3GPP TSG-RAN WG2 Meeting #121 R2-230xxxx

Athens, Greece, 27 February – 03 March 2023

**Agenda item: 8.1.2**

**Source: Nokia, Nokia Shanghai Bell**

**Title: [AT121][706][NCR] Access Link (Nokia)**

**WID/SID: NR\_netcon\_repeater - Release 18**

**Document for: Discussion and Decision**

# 1 Introduction

This document is to kick off the following offline discussion:

* [AT121][706][NCR] Access Link (Nokia)

 Scope:

* Discuss RAN2 issues of access link,
* discuss the proposal on RRCRelease from R2-2300900,
* discuss the proposals p1, p3 and p4 from R2-2300639

 Intended outcome:

 Deadline: Friday CB session

In first NCR session for RAN2#121 a number of items were left unresolved from AI 8.1.2 and AI 8.1.3. In this offline discussion companies are encouraged to provide feedback on these topics. Timely responses are encouraged, so that the discussion coordinator can summarize the company views ahead of the CB session on Friday, March 3.

# 2 Contact Information

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| Company | Contact: Name (E-mail) |
| NEC | Satoaki-hayashi@nec.com |
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# 3 Discussion

## 3.1 RRC side control signalling for NCR-Fwd access beam configuration

RRC signalling related to configuring (a)periodic beam indications for the NCR-Fwd was discussed based on Nokia’s paper R2-2300303. It was proposed that the relevant RRC configurations for periodic and aperiodic beam indications should be provided in ServingCellConfig; however, companies had different views based on the assumption that NCR-MT does not need to receive the NCR-Fwd access beam configuration on a per-cell basis (e.g. some companies believe that NCR-MT should not support DC or CA, hence RRC-based side control signalling messages could be provided either directly within RRCReconfiguration or in an NCR-specific container within RRCReconfiguration).

**Please provide your preference among the below options.**

* **Option 1: Side control configuration for the NCR-Fwd is provided within ServingCellConfig**
* **Option 2: Side control configuration for the NCR-Fwd is not provided within ServingCellConfig, but some other/new message.**
* **Option 3: RAN2 should wait to decide until we have more details from RAN1.**

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| **Company** | **Preferred Option (1,2,3)** | **Further comments (if necessary)** |
| NEC | Option 2 | We think option 2 is much clean for readability. Since side control information is so much independent from other serving cell configuration, it should be still workable when CA is introduced in future. |
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Nokia (R2-2300303) provided a text proposal for the periodic and aperiodic beam configuration IEs based on the existing agreements from RAN1. (These agreements and the proposed IEs are copied below in the Annex of this discussion.) ZTE provided a similar proposal for these IEs in their paper (R2-2301318). The IEs proposed by ZTE have also been copied into the Annex for comparison.

The proposed IEs include a number of constants which have dependencies on RAN1, however we wonder if RAN2 can at least discuss some basic features of the IEs based on the known agreements in RAN1, even if we may not be able to to agree on the exact details in this meeting.)

We observe one major difference between the IEs proposed by Nokia and ZTE:

* Nokia: (A)periodic beam configurations are provided for all resources at the same time and a new set of configurations overwrites all previous configured resources.
* ZTE: (A)periodic beam configurations may be provided for resources selectively. A configured resource may be added, modified, or removed.

Nokia’s proposal could be simpler to implement but is less flexible, whereas ZTE’s proposal could provide more flexibility.

**Companies are asked their preference between the general IE structure for periodic and aperiodic beam indications provided by Nokia and ZTE, or to indicate if they prefer to wait for RAN1 (please indicate what additional information you think is needed from RAN1, if possible):**

* **Option 1: (A)periodic beam configurations are provided for all resources at the same time and a new set of configurations overwrites all previous configured resources.**
* **Option 2: (A)periodic beam configurations may be provided for resources selectively. A configured resource may be added, modified, or removed.**
* **Option 3: Wait for RAN1.**

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| **Company** | **Preferred Option (1,2,3)** | **Further comments (if necessary)** |
| NEC | Option 2 | We tend to agree with Option 2. It would be more flexible to be able to add/update/modify/delete individual beam configuration, e.g., when a new UE is connected through NCR, a new (A)periodic beam configuration might be added.  |
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**Any other comments companies would like to make related to what configuration-related details they think are in scope of RAN2 to determine at this point and how we should proceed with this discussion (e.g. short offline discussion following RAN2#121). (Note: There is no need to comment “No Comment”.)**

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| **Company** | **Comment** |
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## 3.2 NCR-support signalled per PLMN/NPN

In RAN2#120, we agreed that NCR-support would be indicated per PLMN; while it was left FFS whether this indication would also be provided per-NPN. This meeting, Qualcomm (R2-2300639) proposed:

RAN2-120 agreed that an NCR-support indication is included in SIB1 per PLMN to assist the NCR with selection of the parent cell. This is similar to the IAB approach for which the IAB-support indication is also included in SIB1 per NPN. Therefore, the NCR-support indication should also be included in SIB1 per NPN.

**Proposal: NCR-support indication is included in SIB1 per PLMN and per NPN.**

Some companies objected to this proposal. Intel expressed that the per-NPN indication is irrelevant since NCR is an operator-coordinated deployment and therefore the indication creates unnecessary overhead; while Huawei expressed concern that per-PLMN (and per-NPN) indication for NCR-support does not make sense since the NCR has no way to control which UEs access the gNB through the NCR anyway (NCR is transparent to the UEs).

**Companies should indicate their preference among the following options for NCR-support indication:**

* **Option 1: NCR-support indication is included in SIB1 per PLMN and per NPN.**
* **Option 2: NCR-support indication is included in SIB1 per PLMN and no NCR-support indication is provided for NPN.**
* **Option 3: One NCR-support indication is included in SIB1 which is applied for all PLMN/NPN.**

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| **Company** | **Preferred Option (1,2,3)** | **Further comments (if necessary)** |
| NEC | Option 3 | Agree with Huawei that NCR is simply to do cell coverage extension, cannot do PLMN selective forwarding.  |
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## 3.3 NCR-Fwd behaviour after NCR-MT cell reselection

Qualcomm presented the following proposal related to NCR-Fwd behaviour from R2-2300639. The first proposal, relates to NCR-Fwd during cell reselection when NCR-MT is in RRC\_INACTIVE:

The NCR-FWD follows the last side control configuration received from the gNB.

However, this behavior by the NCR-FWD should only apply while the NCR-MT camps on the last serving cell before the NCR-MT was released. Otherwise, the NCR-FWD should switch OFF until the NCR-MT reconnects and receives new side control configuration.

**Proposal: The NCR-FWD is switched OFF if the NCR-MT in RRC\_INACTIVE state reselects a different cell than the last serving cell on which side control configuration was received.**

This proposal was not really discussed in the first online discussion due to limited time.

**Companies are encouraged to provide their view on the following options for NCR-MT cell reselection in RRC\_INACTIVE. Other directly related comments can also be provided.**

* **Option 1: The NCR-FWD is switched OFF if the NCR-MT in RRC\_INACTIVE state reselects a different cell than the last serving cell on which side control configuration was received.**
* **Option 2: The NCR-FWD may stay ON if the NCR-MT in RRC\_INACTIVE state reselects a different cell than the last serving cell on which side control configuration was received.**

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| **Company** | **Preferred Option (1,2)** | **Further comments (if necessary)** |
| NEC | Option 1 | RAN2#120 agreed that “gNB cell that NCR-Fwd is forwarding is the same cell the NCT-MT is connected to”, so our understanding is that the received side control configuration becomes invalid when NCR-MT in RRC\_INACTIVE state reselects a different cell than the last serving cell on which side control configuration was received.Then based on the RAN1#110 agreement (The NCR-Fwd is always expected to be “OFF” unless otherwise explicitly or implicitly indicated by gNB), the NCR-Fwd should switch off. |
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## 3.4 NCR-MT and NCR-Fwd behaviour related to RRCRelease to RRC\_IDLE

NCR-Fwd behaviour during RRCRelease to RRC\_IDLE was left FFS in RAN2#120. Based on contributions to this meeting, a small number of companies were concerned over the idea of NCR-MT getting released to RRC\_IDLE by the network, for example, due to there being no natural trigger for the core network to page an NCR-MT (except possibly due to OAM). We think some of these concerns are more related to “when/how often” or “why” the network would release the NCR-MT to RRC\_IDLE, which is likely outside the scope of what we should be discussing. We think there is at least a common understanding that in some instances (possibly rarely) the NCR-MT could be sent to RRC\_IDLE through RRCRelease (one example being if the NCR is powered down/sent to a low power mode via OAM, in which case the paging is not an issue).

Assuming that the network can indeed release the NCR-MT to RRC\_IDLE we have the following proposal from Qualcomm in R2-2300639 to discuss.

The behavior of the NCR-FWD if the NCR-MT is released to RRC\_IDLE still needs to be determined. Ideally, the NCR-FWD should have similar operation whether the NCR-MT is RRC\_IDLE or RRC\_INACTIVE. The only issue is when the gNB wants to update the side control configuration of the NCR:

* If the NCR-MT is RRC\_INACTIVE, the gNB can page the NCR-MT and provide new side control configuration.
* If the NCR-MT is RRC\_IDLE, RAN-based paging of the NCR-MT is not supported, so side control configuration cannot be updated.

**Proposal: RAN2 to discuss the following options for NCR operation upon releasing the NCR-MT to RRC-IDLE:**

* **Option 1: The gNB provides a wake-up timer to the NCR-MT when released to RRC\_IDLE. The NCR-FWD follows the last side control configuration from the gNB until the timer expires. The NCR-MT may proactively reconnect to the network upon timer expiry to receive updated side control configuration.**
* **Option 2: The NCR-FWD switches OFF.**

**Companies should state their preference among the two options above and provide any additional comments.**

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| **Company** | **Preferred Option (1,2)** | **Further comments (if necessary)** |
| NEC | Option 2 | We are not sure how to determine/configure a proper wake-up timer? And if the proactively reconnect is not enforced, then upon timer expiring, NCR-Fwd will still switch OFF. Therefore, we prefer to go with Option 2. |
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## 3.5 Configuring side control via RRCRelease

Vivo’s paper R2-2300900 presented different options for how an NCR-MT in RRC\_INACTIVE could be configured with SCI. This prompted a debate in the online discussion over whether an NCR-MT should be able to receive side control information in an RRCRelease message. For the case of NCR-MT being released to RRC\_INACTIVE, this would apply to the case of RRCRelease with suspension.

**Companies are asked to provide their preference between the following two options.**

* **Option 1: An NCR-MT may be configured with new SCI when released to RRC\_INACTIVE (i.e., new SCI may be provided in an RRCRelease with suspension).**
* **Option 2: An NCR-MT may only be configured with new SCI through RRCReconfiguration.**

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| **Company** | **Preferred Option (1,2)** | **Further comments (if necessary)** |
| NEC | Option 2 | There is no motivation to do Option 1. In our understanding, RRC\_Inactive mode is mainly used for energy saving when the SCI does not need to be updated frequently, otherwise the NCR-MT should be in RRC\_Connected mode. Therefore, we think option 2 is sufficient. |
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## 3.6 Explicit NCR-Fwd OFF indication provided to NCR-MT

Some of the comments and papers have been using the terminology “ON-OFF configuration”. Our (Nokia) understanding, based on agreements in RAN1, is that ON-OFF indication is implicitly indicated based on the beam configuration:

*For FR2, the “ON” state of NCR-Fwd is indicated:*

*Alt-2: Implicit indication via the beam indication (i.e., if there is beam indication, the NCR is assumed to be ON over the indicated time domain resource associated with corresponding beam(s))*

*For FR1, the “ON” state of NCR-Fwd is indicated:*

*Alt-2: Indication via the beam indication (i.e., if there is beam indication, the NCR is assumed to be ON over the indicated time domain resource associated with corresponding beam(s))*

* *When there is only one beam, the sole purpose of the beam indication is for indicating “ON” state of NCR-Fwd*

In other words, it may not be necessary to explicitly indicate the NCR-Fwd to turn OFF since there would already be a way to provide NCR-MT with the beam configuration. We wonder however, based on today’s discussion if other companies have different interpretations and that an explicit indication is required to turn the NCR-Fwd OFF.

(Note: Whether the OFF indication can be provided in RRCRelease might also depend on the previous proposal related to receiving side control with RRCRelease.)

**Companies are asked to provide their preference between the following two options.**

* **Option 1: To turn the NCR-Fwd OFF, an explicit OFF indication is provided by RRC signalling.**
* **Option 2: To turn the NCR-Fwd OFF, the NCR-Fwd beam configuration framework is re-used.**

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| **Company** | **Preferred Option (1,2)** | **Further comments (if necessary)** |
| NEC | Option 2 | Since RAN1#110 agreed that “The NCR-Fwd is always expected to be “OFF” unless otherwise explicitly or implicitly indicated by gNB”, we don’t see there is a need to have an explicit OFF indication. The NCR-Fwd On/OFF can be controlled via the NCR-Fwd beam configuration framework.  |
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# 4 Summary

[This section will be updated once company views have been collected.]

# Annex: Relevant RAN1#111 agreements and IEs proposed by Nokia and ZTE

## A.1 Periodic beam configuration

For periodic beam indications, RAN1 agreed to the following:

**Agreement**

*For each periodic beam indication for access link, one RRC signalling is used with the information defined by the following:*

*Option-2:*

* *A list of X(*$1\leq X\leq X\_{max}$*) forwarding resource, each is defined as {Beam index, time resource}*
* *FFS: The value of* $X\_{max}$

*Each time resource is defined by {Starting slot defined as the slot offset in one period, starting symbol defined by symbol offset within the slot, duration defined by the number of symbols} with dedicated field.*

* *The periodicity is configured as part of the RRC signaling for periodic beam indication*
	+ *The same periodicity is assumed for all time resource(s) in one periodic beam indication.*
* *The reference SCS is configured as part of the RRC signaling for periodic beam indication*
	+ *The same reference SCS is assumed for all time resource(s) in one periodic beam indication.*

#### – *PeriodicBeamConfig-NCR (IE proposed by Nokia)*

The IE PeriodicBeamConfig-NCR determines the NCR-specific periodic beam indication configuration for the NCR-Fwd access link.

*PeriodicBeamConfig-NCR information element*

-- ASN1START

-- TAG-PERIODICBEAMCONFIG-NCR-START

PeriodicBeamConfig-NCR ::= SEQUENCE {

 periodicBeamConfigList SEQUENCE (SIZE(1..maxPeriodicBeamConfigs) OF PeriodicBeamConfig

}

PeriodicBeamConfig ::= SEQUENCE {

 periodicBeamConfigIndex INTEGER (0..maxPeriodicBeamConfigs-1),

 referenceSCS SubcarrierSpacing,

 periodicity ENUMERATED {periodicity1, periodicity2,..,periodicityMax},

 forwardingResourceList SEQUENCE (SIZE(1..maxFwdResourcesNCR)) OF ForwardingResource

}

ForwardingResource ::= SEQUENCE {

 beamIndex INTEGER (0..maxNrofBeams-1),

 timeResource SEQUENCE {

 slotOffset INTEGER (0..maxNrofSlots-1),

 symbolOffset INTEGER (0..maxNrofSymbols-1),

 durationSymbols INTEGER (1..maxNrofSymbols)

 }

}

-- TAG-PERIODICBEAMCONFIG-NCR-STOP

-- ASN1STOP

*– NCR-PeriodicFwdResourceSet (IE proposed by ZTE)*

The IE *NCR-PeriodicFwdResourceSet* is used to configure a list of periodic forwarding resources for NCR-Fwd access link.

***NCR-PeriodicFwdResourceSet* information element**

-- ASN1START

-- TAG-NCR-PERIODICFWDRESOURCESET-START

NCR-PeriodicFwdResourceSet-r18 ::= SEQUENCE {

 ncr-periodicFwdResourceSetId-r18 NCR-PeriodicFwdResourceSetId-r18

 ncr-periodicFwdResourceToAdddModList-r18 SEQUENCE (SIZE (1..maxNrofPeriodicFwdResource-r18)) OF NCR-PeriodicFwdResource-r18 OPTIONAL, -- Need N

 ncr-periodicFwdResourceToRemoveList-r18 SEQUENCE (SIZE (1..maxNrofPeriodicFwdResource-r18)) OF NCR-PeriodicFwdResourceId-r18 OPTIONAL, -- Need N

 periodicity-r18 ENUMERATED {ffs},

 referenceSCS-r18 SubcarrierSpacing,

 ...

}

NCR-PeriodicFwdResource-r18 ::= SEQUENCE {

 ncr-periodicFwdResourceId-r18 NCR-PeriodicwdResourceId-r18

 beamIndex-r18 INTEGER (0..ffs)

 TimeResource-r18 ::= SEQUENCE {

 slotOffset-r18 INTEGER (0..ffs),

 symbolOffset-r18 INTEGER (0..maxNrofSymbols-1),

 durationInSymbols-r18 INTEGER (0..ffs)

 }

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}

-- TAG-NCR-PERIODICFWDRESOURCESET-STOP

-- ASN1STOP

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| ***NCR-PeriodicFwdResourceSet field descriptions*** |
| ***durationInSymbols***Indicates the time duration in number of symbols. |
| ***beamIndex***Indicates logical beam index for NCR-Fwd access link. NCR-Fwd is assumed to be ON over the indicated time domain resource if there is beam indication. |
| ***ncr-PeriodicFwdResourceSet***Each periodic forwarding configuration includes a list of periodic forwarding resource, a common periodicity and a common reference SCS |
| ***ncr-PeriodicFwdResourceToAdddModList***List of periodic forwarding resources to add and/or modify. |
| ***ncr-PeriodicFwdResourceToRemoveList***List of periodic forwarding resources to remove. |
| ***ncr-PeriodicFwdResource***Indicates the periodic forwarding resource. |
| ***periodicity***Indicates the periodicity for the list of forwarding resource in slot |
| ***referenceSCS***Indicates the reference subcarrier spacing for all the time resource in the list |
| ***slotOffset***Indicates slot offset in one period. |
| ***symbolOffset***Indicates symbol offset in one slot. |

– *NCR-PeriodicFwdResourceSetId (IE proposed by ZTE)*

The IE *NCR-PeriodicFwdResourceSetId* is used to identify one *NCR-PeriodicFwdResourceSet*.

***NCR-PeriodicFwdResourceSetId* information element**

-- ASN1START

-- TAG-NCR-PERIODICFWDRESOURCESETID-START

NCR-PeriodicFwdResourceSetId-r18 ::= INTEGER (1..maxNrofPeriodicFwdResourceSet-r18)

-- TAG-NCR-PERIODICFWDRESOURCESETID-STOP

-- ASN1STOP

*– NCR-PeriodicFwdResourceId (IE proposed by ZTE)*

The IE *NCR-PeriodicFwdResourceId* is used to identify one *NCR-PeriodicFwdResource.*

***NCR-PeriodicFwdResourceId* information element**

-- ASN1START

-- TAG-NCR-PERIODICFWDRESOURCEID-START

NCR-PeriodicFwdResourceId-r18 ::= INTEGER (1..maxNrofPeriodicFwdResource-r18)

-- TAG-NCR-PERIODICFWDRESOURCEID-STOP

-- ASN1STOP

## A.2 Aperiodic beam configuration

For aperiodic beam indications, RAN1 agreed to the following:

**Agreement**

*For each aperiodic beam indication for access link, one DCI is used with the information defined by*

*Option-1:*

* $L\_{max}$ *fields are used to indicate the beam information and each field refers to one beam index ;*
	+ *Note: The bitwidth of this field is determined by the number of beams used for access link.*
* $T\_{max}$ *fields to indicate the time resource;*
	+ *Note: A list of time resource is pre-defined by RRC signalling. The bitwidth of this field for time resource indication is determined by the length of list.*
* *FFS: The value of* $T\_{max}$
	+ *Down-select between* $T\_{max}=1 $*or* $T\_{max}=L\_{max}$*.*
* *FFS: How to define the association between time indication and beam indication*

*Each time resource is defined by {Starting slot defined as the slot offset, starting symbol defined by symbol offset within the slot, duration defined by the number of symbols} with dedicated field.*

#### – *AperiodicBeamConfig-NCR (IE proposed by Nokia)*

The IE *AperiodicBeamConfig-NCR* determines the NCR-specific aperiodic beam indication configuration for the NCR-Fwd access link.

*AperiodicBeamConfig-NCR information element*

-- ASN1START

-- TAG-APERIODICBEAMCONFIG-NCR-START

AperiodicBeamConfig-NCR ::= SEQUENCE {

 aperiodicTimeResourceList SEQUENCE (SIZE (1..maxAperiodicTimeResourcesNCR)) OF AperiodicTimeResourceConfig

}

AperiodicTimeResourceConfig SEQUENCE {

 aperiodicTimeResourceIndex INTEGER (0..maxAperiodicTimeResourcesNCR-1)

 timeResource ::= SEQUENCE {

 slotOffset INTEGER (0..maxNrofSlots-1),

 symbolOffset INTEGER (0..maxNrofSymbols-1),

 durationSymbols INTEGER (1..maxNrofSymbols)

 }

}

-- TAG-APERIODICBEAMCONFIG-NCR-STOP

-- ASN1STOP

– *NCR-AperiodicFwdConfig (IE proposed by ZTE)*

The IE *NCR-AperiodicFwdConfig* is used to configure a list of aperiodic forwarding time resources for NCR-Fwd access link.

***NCR-AperiodicFwdConfig* information element**

-- ASN1START

-- TAG-NCR-APEIODICFWDCONFIG-START

NCR-AperiodicFwdConfig-r18 ::= SEQUENCE {

ncr-aperiodicFwdTimeResourceToAddModList-r18 SEQUENCE (SIZE (1..maxNrofAperiodicFwdTimeResource-r18)) OF NCR-AperiodicFwdTimeResource-r18 OPTIONAL, -- Need N

ncr-aperiodicFwdTimeResourceToRemoveList-r18 SEQUENCE (SIZE (1..maxNrofAperiodicFwdTimeResource-r18)) OF NCR-AperiodicFwdTimeResourceId-r18 OPTIONAL, -- Need N

 ...

}

NCR-AperiodicFwdTimeResource-r18 ::= SEQUENCE {

 ncr-aperiodicFwdTimeResourceId-r18 NCR-AperiodicFwdTimeResourceId-r18

 slotOffsetAperiodic-r18 INTEGER (0..ffs)

 symbolOffset-r18 INTEGER (0..maxNrofSymbols-1)

 durationInSymbols-r18 INTEGER (1..ffs)

 ...

}

-- TAG-NCR-APEIODICFWDCONFIG-STOP

-- ASN1STOP

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| ***NCR-AperiodicFwdConfig field descriptions*** |
| ***durationInSymbols***Indicates the time duration in number of symbols. |
| ***ncr-AperiodicFwdTimeResourceToAddModList***List of aperiodic forwarding time resources to add and/or modify. |
| ***ncr-AperiodicFwdTimeResourceToRemoveList***List of aperiodic forwarding time resources to remove. |
| ***slotOffsetAperiodic***Indicates slot offset between the slot when NCR receives the side control information and the start slot of aperiodic time resource. |
| ***symbolOffset***Indicates symbol offset in one slot. |

– *NCR-AperiodicFwdTimeResourceId (IE proposed by ZTE)*

The IE *NCR-AperiodicFwdTimeResourceId* is used to identify one *NCR-AperiodicFwdTimeResource*.

***NCR-AperiodicFwdTimeResourceId* information element**

-- ASN1START

-- TAG-NCR-APERIODICFWDTIMERESOURCEID-START

NCR-AperiodicFwdTimeResourceId-r18 ::= INTEGER (1..maxNrofAperiodicFwdTimeResource-r18)

-- TAG-NCR-APERIODICFWDTIMERESOURCEID-STOP

-- ASN1STOP