3GPP TSG SA WG5 Meeting 137-e TDoc S5-213689

electronic meeting, online, 10 - 19 May 2021

**Title: LS on using SA5 Performance Measurements and Trace for centralised PCI management**

**Response to: -**

**Release: Rel-17**

**Work Item: Self-Organizing Networks (SON) for 5G networks, eSON\_5G**

**Source:** **SA5#137-e**

**To:** **RAN2**

**Cc: -**

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**Attachments:** **-**

# 1 Overall description

SA5 develops an OAM solution for centralized PCI (C-PCI) management, i.e. the discovery of PCI collisions and confusions, together with the remedy of those errors. This LS deals with discovery of PCI collisions and confusions from an OAM entity, and in particular whether existing SA5 *Performance Measurements* (PM) and existing SA5 *Subscriber and Equipment Trace* (collecting RLF reports) are sufficient to build such a solution.

As the algorithm for such a solution would be out of scope of SA5 specification, **SA5 would like RAN2 to express if the existing mechanisms in SA5 Performance Measurements and SA5 Subscriber and Equipment Trace are sufficient to build such a solution.**

Subclause 1.1 in this LS sketches on how such an algorithm can be constructed.

## 1.1 Detailed description

The purpose of this solution is to provide OAM with sufficient data to be able to discover a PCI collision or a PCI confusion. A PCI collision occurs when a gNB discovers that one of its cells has the same PCI value as one of that cell's neighbours. A PCI confusion occurs when a gNB discovers that one of its cells has two neighbours with the same PCI value.

This proposed C-PCI optimization solution consists of two steps:

1. The first step consists of finding *potential* PCI conflicts or confusions. This is done by analysing SA5 Performance Measurements of failed handovers using existing PM measurements.
2. The second step consists of collecting and analysing Radio Link Failure (RLF) messages using Trace data from cells where potential PCI conflicts or confusions occur.

Theoretically, the first step is not needed as it is only the second step that actually discovers the PCI collision or confusion. However, for practical reasons it is needed. Running the second step continually on all cells would create an excessive overhead, by OAM collecting Trace reports from all cells. The first step is needed to pinpoint the suspect cells where Trace can be initiated.

A brief overview of the second step follows:

PCI collisions and PCI confusions manifest themselves by radio link failures or handover failures. When such a failure is experienced by the UE, it assembles data from this failure and, upon re-establishment to the network, sends this data in a RLF-Report-r16 IE (see 3GPP TS 38.331 clause 6.2.2), which eventually shows up in the gNB of the source cell.

For 3GPP TS 38.331 v16.4.1, this IE looks like this (my yellow marking):

RLF-Report-r16 ::= CHOICE {

nr-RLF-Report-r16 SEQUENCE {

measResultLastServCell-r16 MeasResultRLFNR-r16,

measResultNeighCells-r16 SEQUENCE {

measResultListNR-r16 MeasResultList2NR-r16 OPTIONAL,

measResultListEUTRA-r16 MeasResultList2EUTRA-r16 OPTIONAL

} OPTIONAL,

c-RNTI-r16 RNTI-Value,

previousPCellId-r16 CHOICE {

nrPreviousCell-r16 CGI-Info-Logging-r16,

eutraPreviousCell-r16 CGI-InfoEUTRALogging

} OPTIONAL,

failedPCellId-r16 CHOICE {

nrFailedPCellId-r16 CHOICE {

cellGlobalId-r16 CGI-Info-Logging-r16,

pci-arfcn-r16 SEQUENCE {

physCellId-r16 PhysCellId,

carrierFreq-r16 ARFCN-ValueNR

}

},

eutraFailedPCellId-r16 CHOICE {

cellGlobalId-r16 CGI-InfoEUTRALogging,

pci-arfcn-r16 SEQUENCE {

physCellId-r16 EUTRA-PhysCellId,

carrierFreq-r16 ARFCN-ValueEUTRA

}

}

},

reconnectCellId-r16 CHOICE {

nrReconnectCellId-r16 CGI-Info-Logging-r16,

eutraReconnectCellId-r16 CGI-InfoEUTRALogging

} OPTIONAL,

timeUntilReconnection-16 TimeUntilReconnection-16 OPTIONAL,

reestablishmentCellId-r16 CGI-Info-Logging-r16 OPTIONAL,

timeConnFailure-r16 INTEGER (0..1023) OPTIONAL,

timeSinceFailure-r16 TimeSinceFailure-r16,

connectionFailureType-r16 ENUMERATED {rlf, hof},

rlf-Cause-r16 ENUMERATED {t310-Expiry, randomAccessProblem, rlc-MaxNumRetx,

beamFailureRecoveryFailure, lbtFailure-r16,

bh-rlfRecoveryFailure, spare2, spare1},

locationInfo-r16 LocationInfo-r16 OPTIONAL,

noSuitableCellFound-r16 ENUMERATED {true} OPTIONAL,

ra-InformationCommon-r16 RA-InformationCommon-r16 OPTIONAL,

...

},

eutra-RLF-Report-r16 SEQUENCE {

failedPCellId-EUTRA CGI-InfoEUTRALogging,

measResult-RLF-Report-EUTRA-r16 OCTET STRING,

...

}

}

A **PCI collision** typically occurs when a UE moves from the source cell (cell A) towards another cell (cell B) and where both cells use the same PCI. The UE believes it is talking to and measures on cell A, as it is using its (and cell B's) PCI. However, despite the fact that it receives strong signals from this PCI, it is unaware that the strong signal belongs to cell B. Eventually, as cell B does not communicate with the UE, the UE experiences a Radio Link Failure. The UE typically immediately re-establishes with cell B, as that was the strongest cell during the cell selection procedure. Upon re-establishment, the UE sends an RLF-Report-r16 IE to cell B, which forwards the IE to cell A. Here, the C-SON PCI algorithm can tap into the messages using Trace.

The C-SON PCI optimization algorithm analyses the RLF-Report-r16 IE and finds that both the source cell (cell A), which Cell Global Identifier (CGI) is contained in the failedPCellId-r16 IE, and the reestablishment cell, which CGI is contained in the reestablishmentCellId IE have the same PCI. Furthermore, the timeSinceFailure-r16 IE provides the time between declaring the failure and sending the RLF report at Cell-B. As this value will be very small when the UE immediately re-establish in Cell-B, the C-SON algorithm can implicitly derive that Cell-A and Cell-B should be neighbour cells. From this single message, the C-SON PCI optimization algorithm can deduce that a PCI collision has occurred.

A **PCI confusion** typically occurs when a UE, camping on a source cell (cell A), is ordered to hand over to a target cell (cell B). The handover fails, and the UE typically immediately re-establishes with another cell (cell C), the re-establishment cell, where both the target cell and the re-establishment cell use the same PCI. Upon re-establishment, the UE sends an RLF-Report-r16 IE to cell C, which forwards the IE to cell A. Here, the C-SON PCI algorithm taps into the messages using Trace.

The C-SON PCI algorithm analyses the RLF-Report-r16 IE and finds that both the target cell, which CGI is contained in the failedPCellId-r16 IE, and the reestablishment cell, which CGI is contained in the reestablishmentCellId IE have the same PCI. From this single message, the C-PCI algorithm can deduce that a PCI confusion has occurred.

# 2 Actions

**To RAN2**

**ACTION:** SA5 kindly requests RAN2 to tell SA5 whether a solution for centralized PCI management can be built using existing mechanisms in SA5 Performance Management and SA5 Subscriber and Equipment Trace.

SA5 expects an answer by SA5#139-e, 11-15 October 2021.

# 3 Dates of next TSG SA WG 5 meetings

SA5#138-e 23 - 31 August 2021 electronic meeting

SA5#139-e 11 – 15 October 2021 electronic meeting