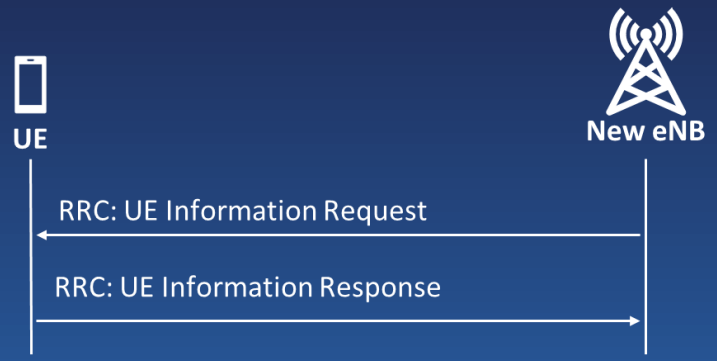


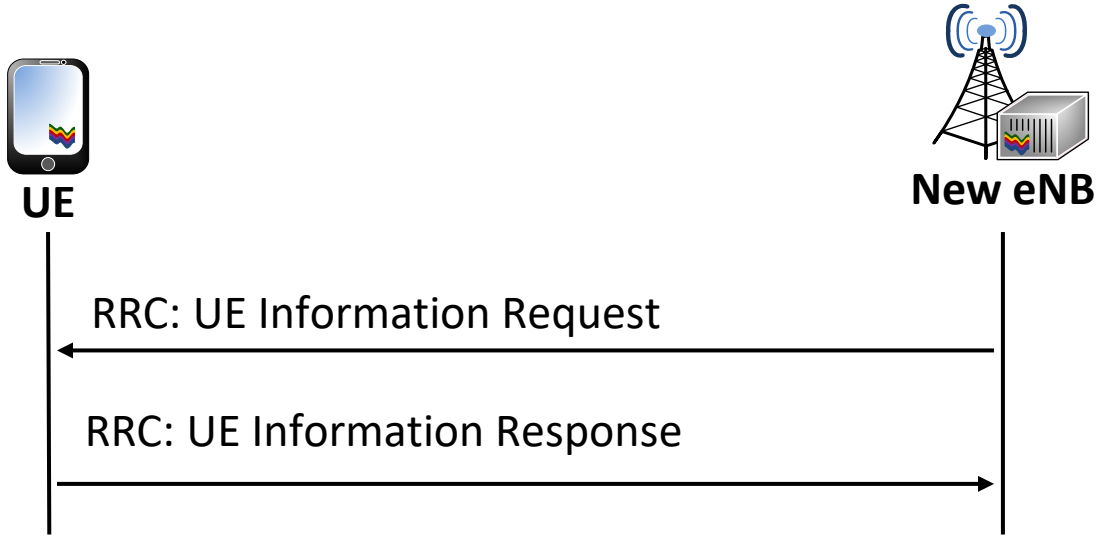
3GPP SON Series:

RACH Optimization

@3g4gUK

RACH Optimization

- The eNB continuously or periodically performs RACH optimization based on the UE feedback and knowledge of neighbouring eNB's RACH configuration
- An optimized RACH will:
  - Reduce connection time
  - Help achieve Higher Throughput
  - Improve cell coverage



RRC UE Information Request message

– *UEInformationRequest*

The *UEInformationRequest* is the command used by E-UTRAN to retrieve information from the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: E-UTRAN to UE

UEInformationRequest message

```
-- ASN1START

UEInformationRequest-r9     ::=            SEQUENCE {
    rrc-TransactionIdentifier       RRC-TransactionIdentifier,
    criticalExtensions              CHOICE {
        c1                              CHOICE {
            ueInformationRequest-r9             UEInformationRequest-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture            SEQUENCE {}
    }
}

UEInformationRequest-r9-IEs ::=     SEQUENCE {
    rach-ReportReq-r9                           BOOLEAN,
    rlf-ReportReq-r9                            BOOLEAN,
    nonCriticalExtension                UEInformationRequest-v930-IEs                   OPTIONAL
}

UEInformationRequest-v930-IEs ::= SEQUENCE {
    lateNonCriticalExtension            OCTET STRING                        OPTIONAL,   -- Need OP
    nonCriticalExtension                SEQUENCE {}                         OPTIONAL    -- Need OP
}

-- ASN1STOP
```

***UEInformationRequest* field descriptions**
rach-ReportReq This field is used to indicate whether the UE shall report information about the random access procedure.

RRC UE Information Response message

RLC-SAP: AM

Logical channel: DCCH

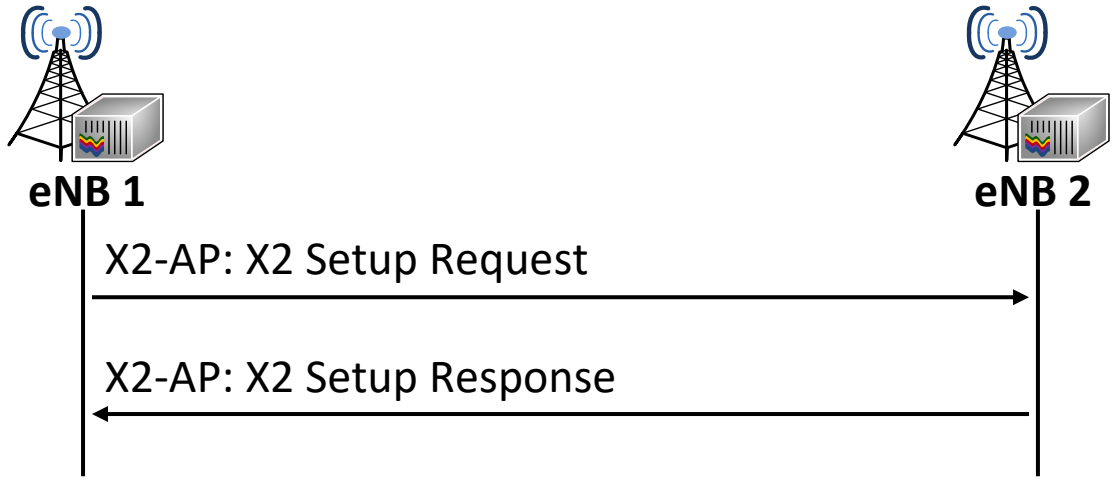
Direction: UE to E-UTRAN

UEInformationResponse message

```
-- ASN1START

UEInformationResponse-r9 ::=   SEQUENCE {
    rrc-TransactionIdentifier  RRC-TransactionIdentifier,
    criticalExtensions         CHOICE {
        c1                     CHOICE {
            ueInformationResponse-r9           UEInformationResponse-r9-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture           SEQUENCE {}
    }
}

UEInformationResponse-r9-IEs ::=     SEQUENCE {
    rach-Report-r9                 SEQUENCE {
        numberOfPreamblesSent-r9           INTEGER (1..200),
        contentionDetected-r9          BOOLEAN
    }                                                  OPTIONAL,
    rlfReport-r9                   RLF-Report-r9           OPTIONAL,
    nonCriticalExtension           UEInformationResponse-v930-IEs
    OPTIONAL
}

UEInformationResponse-v930-IEs ::=    SEQUENCE {
    lateNonCriticalExtension   OCTET STRING                    OPTIONAL,
    nonCriticalExtension       SEQUENCE {}                        OPTIONAL
}

RLF-Report-r9 ::=              SEQUENCE {
    measResultLastServCell-r9      SEQUENCE {
        rsrpResult-r9                  RSRP-Range,
        rsrqResult-r9                  RSRQ-Range          OPTIONAL
    },
    measResultNeighCells-r9        SEQUENCE {
        measResultListEUTRA-r9             MeasResultList2EUTRA-r9      OPTIONAL,
        measResultListUTRA-r9          MeasResultList2UTRA-r9       OPTIONAL,
        measResultListGERAN-r9             MeasResultListGERAN          OPTIONAL,
        measResultsCDMA2000-r9             MeasResultList2CDMA2000-r9   OPTIONAL
    }                                                  OPTIONAL,
    ...
}

MeasResultList2EUTRA-r9 ::=        SEQUENCE (SIZE (1..maxFreq)) OF
MeasResult2EUTRA-r9

MeasResult2EUTRA-r9 ::=          SEQUENCE {
    carrierFreq-r9               ARFCN-ValueEUTRA,
    measResultList-r9            MeasResultListEUTRA
}

MeasResultList2UTRA-r9 ::=       SEQUENCE (SIZE (1..maxFreq)) OF
MeasResult2UTRA-r9

MeasResult2UTRA-r9 ::=           SEQUENCE {
    carrierFreq-r9               ARFCN-ValueUTRA,
    measResultList-r9            MeasResultListUTRA
}

MeasResultList2CDMA2000-r9 ::= SEQUENCE (SIZE (1..maxFreq)) OF
MeasResult2CDMA2000-r9

MeasResult2CDMA2000-r9 ::=       SEQUENCE {
    carrierFreq-r9                  CarrierFreqCDMA2000,
    measResultList-r9               MeasResultsCDMA2000
}

-- ASN1STOP
```

***UEInformationResponse* field descriptions**
numberOfPreamblesSent This field is used to indicate the number of RACH preambles that were transmitted. Corresponds to parameter PREAMBLE_TRANSMISSION_COUNTER in TS 36.321 [6].
contentionDetected This field is used to indicate that contention was detected for at least one of the transmitted preambles, see also [6].

PRACH Configuration in X2-Setup



9.2.50 PRACH Configuration

This IE indicates the PRACH resources used in neighbor cell.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
RootSequenceIndex	M		INTEGER (0..837)	See section 5.7.2. in TS 36.211 [10]	–	–
ZeroCorrelationZoneConfiguration	M		INTEGER (0..15)	See section 5.7.2. in TS 36.211 [10]	–	–
HighSpeedFlag	M		BOOLEAN	TRUE corresponds to Restricted set and FALSE to Unrestricted set, see section 5.7.2 in TS 36.211 [10]	-	-
PRACH-FrequencyOffset	M		INTEGER (0..94)	See section 5.7.1 of TS 36.211 [10]	–	–
PRACH-ConfigurationIndex	O		INTEGER (0..63)	Mandatory for TDD, shall not be present for FDD. See section 5.7.1. in TS 36.211 [10]	-	-

References and Further Reading

- Self-Organizing Networks (SON) in 3GPP Long Term Evolution by Sujuan Feng and Eiko Seidel, Nomor Research (link)
- From 4G to 5G: Self-organized Network Management meets Machine Learning by Jessica Moysen and Lorenza Giupponi (link)
- Self Organizing Networks for 3GPP LTE by Aderemi A. Atayero, Oluwadamilola I. Adu, and Adeyemi A. Alatishe (link)
- 3G4G: Self-Organizing Networks / Self-Optimizing Networks (link)
- The 3G4G Blog: SON (link)

Thank You

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