be extracted for reference and may be listed more than once. Some proposals may touch upon multiples aspects and may not be explicitly listed on every subtopic discussed in this document but should overall be reflected in the proposals in the document. Note TP changes can be assessed later once we progress on the main proposals.

# 2 Summary of remaining issues

## 2.1 Main aspects to be discussed

### 2.2.1 Definition of (non-)anchor cell

The following proposals were related to (non-)anchor cell definition:

From [6]: Fujitsu
**Proposal 2: Anchor cell in SIB-less solution is defined as the cell transmitting SIBs and necessary information for accessing the NES cell which does not transmit SIBs.**

**Proposal 5: Anchor cell in SSB-less solution is defined as the cell transmitting SSB, SIBs and necessary information for accessing the NES cell which does not transmit SSB and SIBs.**

**Proposal 6: For SSB-less solution, the necessary information carried by anchor cell is same to the SIB-less solution.
Proposal 7: NES-capable UE should use the SSB of anchor cell for SSB associated operation in SSB-less cell.**

From [16]: KDDI

**Proposal 1: Specification enhancement is needed for the connected UE to obtain SIB of NES cell in the in the CA scenario of anchor cell + NES cell.

Proposal 3: Anchor cell deliver the NES cell SIBx within its SIBx or anchor cell scheduling the NES cell SIBx via si-schedulinginfo can be considered as two possible solutions to provide NES SIBx to the UE.**

From [1]: CATT

**Proposal 1: For NES cell without SSB&SIB:**

**- Anchor cell is a cell where UEs (legacy and R18) assume SSB, system information and paging are transmitted. While an NES cell is a cell where NES-capable UEs do not assume SSB or system information are transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access via an NES cell, e.g. random access related configuration of an NES cell, the configuration for selection criteria for random access, and so on.**

**- A UE (legacy or R18) in RRC\_IDLE/RRC\_INACTIVE always camps on an anchor cell. A UE can acquire time and frequency synchronization with NES cell(s) based on receptions of SSB on the anchor cell. The NES-capable UE in RRC\_IDLE/RRC\_INACTIVE, based on system information from the anchor cell, can perform random access via the anchor cell or a NES cell. The UE can enter RRC\_CONNECTED via a NES cell directly via performing random access on the NES cell.**

**Proposal 6: For NES cell with SSB but without SIB:**

**- Anchor cell is a cell where UE assumes SSB, system information and paging are transmitted. While an NES cell is a cell where NES-capable UEs do not assume system information is transmitted but SSB is transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access via an NES cell, e.g. random access related configuration of an NES cell, the configuration for selection criteria of cell for random access, and so on.**

**- A UE in RRC\_IDLE/RRC\_INACTIVE always camps on an anchor cell. The NES-capable UE in RRC\_IDLE/RRC\_INACTIVE, based on system information from the anchor cell, can perform random access via the anchor cell or a NES cell. Before performing random access via a NES cell, the NES capable UE needs to acquires time and frequency synchronization of the NES cell based on receptions of SSB on the cell. The UE can enter RRC\_CONNECTED via a NES cell directly via performing random access on the NES cell.**

From [11]: ZTE
**Proposal 3: A new access model with anchor cell and NES cell defined should be supported to reduce the network power consumption:
Anchor cell: A cell which transmits SSB, broadcasts system information, sends paging message and provides access information of NES cells.
NES cell: A cell which is co-located with anchor cell and does not transmit SSB, broadcast system information or send paging message and allows UE to get access for signaling and data transmission based on the access information provided by the anchor cell.**

From [2]: Qualcomm

**Proposal 6: RAN2 to confirm it is up to RAN1/RAN4 whether it is possible for the UE to synchronize with the non-anchor cell using anchor cell SSB and the conditions to do so.**

Considering the proposals above, an anchor cell and non-anchor cell could be further defined as below.

1. Anchor cell is a cell where UE assumes SSB, system information and paging are transmitted.
2. Non-anchor cell without SIB is a cell where NES-capable UEs do not assume system information is transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access a non-anchor cell.
3. Non-anchor cell without SIB and SSB is a cell where NES-capable UEs do not assume SSB or system information are transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access a non-anchor cell.
4. It is up to RAN1/RAN4 whether it is possible for the UE to synchronize with the non-anchor cell using anchor cell SSB and the conditions to do so.

### 2.2.2 On which cell the UE should camp and perform random access

The following proposals were related to which cell the UE should camp and perform random access:

From [16]: KDDI

**Proposal 2: In Rel-18, to reach energy saving, UE is allowed to camp on the NES while combing multiple energy saving technologies.**

From [9]: Samsung

**Proposal 1: UE camps on the anchor cell, not SSB-less/SIB-less cell**

**Proposal 3: UE in RRC\_INACTIVE/IDLE initiates the random access procedure on the anchor cell.
Proposal 4: gNB may re-direct UE to an NES or non-anchor cell during the random access procedure.**

From [11]: ZTE

**Proposal 5: UE camps on the anchor cell, acquires synchronization, system information and monitors paging from the anchor cell.**

From [14]: Ericsson

**Proposal 1: As a working assumption, it should be possible for the UE to camp on the anchor cell as well as the SIB-less/SSB-less cell.**

From [15]: CMCC
**Proposal 2: UE camps on and perform SSB measurements on the anchor cell in IDLE mode. Then UE is allowed to select RACH occasion & preamble and perform random access to the NES cell, according to the NES cell PRACH configuration received on the anchor cell.**

From [1]: CATT

**Proposal 1: For NES cell without SSB&SIB:
- Anchor cell is a cell where UEs (legacy and R18) assume SSB, system information and paging are transmitted. While an NES cell is a cell where NES-capable UEs do not assume SSB or system information are transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access via an NES cell, e.g. random access related configuration of an NES cell, the configuration for selection criteria for random access, and so on.
- A UE (legacy or R18) in RRC\_IDLE/RRC\_INACTIVE always camps on an anchor cell. A UE can acquire time and frequency synchronization with NES cell(s) based on receptions of SSB on the anchor cell. The NES-capable UE in RRC\_IDLE/RRC\_INACTIVE, based on system information from the anchor cell, can perform random access via the anchor cell or a NES cell. The UE can enter RRC\_CONNECTED via a NES cell directly via performing random access on the NES cell.**

**Proposal 6: For NES cell with SSB but without SIB:**

**- Anchor cell is a cell where UE assumes SSB, system information and paging are transmitted. While an NES cell is a cell where NES-capable UEs do not assume system information is transmitted but SSB is transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access via an NES cell, e.g. random access related configuration of an NES cell, the configuration for selection criteria of cell for random access, and so on.**

**- A UE in RRC\_IDLE/RRC\_INACTIVE always camps on an anchor cell. The NES-capable UE in RRC\_IDLE/RRC\_INACTIVE, based on system information from the anchor cell, can perform random access via the anchor cell or a NES cell. Before performing random access via a NES cell, the NES capable UE needs to acquires time and frequency synchronization of the NES cell based on receptions of SSB on the cell. The UE can enter RRC\_CONNECTED via a NES cell directly via performing random access on the NES cell.**

From [6]: Fujitsu

**Proposal 1: RAN2 to confirm NES-capable UEs can perform RACH and establish connection directly in SSB/SIB-less cell.**

From [7]: OPPO

**Proposal 3: In the case that the NES cell transmits SSB but not the system information, the UE camps on the anchor cell.
Proposal 4: In the case that the NES cell transmits SSB but not the system information, the UE can access the NES cell by using the NES cell-related RACH configuration which is indicated by the anchor cell.**

From [3]: Vivo

**Proposal 2 RAN2 to discuss whether to reuse probability-based RACH carrier selection method for NES cell without SIB.**

**Proposal 3 RAN2 to discuss whether RACH parameters of the non-anchor cell(s) can be transmitted in the SIB from the anchor cell? If yes, FFS which parameters.**

From [4]: Apple

**Proposal 2: For the UE without CA capability in SSB-less solution, multi-carrier operation of Rel-13 NB-IoT is baseline:**

**• NW transmit SSB, SIB and paging only in anchor cell, to reduce NW power consumption**

**• The UE performs initial access, RACH and monitors paging only in anchor cell**

**• After entering CONNECTED state, the UE can be configured to monitor unicast DL/UL traffic in one NES cell without SSB via RRC message from anchor cell.**

**• Upon entering IDLE / INACTIVE state, the UE retunes back to anchor cell**

**• If RACH is triggered, the UE retunes to anchor cell to perform RACH, and then retunes back to last stayed SSB-less cell**

**Proposal 5: For UE without CA capability in SIB-less solution, RAN2 capture below 3 alternatives in TR:**

**• Alt-1: Same as SSB-less solution, the UE camps in anchor cell, and configured by RRC from anchor cell to monitor unicast DL/UL data traffic in one NES SIB-less cell.**

**• Alt-2: The UE camps in anchor cell first, and may select one NES SIB-less cell to perform RACH to enter CONNECTED state upon MO traffic or reception of paging.**

**• Alt-3: The UE selects one SIB-less cell to camp upon acquisition of “piggybacked” SIB-less cell info in anchor cell’s SIB. Upon reception of short message, it needs to retune to anchor cell for SIB update**

**Proposal 7: For UE without CA capability in SIB-less solution, RAN2 discuss below two alternatives on carrier selection for RACH:**

**• Alt-1: random selection similar to multi-carrier operation in Rel-14 NB-IoT**

**• Alt-2: random selection among carriers whose RSRP is larger than one threshold, similar to SUL**

In general, it seems most of the companies would be fine to define that the UE camps on the anchor cell. While there are further details on how exactly to perform random access on the non-anchor cell, it seems sufficient for now to agree that the UE is able to perform random access on the non-anchor cell. Hence, the proposals below should generally capture the aspects above:

1. UE camps on the anchor cell, not SSB-less/SIB-less cell.
2. UE is able to initiate random access procedure on the non-anchor cell. Details under which conditions can be further discussed.

Other aspects were also raised on the access information of the non-anchor cell and relation with anchor cell information. In line with the above, those aspects can be discussed in WI phase.

From [11]: ZTE

**Proposal 4: The access information of an NES cell includes the following:
The conditions for selecting the NES cell for access;
The radio resources of the NES cell.**

From [2]: Qualcomm

**Proposal 5: For SIB-less solutions, RAN2 assumes that the SIB content of anchor and non-anchor cells, and between non-anchor cells with the same anchor cell is different.**

From [6]: Fujitsu
**Proposal 3: For NES-capable UE selecting and establishing connection with the SIB-less cell, the necessary information for the SIB-less cell which is carried by the anchor cell includes cell selection info, access related info, connection establishment info and serving cell common configuration.
Proposal 4: NES cell’s SI should not be transmitted by the anchor cell.**

From [7]: OPPO
**Proposal 2: In the case that the NES cell transmits SSB but not the system information, the SIB1 of the NES cell can be delivered via the SI of the anchor cell. FFS on how the UE knows the association between the NES cell and the anchor cell.**

### 2.2.3 Paging

The following proposals were related to paging:

From [9]: Samsung

**Proposal 2: UE monitors paging on the anchor cell.

Proposal 5: Paging may redirect UE to perform the random access procedure on an NES or non-anchor cell.**

From [6]: Fujitsu

**Proposal 8: RAN2 should discuss paging-less solution in case the NES cell which has overlapping coverage and the same paging area with another cell.
Proposal 9: Anchor cell in paging-less solution is defined as the cell where the UEs camping on the paging-less cell receive paging. The anchor cell shares the same paging area and has the overlapping coverage with the paging-less cell.
Proposal 10: Considering the impact to UE, paging-less solution can be supported together with SSB-less solution.**

From [12]: LG

**Proposal 4: Do not consider the case that the SIB-less cell and the anchor cell belong to different paging area. (I.e. Do not support paging transmission from the SIB-less cell.)**

From [14]: Ericsson

**Proposal 3: Paging can be performed on a SIB-less cell, but not on an SSB-less cell.**

From [1]: CATT

**Proposal 5: Paging reception on NES cell(s) is deprioritized considering NES benefit.**

**Proposal 10: Considering the limited use case and the complexity, paging reception on NES cell(s) with SSB but without SIB is not considered.**

From [3]: Vivo

**Proposal 4 RAN2 to discuss whether to support paging on a NES cell without SIB. If yes, wait for RAN4’s conclusion on whether the UE can get synchronization from SSB of the anchor cell before further discussion about paging on a NES cell without SIB.**

Considering the proposals above, the following needs to be discussed in the context of paging:

1. RAN2 to discuss whether to support paging on a cell without SIB and/or a cell without SIB and SSB.

### 2.2.1 Benefits and impacts

The proposals below are related to benefits and impact of the solutions:

From [1]: CATT
**Proposal 2: The benefits of NES cell without SSB&SIB includes:
- Network energy saving can be achieved as neither SSB nor system information is transmitted on NES cell(s) while only some necessary information of NES cell(s) is transmitted on anchor cell.
- Signaling overhead is reduced, energy saving is achieved and the access load of anchor cell is reduced when entering RRC\_CONNECTED is performed.
- Enables a broader use of the SCell without SSB.
Proposal 3: Impact on the UE behaviour of NES cell without SSB&SIB:
- New behaviours for NES-capable UEs in RRC\_IDLE/RRC\_INACTIVE mode to perform random access procedure and enter RRC\_CONNECTED mode via an NES cell directly.
Proposal 4: Applicability of existing solutions: NB-IoT solution can be used as a baseline.
Proposal 7: Benefits of NES cell with SSB but without SIB include:**

**- Network energy saving can be achieved as system information is not transmitted on NES cell(s) while only some necessary information of NES cell(s) is transmitted on anchor cell.**

**- Signaling overhead is reduced, energy saving is achieved and the access load of anchor cell is reduced when entering RRC\_CONNECTED is performed.**

**Proposal 8: Impact on the UE behaviour of NES cell with SSB but without SIB:**

**- New behaviours for NES-capable UEs in RRC\_IDLE/RRC\_INACTIVE mode to perform random access procedure and enter RRC\_CONNECTED mode via an NES cell directly.**

**- The NES-capable UEs in RRC\_IDLE/RRC\_INACTIVE mode needs to maintain time and frequency synchronization with both an anchor cell and an NES cell simultaneously during random access procedure.**

**Proposal 9: Applicability of existing solutions: NB-IoT solution can be used as a baseline for NES cell with SSB but without SIB. And some enhancements need to be considered when the UE needs to acquire time and frequency synchronization of an NES cell.**

From [3]: Vivo

**Proposal 1 RAN2 to discuss whether to reuse the CEL concept in NB-IOT for NES cell without SIB.**

From [4]: Apple

**Proposal 1: For the UE with CA capability in SSB-less solution, no spec impact is needed if SSB-less SCell is supported in inter-band CA.**

**Proposal 4: For the UE with CA capability in SIB-less solution, no spec impact is needed because legacy system supports reception of SIB update via dedicated RRC signaling.**

On the benefits of the solutions, it seems sufficient to capture the main benefit outline. Note that a discussion on detailed benefits can take long time and it may not help to further define the feature. Hence, capturing a general proposal seems sufficient:

1. The benefits of a cell without SIB and cell without SSB/SIB may include: Network energy saving given that neither SSB (in case of cell without SSB/SIB) nor system information is transmitted on NES cell(s) while only some necessary information of NES cell(s) is transmitted on anchor cell.

On the specification impacts, it would be good to focus on what can be used for further work in RAN2 in WI phase as a starting point.

1. NB-IoT solution can be used as a baseline for the specification work on cell without SSB and cell without SSB/SIB.

## 2.2 Scope and scenarios

The following proposals were related to scenarios to be studied and possible scoping within those:

From [8]: Nokia

**Proposal 4: Study the gain of “anchor cell” approach against just handing over UE after the access to the NES cell**

From [7]: OPPO

**Proposal 1: In the case that the NES cell transmits neither SSB nor SI message, RAN2 considers the NES cell as a serving cell other than SpCell and checks whether/how to enhance the current CA mechanism.**

From [17]: Mediatek

**Proposal 1: Disabling SSB and/or SIB1 for SCell is NOT pursued for network energy saving.**

From [18]: Huawei

**Proposal 1: SIB-less carrier/cell without SSB is feasible and can be recommended to normative work in following scenarios: 1) anchor carrier and NES carrier belong to the same cell; 2) anchor carrier and NES carrier serve as individual cells**

**Proposal 2: SIB-less cell with SSB is feasible and can be recommended to normative work.**

From [4]: Apple

**Proposal 8: As SI needs to be concluded in this RAN2 meeting, RAN2 have no sufficient time to discuss SSB-less / SIB-less in single carrier. Thus, RAN2 leave single carrier discussion to RAN1.**

From [10]: Intel

**Proposal: Work on further on approach 1): NES/non-anchor cell does not transmit SSB as well as SIB1 in the WI phase.**

From [16]: KDDI

**Proposal 4: RAN2 pending the inter-band SSB-less +SIB1 less discussion for the feasibility analyses of RAN1 and RAN4.
Proposal 5: to allow idle UE to camp on the NES cell. In intra-band scenario, the intra-band scenario of anchor cell and NES cell can be considered as a startpoint. RAN1 and RAN4 needs to be involved for the feasibility analyses.**

From [2]: Qualcomm

**Proposal 1: It is up to RAN1/RAN4 whether to support inter-band SSB-less CA.
Proposal 3: RAN2 to deprioritize discussing the SSB-less inter-band CA until further guidance from RAN1/RAN4 on if/how this solution is supported.**

**Proposal 8: RAN2 to hold-off discussions on SIB-less operation specifics until there is an agreement on the rationale of NES savings.**

From [12]: LG

**Proposal 5: Do not consider the initial access/RRC resume on SSB-less cell until RAN4 confirms the PCell without SSB is feasible.**

From [11]: ZTE

**Proposal 1: RAN2 should prioritize the scenario where the NES cell is co-located with anchor cell, and focus on a solution which can save the transmission for both SSB and SIB on NES cell.
Proposal 2: For the colocated deployment, the SSB less transmission in NES cell should be supported.**

From [15]: CMCC

**Proposal 1: Requirement for SSB/SIB/paging less solution includes, anchor cell and NES cells shall be co-located and synchronized.**

From the proposals above, it could be good to capture that the anchor and non-anchor cell in those solutions should be co-located.

1. Focus on the scenario where the NES cell is co-located with anchor cell.

There were also proposals to limit/postpone the study on inter-band CA and single carrier for SSB-less case, while it was also raised which scenario to focus between cell without SSB and SIB and cell without SIB. For the TR, it could worth to at least discuss which scenario to focus on.

1. RAN2 to discuss whether to (de)prioritize the solution of cell without SSB and SIB or cell without SIB.

Some further aspects were raised on the scope and scenarios. We understand most of those aspects can be discussed later once the solutions are more mature, hence no proposals are captured on those aspects.

From [9]: Samsung
**Proposal 6: Common mechanism is applied for both SSB/SIB-less and SIB-less solutions.**

From [14]: Ericsson

**Proposal 2: SSBs/SSB-less solutions are applicable to RRC\_IDLE, RRC\_INACTIVE and RRC\_CONNECTED.**

From [8]: Nokia

**Proposal 2: RAN2 should focus on scenario where most of carriers are turned off and single carrier is usable by legacy UEs as well as NES capable UEs
Proposal 3: RAN2 to study procedures and signalling to enable dynamic SSB/SIB1 transmission reduction/adaptation and consider the impact to RRC Idle/Inactive UEs.**

## 2.3 Other

This section contain general details proposed to be postponed e.g. to once we capture TR details or to WI phase.

From [13]: Interdigital

**Proposal 1: Adopt the TP in Annex A for SSB/SIB-less cell operation into TR 38.864.**

From [8]: Nokia

**Proposal 1: Study possibilities to save base station energy via time domain enhancements of the paging mechanism e.g. with clustered paging.
Proposal 5: RAN2 to study cell/network node activation request by the UE including the conditions for the UE to trigger such request.**

From [14]: Ericsson

**Proposal 4: Paging can be done only on a subset of beams.**

From [12]: LG

**Proposal 1: RAN2 assumes that a list of SIB-less cells and the associated anchor cells are provided from neighbour cells, e.g. via new SIB.
Proposal 2: RAN2 assumes that UE stores the association between the SIB-less cell and the anchor cell within the valid area.
Proposal 3: To utilize RACH resource of SIB-less cell, consider following two models:
Model 1: UE camps on the anchor cell only and decides whether to use RACH resource of the serving cell or SIB-less cell when the RACH is triggered.
Model 2: UE camps on either SIB-less cell and anchor cell, and performs RACH using RACH resources of the serving cell.
Proposal 6: Discuss how to make the SSB-less cell and the anchor cell have different ranking to distribute UEs to SSB-less cell and the anchor cell, if they are deployed on the equal priority frequency.**

From [4]: Apple

**Proposal 3: For the UE without CA capability in SSB-less solution, RAN2 discuss below two alternatives on how to perform RRM / RLM / BFD:**

**• Alt-1: Rely on CSI-RS based RRM / RLM / BFD in NES SIB-less cell**

**• Alt-2: The UE is configured to periodicity retune to anchor cell for SSB based RRM / RLM / BFD**

**Proposal 6: For UE without CA capability in SIB-less solution, the “piggybacked” SIB-less cell info in anchor cell’s SIB includes SFN, ARFCN, Uu PHY common resource, CORESET#0, cellAccessRelatedInfo, Common PHY parameters, uac-BarringInfo and ue-TimersAndConstants.**

From [11]: ZTE

**Proposal 6: When UL/DL data arrives, UE evaluates according to the evaluation condition for selecting the NES cell for access and selects an NES cell for access and then gets access to the NES cell for subsequent signaling or data transmission using the radio resources of the selected NES cell.**

From [2]: Qualcomm

**Proposal 2: If Inter-band SSB-less CA is supported, RAN2 to study the following potential impacts:
UE procedure on Pcell and Scell when RACH is triggered.
Effect on beam management
Effect on Radio link monitoring
Effect on RRM measurement
Signalling the timing offset between Pcell and Scell to the UE when the cells operate on different bands**

**Proposal 4: To assess SIB-less solutions, legacy CA is used as a baseline for comparison.
Proposal 7: RAN2 to discuss how mobility and cell (re)-selection works between non-anchor SSB/SIB-less cells.**

# 3 Conclusion

Based on the discussion in the previous sections we propose the following:

[Proposal 1 Anchor cell is a cell where UE assumes SSB, system information and paging are transmitted.](#_Toc118968342)

[Proposal 2 Non-anchor cell without SIB is a cell where NES-capable UEs do not assume system information is transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access a non-anchor cell.](#_Toc118968343)

[Proposal 3 Non-anchor cell without SIB and SSB is a cell where NES-capable UEs do not assume SSB or system information are transmitted. The system information transmitted by anchor cell also includes the necessary information for NES-capable UEs to access a non-anchor cell.](#_Toc118968344)

[Proposal 4 It is up to RAN1/RAN4 whether it is possible for the UE to synchronize with the non-anchor cell using anchor cell SSB and the conditions to do so.](#_Toc118968345)

[Proposal 5 UE camps on the anchor cell, not SSB-less/SIB-less cell.](#_Toc118968346)

[Proposal 6 UE is able to initiate random access procedure on the non-anchor cell. Details under which conditions can be further discussed.](#_Toc118968347)

[Proposal 7 RAN2 to discuss whether to support paging on a cell without SIB and/or a cell without SIB and SSB.](#_Toc118968348)

[Proposal 8 The benefits of a cell without SIB and cell without SSB/SIB may include: Network energy saving given that neither SSB (in case of cell without SSB/SIB) nor system information is transmitted on NES cell(s) while only some necessary information of NES cell(s) is transmitted on anchor cell.](#_Toc118968349)

[Proposal 9 NB-IoT solution can be used as a baseline for the specification work on cell without SSB and cell without SSB/SIB.](#_Toc118968350)

[Proposal 10 Focus on the scenario where the NES cell is co-located with anchor cell.](#_Toc118968351)

[Proposal 11 RAN2 to discuss whether to (de)prioritize the solution of cell without SSB and SIB or cell without SIB.](#_Toc118968352)

# 4 References

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