**3GPP TSG-RAN WG2 Meeting #123bisR2-23xxxxx**

**Xiamen, China, 9th – 13th Oct 2023**

Agenda Item: 7.17.2

Source: vivo

Title: Report of [Post123][234][MUSIM] UE preferred frequency (vivo)

Document for: Discussion and Decision

# Introduction

This is the report of the following email discussion:

* [Post123][234][MUSIM] UE preferred frequency (vivo)

Scope: Discuss (for the proactive approach) whether/how UE can indicate frequency that it would prefer to use, and how would that be signalled. Can include Stage-3 TP.

Intended outcome: Email discussion report

Deadline: Long

This email discussion is split in two phases:

* **Phase 1**: Companies are invited to provide feedback on the email discussion questionnaire by **Friday Sept 15th, 10:00UTC**.
* **Phase 2**: Rapporteur submits report and potentially Stage-3 TP. Companies are further invited to provide feedback on the email discussion report and TP by **Thursday Sept 28th, 10:00UTC**.

**Contact person for each person participating company.**

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| --- | --- | --- |
| **Company** | **Contact Name** | **Email** |
| Ericsson | Håkan Palm | hakan.l.palm@ericsson.com |
| ZTE | Wenting Li | Li.wenting@zte.com.cn |
| Nokia | Srinivasan Selvaganapathy | Srinivasan.selvaganapathy@nokia.com |

# Discussion

## UE reporting on proactive capability restriction

## Whether UE needs to report preferred frequencies

According to the below agreement made in RAN2#121bis [1], to avoid potential network configuration exceeding the temporary UE capability, RAN2 agreed to introduce proactive approach to allow UE to report its temporary capability restriction in NWA due to MUSIM operation in NW B.

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| * Consider “proactive” approach (wherein the UE can request capability restrictions which can be independent of current RRC configuration if allowed by the NW) to MUSIM capability restrictions in addition to the reactive approach (which has been agreed previously). Such a mechanism shall still be under NW control, i.e. it is up to network whether to allow such signalling. FFS on the details – should aim for a common framework for the reactive and proactive approach. FFS on UE capabilities |

In RAN2#123 [2], RAN2 has agreed that UE can indicate that some frequencies are impacted by the network B so that they are forbidden because of collision.

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| * 1: The UE can indicate that some frequencies (e.g. frequency ranges, bands or BCs) are impacted by NW B so that they are:   1) forbidden because of collision  2) having restricted (lower) capabilities (e.g. with lower MIMO layer). |

That is to say, the UE can also indicate the frequencies that cannot be temporarily supported in proactive way, if proactive reporting is allowed by the network. With this, the network can know which frequencies it can configure to the UE for handover or SCell change subsequently. In other word, when UE reported which of its supported capabilities are temporary restricted, the network can implicitly know which of UE frequencies are not restricted and can be used to configured UE with. Therefore, the rapporteur does not see the motivation of introducing the reporting of UE preferred frequencies in addition to the reporting of impacted frequencies in the proactive approach. Thus, the rapporteur invites the companies to provide their view for the below question.

**Q1: For proactive UE temporary capability reporting, do companies agree that UE reporting of its impacted frequencies is sufficient and there is no need for UE to additionally report preferred frequencies?**

1. **Yes**
2. **No (Please clarify for which scenario(s))**

|  |  |  |
| --- | --- | --- |
| **Company** | **Answers (Yes/No)** | **Comments** |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Nokia | Yes..but | The frequencies indicated here are the frequencies that NW should avoid in the configuration. If this is right, UE report preference-for-frequencies to avoid to be forbidden. |

**Summary:**

TBD

## How to indicate the impacted frequencies

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| **Contributions** | **Related proposals** |
| Huawei  [R2-2307454] | Proposal 6: Consider the following signaling solutions for proactive approach:  1) The UE indicates the affected frequency band(s) and the corresponding band combination(BC) based on the candidate frequency band/band combinations configured by the NW;  2) The UE indicates that a frequency is not supported to be configured as SCell/SCG based on the measurement purpose of that frequency configured by the NW. |
| vivo  [R2-2307691] | Proposal 1: A network configured band filtering is only applied for proactive approach. For proactively reporting DC/CA capability change and band conflict issue, if a band filtering is configured, the UE is only allowed to report constrained BCs or constrained bands in a BC or constrained FeatureSetDownlinkPerCC-Id(s) in a BC which has a band included in the band filtering. |
| CT  [R2-2308758] | Proposal 6: Compared to explicit request in reactive way, proactive way favours implicit request. In proactive case, UE can indicate a list of constrained/affected band combinations/bands(e.g., band combinations/bands affected by camping frequency in NW B, band combinations/bands may affected in the future) to NW A via UAI. |
| Samsung  [R2-2307598] | Proposal 5: For Rel-18 MUSIM dual active operation, to address MUSIM band conflict, UE indicates its constrained/affected UL/DL bands or band combinations based on the existing UE configuration, to the NW A in the UAI signalling. |
| Nokia  [R2-2307776] | Proposal 4: The frequency/band information for reporting band conflict is controlled by NW configuration. |
| OPPO  [R2-2307161] | Proposal2: If “reactive” method is enabled, UE can at least explicitly request specific serving cells and/or serving cell group to be released for Rel-18 MUSIM purpose; while if “proactive” method is enabled, UE can at least explicitly report the potential impacted band info to NWA, in which the reported band is under NW A control. |
| Intel  [R2-2308089] | Proposal #1: Adopt a solution for signalling MUSIM proactive capability restriction similar to the one agreed for IDC, where UE can provide capability restriction using UE assistance information on (including non-serving) frequencies that are requested (e.g., frequencies that are of interest) by the network. |
| Ericsson  [R2-2308941] | [Proposal 1: Reuse the principle from IDC feature to allow the UE to indicate NR co-existence problems at Dual Rx//Tx MUSIM operation.](file:///D:\Users\11065669\AppData\Local\Temp\Temp1_R2-2308257.zip\R2-2308257%20Discussion%20on%20frequencies%20restriction.docx#_Toc142584207) |

According to the above companies’ contributions, for indicating the impacted frequencies proactively, there are several options that can be categorized as follows:

* **Option 1:** UE indicates impacted BCs.
* **Option 2:** UE indicates impacted bands in a BC.
* **Option 3:** UE indicates impacted CCs in a band in a BC (e.g., FeatureSetDownlinkPerCC-Id(s) for a BC).
* **Option 4:** UE indicates impacted frequencies by using ARFCN, similar to IDC feature.

Based on the above information, the companies are invited to provide their view for the below question.

**Q2: Which of the option(s) do you prefer for UE to indicate the impacted frequencies?**

1. **UE indicates impacted BCs.**
2. **UE indicates impacted bands in a BC.**
3. **UE indicates impacted CCs in a band in a BC (e.g., FeatureSetDownlinkPerCC-Id(s) for a BC).**
4. **UE indicates impacted frequencies by using ARFCN, similar to IDC feature.**
5. **Other (Please specify)**

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| --- | --- | --- |
| **Company** | **Options (a/b/c/d/e)** | **Comments** |
| Ericsson | d | Reusing the same principles for UE to indicate impacted frequencies similar to IDC principle would mean less implementation effort for UE and gNB, since already included in UAI framework (see Rel-18 endorsed CR in [R2-2306925](http://www.3gpp.org/ftp//tsg_ran/WG2_RL2/TSGR2_122/Docs//R2-2306925.zip), the FDM-Assistance part with center frequency and bandwidth). We assume the gNB can filter the frequencies used in the local network deployment with the impacted frequencies indicated by UE. With Option “d”, it is also possible for UE to indicate problems for only parts of a frequency band.  RAN2 concluded in earlier WIs (for other features) that temporary restrictions in UAI framework should not refer to or link to the fields indicated in UE capabilities.  Indicating indexes to BCs/Band in BC/FSPCC tend to be complex both for UE to compute and for gNb to analyze, and there is risk for errors.  Option “a” does not offer a complete solution, since UE in supportedBandCapabilites indicates only “parent” BCs, and the UE supports the fallback BCs without explicit signalling of the fallback BCs.  Option “b” would be similar to option “d”, but cannot indicate problems for only parts of a frequency band.  With Option “c” we assume the intention is to e.g. indicate restricted MIMO capabilities. Existing “max Mimo Layers” per FRx and UL/DL in UAI framework offers sufficient granularity also for the Rel-18 MUSIM solution. |
| ZTE | c (can accept b) | We think per BC based solution (including option a/b/c) are quite simple, and which is similar to the existing mechanism of the MN-SN coordination.  The UE indicates which BCs are forbidden, which BCs are affected. For the affected BCs, the UE can further report the reduced MIMO layer per CC.(or per band or per BC as the option b/a)  About the comments from Ericsson on the option a, we think the UE can indicate the allowed band entries for the BC at network A (similar to the allowed band entry in the MN-SN coordination)  For the option d, from the frequency range aspect, it’s similar to the IDC. But the difference is that in the IDC, only frequency range reporting required. For the MUSIM, we have agreed that the UE also need to report the affected capabilities e.g. MIMO layer, then to achieve the similar granularity as the BC based option (including option a/b/c), it would also require the UE to report the different MIMO layer restriction on the different frequency ranges and/or the different frequency range combinations. At the network side, the NW may also needs to determine which BCs are still available and which BCs would be affected first based on these reported frequency range information.  So we think reusing the current BC concept, and the BC index would reduce the signaling overhead and also reduce the network processing complexity. |
| Nokia | 1. And a or b) | If the conflict is due to the complete band UE need not list all the frequencies and band.. This anyhow can be achieved by giving band with empty ARFCN in the approach d). |

**Summary:**

TBD

Furthermore, to limit the reporting size, several companies think it is preferred that the network also provides some candidate frequency/band information that the network is interested in. Or some companies may think the UE should be allowed to report the impacted information for all supported frequencies/bands. Thus, according to the companies’ views, the following options can be considered:

- **Option 1:** The network can explicitly configure a frequency/band filter list (e.g. frequencies/bands that the network is interested in) to control the UE to report the impacted frequencies. If the list is not configured, the UE is allowed to report the impacted information for all supported frequencies.

- **Option 2:** The network can indicate the UE to only report the impacted frequencies based on the corresponding measurement configuration and the corresponding purpose of the measurement. If this is not indicated, the UE is allowed to report the impacted information for all supported frequencies.

- **Option 3:** The network does not provide any candidate frequency information, and the UE is always allowed to report the impacted information for all supported frequencies.

Companies are invited to provide their view on the below question.

**Q3: Which of the following filtering options do you prefer the UE to be provided to report the impacted frequencies information?**

1. **UE is allowed to only report the impacted frequencies based on a frequency/band filter list (e.g. frequencies/bands configured by the network.**
2. **UE is allowed to only report the impacted frequencies based on the corresponding measurement configuration and the corresponding purpose of the measurement indicated by the network.**
3. **None, i.e., UE is always allowed to report the impacted information for all supported frequencies**
4. **Other (Please specify).**

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| **Company** | **Options**  **(a/b/c/d)** | **Comments** |
| Ericsson | a | UE should report impacted frequencies based on a Candidate Frequency list, similar to IDC feature. |
| ZTE | d | We think we can further discuss this when the reporting detail is clear |
| Nokia | A | NW knows its potential operating frequencies and band combinations for CA and DC. So NW configuration of filter for specific band/frequencies. It can provide the filter for DC and CA. |

**Summary:**

TBD

## How to signal for proactive approach

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| **Contributions** | **Related proposals** |
| Nokia  [R2-2307774] | Proposal 7: For the proactive approach, UE indicates its state of reduced capability in UAI to inform the NW about the reduced capability at UE due to MUSIM operation.  Proposal 8: Number of proactive UAI, Triggering condition for UAI can be configured by NW.  Proposal 9: Pro-active temporary capability restriction triggering on the reception of RRC-Reconfiguration is supported. |
| Intel  [R2-2308089] | Proposal #1: Adopt a solution for signalling MUSIM proactive capability restriction similar to the one agreed for IDC, where UE can provide capability restriction using UE assistance information on (including non-serving) frequencies that are requested (e.g., frequencies that are of interest) by the network.  Proposal #2: Same signalling mechanism as for proactive approach (and IDC) using UE assistance information is adopted also for reactive approach. MAC CE based solution is not considered. |
| Samsung  [R2-2308498] | Proposal 5: UAI based framework can be used for proactive reporting of temporary UE capability restriction. |
| CT  [R2-2308758] | Proposal 1: It is not necessary to explicitly distinguish reactive and proactive approach in specifications, but may include different IEs in UAI. Both reactive and proactive UE capabilities restrictions can be included in one UAI. |
| LG  [R2-2308787] | Proposal 3： RAN2 uses the UAI procedure as a common framework for both the reactive and proactive approaches. |
| Apple  [R2-2307873] | Proposal 1: UE can signal the set of conflicting bands via UE ASSISTANCE INFORMATION (UAI) framework, using which both UE and NW can derive the set of conflicting band combinations to help in band conflict mitigation. |

Several companies mentioned that, from a framework point of view, it makes sense to keep UE reporting signaling for both reactive and proactive approaches, i.e, UE can also use UAI for proactive reporting. So, the companies are invited to provide their view the below question.

**Q4: Do companies agree that the UAI based signalling is also used for proactive reporting of temporary UE capability restriction?**

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| **Company** | **Answers**  **(Yes/No)** | **Comments** |
| Ericsson | Yes | We understand both proactive and reactive signalling can use UAI. |
| ZTE | Yes | Same view as Ericsson |
| Nokia | Yes.But | Use of UAI for both cases is agreed in our understanding. But we intend to have two fields in UAI for reactive case : Like list of secondary-cells to release or SCG-release. For pro-active case: UAI will indicate preference for frequency/BC to be avoided or preferred gaps or preferred MIMO layers.  Whether these multiple fields of UAI can be send optionally in both reactive and pro-active OR some fields are only applicable for reactive or proactive can be discussed. |

**Summary:**

TBD

## NW configuration for proactive capability restriction

## How to enable proactive reporting configurations

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| **Contributions** | **Related proposals** |
| OPPO  [R2-2307161] | Proposal3: “proactive” and “reactive” share a common toggle indicator (called field1), which is used to enable/disable the UE temporary capability restriction reporting behavior, while for “proactive” method, an extra parameter (called field2) is defined to list the concerned band(s) from NW A for MUSIM operation.  Proposal4: If field1 is not present, neither “proactive” and “reactive” method is supported, which means UE temporary capability restriction reporting behavior is disabled. If field1 is present while field2 is not present, only “reactive” method is supported. If both field1 and field2 are present, only “proactive” method is supported. |
| vivo  [R2-2307691] | Proposal 8: Introduce separate network enable configurations for the “proactive” and “reactive” approaches. |
| Qualcomm  [R2-2308791] | Proposal 5: RAN2 should discuss whether “proactive” approach is an additional/optional behavior for UE capability restriction or is always allowed as part of dual-active MUSIM feature.  Proposal 6: “Proactive” approach is allowed based on NW configuration, similar to other UAI reporting. |

On how the network can enable proactive configuration, one view is that the proactive approach is just an enhancement for the reactive approach, which could be optionally supported by the network. Besides, from the network perspective, the network may not be interested in the proactive information in some cases. Thus, the proactive reporting and reactive reporting should be enabled separately. A different view is that the proactive approach should be always allowed as part of MUSIM capability restriction feature.

Based on the above information, the companies are invited to provide their view on the below question

**Q5: On how network enable UE temporary capability restriction configuration, do companies agree that “Proactive approach” and “Reactive approach” can be configured separately?**

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| **Company** | **Answers**  **(Yes/No)** | **Comments** |
| Ericsson | No | From UE point of view, the UE indicates reactive and proactive capability restrictions in a UAI message). So we see no need for separate configuration of the approaches, and also no need to introduce the terms in the specifications. |
| ZTE | No | Share the same view as Ericsson |
| Nokia | No | Single configuration as part of ‘Other-config’ for MUSIM-Cap-Restriction that contains parameter for ‘filter for frequency/band’. If this is set to all, then UE will report all bands. If this is set to ‘no-report’ it can disable pro-active reporting. Absence of this UE itself indicates the complete Rel-18 is disabled. In our view, reactive reporting is needed to avoid abrupt release of resource from UE autonomously so can be prioritized. Proactive may require some dynamic control depending on NW situation. Above proposal covers both options. |

**Summary:**

TBD

Moreover, an FFS issue was left in the running CR as: *whether one configuration to control all temporary capabilities update or introduce individual control for each temporary capability update*.

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| **Contributions** | **Related proposals** |
| Samsung  [R2-2308498] | Proposal 2: A single configuration is used to control all temporary capabilities. |
| ZTE  [R2-2307540] | Proposal 9: Apply one configuration to control all temporary capabilities update. |
| Vivo  [R2-2307691] | Proposal 9: Not introduce individual control for each temporarily changed capability. |

Several companies mentioned that it would be better to control all temporary capabilities using a single configuration. So, the companies are invited to provide their view on below question.

**Q6: Do companies agree that one configuration can apply to control all temporary capabilities update?**

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| **Company** | **Answers**  **(Yes/No)** | **Comments** |
| Ericsson | Yes |  |
| ZTE | Yes |  |
| Nokia | Yes |  |

**Summary:**

TBD

## Prohibit timer

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| **Contributions** | **Related proposals** |
| vivo  [R2-2307691] | Proposal 10: Prohibit timer for the signaling of UE capability changes is not supported in Rel-18 MUSIM. |
| CT  [R2-2308758] | Proposal 3: Introduce a prohibit timer for proactive capability restriction reporting to prevent the frequently UAI reporting. UAI cannot report again until the timer expiry. And it’s FFs whether the wait timer and prohibit timer can be merged into one single timer. |
| Huawei  [R2-2307454] | Proposal 8: No prohibit timer is defined for the UAI for R18 MUSIM purpose. |

From companies’ contributions, companies that support to introduce a prohibit timer think it can be used to prevent the UE frequently requesting capability change. Other companies propose not to support prohibit timer. The argument is that RRC state transition may not be so frequent, and the UE may not request capability change frequently. Even if the UE requests capability change frequently, the UE should also be able to inform the changes to the NW A, which is beneficial to achieve a better user experience. Thus, the companies are invited to indicate their preference on whether to introduce a prohibit timer for proactive capability restriction reporting.

**Q7: Do companies agree to introduce a prohibit timer for proactive capability restriction reporting?**

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| --- | --- | --- |
| **Company** | **Answers**  **(Yes/No)** | **Comments** |
| Ericsson | Yes | In existing UAI framework, the prohibit timer prevents the UE from repeating the UAI message with the different content/preferences from a previous message. The timer can be also be set to 0. We see no reason to deviate from this for proactive capability restriction reporting. |
| ZTE | FFS | The procedure for both proactive case and reactive case is not clear now, e.g. whether and how the network response the UE.  We think to adopt the common framework for the proactive and reactive case, the UE shall only trigger the UAI reporting when the UE need to modify the current configuration, e.g. when the UE report the UAI, the UE can report some “proactive” assistance informations that maybe used later together with the assistance information that can solve the current issues.  For example, the UE is working on the band 1 with 2 cc with NWA, then because of the NWB, the UE need to reduce to only single cc on the band1, the UE can indicate the release one scell together with some other potential frequency info (for the proactive purpose).  By this trigger condition restriction, the UE would need to always receive the network response within a waiting timer. Then RAN2 can focus on the UE action when the waiting timer expiry. We don’t need to discuss more about the proactive procedure separately (especially considering that only 2 meetings left)  But we don’t have strong view on this issue, we are open to see other companies’ view. |
| Nokia | See comments | Not critical if the Network can control the proactive reporting via separate flag. NW can disable depending on the actual number of events. But UE is expected not to repeat the same preference unless until the configuration is changed that requires different preference. This behavior can be captured. |

**Summary:**

TBD

We propose to include the following question.

When the secondary-cells or secondary cell groups to be released at NW-A to start RRC connection at NW-B, If the UE does not indicate that the release is due to actual CC/DC restriction or BC, it may lead to release of secondary cells where the conflict can be resolved at NW by NW adding another secondary-cell instead of released secondary-cells for CA scenario. There can be different options to resolve this problem for CA and DC.

Q : Views from companies on including additional information about impacted BC/Frequency in UAI for reactive approach (in addition to the agreed information for reactive approach).

# Conclusion

In this paper, the following proposal are given:

1. TBD

# References

[1] R2#121bis meeting minutes.

[2] R2#123 meeting minutes.

[[3] R2-2307454](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307454.zip) Discussion on proactive and reactive approaches Huawei, HiSilicon

[4] [R2-2307691](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307691.zip) Procedures for MUSIM temporary capability restriction vivo

[5] [R2-2308758](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2308758.zip) Procedure for MUSIM temporary capability restriction China Telecom

[6] [R2-2307598](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307598.zip) Allowed MUSIM temporary capability restrictions Samsung R&D Institute India

[[7] R2-2307776](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307776.zip) Analysis on capability restriction for Dual TX/RX MUSIM Operation Nokia, Nokia Shanghai Bell

[[8] R2-2307161](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307161.zip) Discussion on proactive and reactive approaches OPPO

[[9] R2-2308089](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2308089.zip) Common framework for proactive and reactive approach for MUSIM Intel Corporation

[10] [R2-2308257](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2308257.zip) Discussion on frequencies restriction for MUSIM UE Ericsson discussion

[11] [R2-2307774](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307774.zip) Basic signalling procedure for reactive and proactive approach for Dual TX/TX MUSIIM operation Nokia, Nokia Shanghai Bell

[12] [R2-2308498](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2308498.zip) Discussion on temporary capability restriction Samsung

[13] [R2-2308787](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2308787.zip) General procedure for Both Proactive and Reactive cases LG Electronics

[14] [R2-2307873](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307873.zip) Allowed MUSIM temporary capability restriction for band conflict mitigation Apple

[15] [R2-2308791](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2308791.zip) Procedures for Dual-Active MUSIM Qualcomm Incorporated

[16] [R2-2307540](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123/Docs/R2-2307540.zip) Consideration on the Temporary Capability Reporting ZTE Corporation, Sanechips