

Agenda Item: 14.1
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Title: Proposed Introduction of Radio failure detection in lur/lub user plane protocols
Document for: Discussion

1.Introduction

While a UE is in communication using DCH, failure in radio links may happen. Currently, the process how the failure in all the radio links in the active set is detected has not been fully specified. This contribution discusses and proposes the process, and proposes to introduce a new control information for the lur/lub UP protocol control frame.

2.Discussion

2.1 Detection of the failure

The failure in the radio segment has to be judged based on the condition of all the radio links in the active set. While a UE is in the soft-handover state, each of the Node Bs handling the radio links may detect out-of-synchronisation of the radio link frequently because of the transmission power control in the UL. However, as far as any of the radio links is in synchronisation, the quality of the radio segment as a whole can be fulfilled.

Considering the above requirement, the failure has to be detected in the SRNC taking into account the status of all the radio links. Only the simultaneous out-of-synchronisation in the all radio links in the active set leads to the detection of the failure. In addition, the judgement of the failure should be made after a certain period of continuous out-of-synchronisation in all the radio links.

As a summary, the failure in the radio segment should be:

- judged in SRNC taking into account the condition of all the radio links in the active set and
- decided after a certain period of continuous out-of-synchronisation.

2.2 Required capabilities

To enable the detection of the failure in SRNC, the following capabilities need to be introduced.

- A. Each Node B involved in the active set needs to be able to indicate its out-of-synchronisation state to SRNC.
- B. SRNC needs to be able to detect the simultaneous out-of-synchronisation in the radio links.
- C. SRNC needs to be able to detect the continuity of the failure condition.

2.3 Solution

2.3.1 Reporting by Node B

As the method of out-of-sync indication by Node Bs, the following alternatives can be considered.

- Out-band reporting (i.e., NBAP signaling)
- In-band reporting (i.e., lur/lub UP protocol)

However, considering the following requirements, in-band reporting should be used.

- **Real-time reporting:** The reporting should be in real-time since the SRNC needs to know whether the out-of-sync is happening simultaneously in the active set or not. In-band reporting is appropriate for such a real-time reporting.

- **Periodical reporting:** The reporting should be made frequently (e.g., for every radio frame) to indicate the continuity of the situation since the condition can change very frequently because of the fast transmission power control. In-band reporting involves less overhead.

Applying the in-band reporting (Iur/Iub UP protocol), the following alternatives can be considered.

- Data frame, using the "Quality Estimate" information element
- Control frame, using a new control information indicating the out-of-sync state

Control frame with a new control information should be used for the following reason. Data frames are basically generated and handled once in the interleaving period in both transmitting and receiving side. The interleaving period is of several radio frames in certain radio bearers and different depending on the type of the service. However, the reporting period should be able to be set short (e.g., for every radio frame) and independent of the type of service being provided. Using a control frame, the reporting frequency in the transmitting side and the handling frequency in the receiving side can be set independently of the type of service. Once a Node B detects out-of-sync state, it can be reported immediately.

2.3.2 Detection of the failure in SRNC

Detection of the failure should be made in DHO in SRNC as follows.

- Receiving the out-of-sync indication, the DHO checks whether it received the same indication for the same CFN from all the Node Bs in the active set.
- If the indication has been made by all the Node Bs, DHO counts up a counter for the failure detection.
- If the same indication is made by all the Node Bs again in the next indication timing, DHO counts up the counter again. However, if a data frame is received from any of the Node Bs instead of the out-of sync indication or if neither data frame nor control frame is received from any of the Node Bs, the counter should be reset. (In normal mode operation, this means a transport error in which a data frame might be transmitted. In silent mode, this means either the transport error or no reception of data in a synchronised radio frame. In both cases, the counter should be reset to prevent incorrect detection of failure.)
- If the DHO detects that the counter value reached a certain threshold value, it detects the failure.

Once the failure is detected by the DHO, SRNC releases all the radio links in the active set.

3. Proposal

Based on the above discussion, the following actions are proposed.

3.1 Proposed new text for Section 7.2, TS 25.427

The following new control information for Iur/Iub UP control frame is proposed.

Out-of-sync indication: Out-of-sync control frames are used by Node Bs to indicate the SRNC that the radio link in the active set is out of synchronisation on the radio interface.

Table below shows the structure of the payload when control frame is used for the out-of-sync indication. This control information is sent in UL only.

NAME	Out-of-sync Indication
Parameters	CFN

3.2 Proposed new Section 8.6, TS 25.427

The following description of the procedure for the radio failure detection is proposed as a new Section 8.6.

8.6 Radio failure detection

In radio failure detection procedure, the Node Bs sends Out-of-sync Indication control frames towards SRNC. This message indicates the CFN in which the out-of-synchronisation of the radio interface has been detected in the Node Bs. Node Bs sends the Out-of-sync Indication control frames periodically while they are detecting the out-of-synchronisation condition continuously.

Upon the reception of the Out-of-sync Indication control frame, SRNC checks whether it received the same indication for the same CFN from all the Node Bs in the active set. If the indication has been made by all the

Node Bs, SRNC counts up a counter for the failure detection. If the same indication is made by all the Node Bs again in the next indication timing, SRNC counts up the counter again. However, if a data frame is received from any of the Node Bs instead of the out-of sync indication or if neither data frame nor control frame is received from any of the Node Bs, the counter should be reset. (In normal mode operation, this means a transport error in which a data frame might be transmitted. In silent mode, this means either the transport error or no reception of data in a synchronised radio frame. In both cases, the counter should be reset to prevent incorrect detection of failure.) If the SRNC detects that the counter value reached a certain threshold value, it detects the radio failure.

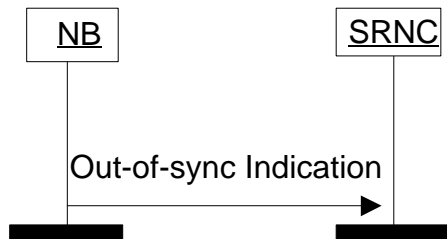


Figure X. Radio failure detection procedure.

3.3 Proposed new text for Section 8.5, TS 25.427

The following modification is proposed for the silent mode.

Silent Mode: If the RX side in *silent mode* does not receive an expected FP frame, it considers it as an empty frame. Thus the TX-side, when the RX side is known to be in *silent mode*, is not mandated to send empty FP frames. In the case of the detection of out-of-synchronisation condition in the radio interface, however, the TX-side sends a control frame with Out-of-sync indication control information to the RX-side.