- We have identified a number of important gaps in the LTE parts of the FAPService:2 data model as defined in TR-196 up to and including version 2.1.

- Currently, any vendor who wants to manage an LTE HeNB using TR-069 would have to add vendor-specific extensions to the FAPService:2 data model in order to be able to configure even a fairly basic, standard, LTE service conforming to 3GPP release 9 specifications.

- This slide set describes the gaps we have identified, and makes some suggestions as to how TR-196 could be modified to fill them.

- In making these suggestions, we have retained backward compatibility with TR-196 version 2.1 (and hence with version 2.0)

- The list of issues presented here is not claimed to be exhaustive – they are just the ones we've come across so far!

- No support for the *eNB Name* carried in S1AP messages
- Full range of LTE frequency bands not supported
- Insufficient support for S1 handover 'Target ID' in neighbour cell object
- No support for RAN sharing in neighbour cell object
- Issues with support for controlling whether optional IEs in SIBs are transmitted or not
- No support for cell selection based on signal quality
- No support for antenna port information for intra-freq cells
- No support for the allowed measurement bandwidth of neighbour cells being different from the DL bandwidth of the serving cell
- No support for avoiding unnecessary UE measurements of intra-freq cells based on signal quality
- No support for intra-freq cell reselection based on signal quality

- No support for CSG cell identification assistance during intra-freq cell reselection
- No support for antenna port information for inter-freq carriers
- No support for allowed measurement bandwidth for inter-freq carriers
- No support for MBSFN neighbour cell config for inter-freq neighbour cells
- No support for avoiding unnecessary UE measurements of inter-freq and inter-RAT cells based on signal quality
- No support for inter-freq cell reselection based on signal quality
- No support for quality based reselection to lower priority frequencies

- No support for inter-RAT TDD UTRA cell reselection at all
- No explicit support for defining a common set of parameters for cell reselection to multiple inter-RAT GERAN carrier freqs
- No support for access class barring for special ACs
- No support for service specific access class barring

- There is currently no support in TR-196 for the *eNB Name* that is carried in S1AP messages

- We suggest adding a parameter ENBName of type string(150) to the FAPService.{i}.CellConfig.LTE.EPC. object

- The string must conform to the ASN.1 type PrintableString

- TR-196 v2.1 (and earlier) defines the parameter in the FAPService.{i}.CellConfig.LTE.RAN.RF.FreqBandIndicator as being of type unsigned int[1:40]

- The descriptive text for the parameter FAPService.{i}.Capabilities.LTE.BandsSupported says that it is a list of unsigned integers of value 1 to 21, or 33 to 40

- 3GPP have now specified FDD bands 1 to 32 inclusive, and TDD bands 33 to 44 inclusive, and at least some of the newer bands are already being used in live networks

- We suggest that the definition of FAPService.{i}.CellConfig.LTE.RAN.RF.FreqBandIndicator should be changed to unsigned int[1:256], in line with the extended FBI range defined in 3GPP TS 36.331

- We suggest that the descriptive text for FAPService.{i}.Capabilities.LTE.BandsSupported be changed to allow values 1 to 256

- When performing a handover using the S1 interface, an HeNB has to include in the S1AP Handover Required message a *Target ID*

- In the case of intra-LTE handover, the *Target ID* has to be a *Target eNB-ID* that identifies the eNB controlling the target cell

- *Target eNB-ID* consists of a *Global eNB ID* and a *Selected TAI*

- The *Global eNB ID* consists of the target eNB's primary PLMN code and either a *Macro eNB ID* or a *Home eNB ID*, but there is nothing in the current TR-196 data model indicating which should be used

- The *Selected TAI* consists of the target PLMN code and the target cell's TAC (tracking area code), but the current TR-196 data model does not include the TAC of a neighbour cell

- We suggest that a Boolean parameter IsMacroEnb be added to the FAPService.{i}.CellConfig.LTE.RAN.NeighborList.LTECell.{i}. object, which would enable the HeNB to derive the value of *Macro eNB ID* or *Home eNB ID* as appropriate, from the existing FAPService.{i}.CellConfig.LTE.RAN.NeighborList.LTECell.{i}.CID parameter

- We suggest that a parameter TAC, of type unsignedint[0:65535] be added to the FAPService.{i}.CellConfig.LTE.RAN.NeighborList.LTECell.{i}. object

- When handing a UE over to another LTE cell that implements RAN sharing, the HeNB needs to know both the primary PLMN of the target cell, and the target PLMN (i.e. the PLMN that the UE should serve the UE), which may be different

- The FAPService.{i}.CellConfig.LTE.RAN.NeighborList.LTECell.{i}. object contains only a single PLMNID parameter

- We suggest that the existing PLMNID parameter be used to represent the neighbour cell's primary PLMN, so that in the case where there is no RAN sharing, its use is unchanged

- We suggest that a parameter SecondaryPLMN be added to the FAPService.{i}.CellConfig.LTE.RAN.NeighborList.LTECell.{i}. object, this parameter being of type string(34) and containing up to five, comma-separated, PLMN Ids

- 3GPP TS 36.331 specifies that the IE *q-RxLevMinOffset* is optional in SIB1

- If the IE is present, its range is 1..8, and the UE uses an offset of 2 x IE value (dBm); otherwise, the UE uses an offset of 0 dBm.

- The TR-196 object

  FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. has a parameter QRxLevMinOffset of type unsignedint[1:8]

- Thus the TR-196 data model does not provide a way to specify an offset of 0 dBm

- We suggest that the type of the existing QRxLevMinOffset parameter in TR-196 be changed to be unsignedint[0:8], and that if the value of the parameter is set to 0, the HeNB shall omit the *q-RxLevMinOffset* IE from SIB1

- 3GPP TS 36.331 says that the IE *p-Max* is optional in SIB1and SIB3

- *p-Max* in SIB1 limits the UE transmit power used in the current cell

- *p-Max* in SIB3 limits the UE transmit power used in intra-freq LTE neighbour cells

- In both cases, if the IE is absent, a UE may transmit up to the maximum power it is capable of

- *p-Max* is also used in the calculation of Srxlev, which contributes to the cell selection criterion

- TR-196 has a parameter PMax of type int[-30:33] in the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, and says that it corresponds to the parameter *p-Max* transmitted in SIB1 and SIB3

- Thus the TR-196 data model constrains the values of *p-Max* transmitted in SIB1 and SIB3 to be the same, whereas in practice it could be desirable for them to be different

- TR-196 has no parameters to control whether *p-Max* is to be transmitted or not in SIB1 and SIB3

- We suggest that the existing PMax parameter be changed to correspond to the parameter *p-Max* in SIB1 (and not that in SIB3)

- We suggest that a new parameter PMaxSIB3 of type int[-30:33] be added to correspond to the parameter *p-Max* in SIB3

- We suggest that a new parameter UsePMax be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, and only if its value is true shall the HeNB transmit *p-Max* in SIB1

- We suggest that a new parameter UsePMaxSIB3 be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, and only if its value is true shall the HeNB transmit *p-Max* in SIB3

- 3GPP TS 36.331 says that the IE *p-Max* is optional in SIB5

- *p-Max* in SIB5 limits the UE transmit power used in inter-freq LTE neighbour cells of a given carrier frequency

- If the IE is absent, a UE may transmit up to the maximum power it is capable of

- *p-Max* is also used in the calculation of Srxlev, which contributes to the cell selection criterion

- TR-196 has a parameter PMax of type int[-30:33] in the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. object, and says that it corresponds to the parameter *p-Max* transmitted in SIB5 for the corresponding carrier frequency

- TR-196 has no parameter to control whether *p-Max* is to be transmitted or not in SIB5

- We suggest that a new boolean **parameter** UsePMaxSIB5 be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. object, and only if its value is true shall the HeNB transmit *p-Max* in SIB5 for the corresponding carrier frequency

- 3GPP TS 36.331 says that the IE *p-MaxGERAN* is optional in SIB7

- *p-MaxGERAN* in SIB7 limits the UE transmit power used in inter-RAT GERAN neighbour cells of a given carrier frequency

- If the IE is absent, a UE may transmit up to the maximum power it is capable of

- *p-MaxGERAN* is also used in the calculation of Srxlev, which contributes to the cell reselection criterion

- TR-196 has no parameter corresponding to *p-MaxGERAN*

- TR-196 has no parameter to control whether *p-MaxGERAN* is to be transmitted or not in SIB7 for a given carrier frequency

- ■ We suggest that:

  - ■ Adding a parameter PMaxGERAN **of type** unsignedInt[0:39] **in the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.GERAN.GERANFreqGroup.{i}. object, corresponding to the parameter *p-MaxGERAN* transmitted in SIB7 for the corresponding carrier frequency

  - ■ Adding a boolean **parameter** UsePMaxGERAN **of type** unsignedInt[0:39] **in the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.GERAN.GERANFreqGroup.{i}. object, and only if its value is true shall the HeNB transmit *p-MaxGERAN* in SIB7 for the corresponding carrier frequency

Optional speed-dependent cell reselection (1)

- 3GPP TS 36.331 specifies that an eNB may optionally transmit IEs supporting speed-dependent cell reselection so that a UE can determine its mobility state, and apply speed-dependent factors to parameters that affect how quickly cell reselection can take place

- These are grouped into:

  - Common speed-dependent IEs, which are related to cell reselection to all categories of neighbour cells

  - Intra-freq speed-dependent IEs, which apply only to cell reselection to intra-frequency E-UTRAN cells

  - Inter-freq speed-dependent IEs, which apply only to cell reselection to inter-frequency E-UTRAN cells

  - UTRA speed-dependent IEs, which apply only to cell reselection to inter-RAT UTRAN cells

  - GERAN speed-dependent IEs, which apply only to cell reselection to inter-RAT GERAN cells

Optional speed-dependent cell reselection (2)

- The common speed-dependent IEs only need to be broadcast if one or more of the other groups of speed-dependent IEs is broadcast

- The TR-196 data model contains parameters corresponding to all of the 3GPP speed-dependent IEs, but has no parameters to control which groups of those IEs are broadcast

- In principle, one could apply the rule that if all of the speed-dependent scaling factors are set to values that would have no effect (i.e. offsets set to 0, multipliers set to 1), the HeNB should broadcast no speed-dependent IEs, otherwise it should broadcast all those – and only those – IEs that are needed

- However, this would only provide an indirect way for the ACS user to turn speed-dependent cell reselection behaviour on and off: it might be better to provide an obvious 'on/off' switch

Optional speed-dependent cell reselection (3)

- **We therefore suggest that:**
  - a Boolean parameter UseSpeedDepSF **be added to the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. **object**
  - If UseSpeedDepSF **is false, the eNB transmits no IEs related to speed-dependent cell reselection in the SIBs**
  - If UseSpeedDepSF **is true and either** TReselectionEUTRASFMedium **or** TReselectionEUTRASFHigh **in the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. **object is not set to 100, the eNB transmits the** *speedStateReselectionPars* **IE in SIB3 and the** *t-ReselectionEUTRA-SF* **IE in SIB3**
  - If UseSpeedDepSF **is true and either** TReselectionEUTRASFMedium **or** TReselectionEUTRASFHigh **in any** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. **object is not set to 100, the eNB transmits the** *speedStateReselectionPars* **IE in SIB3 and the** *t-ReselectionEUTRA-SF* **IE in the relevant** *InterFreqCarrierFreqInfo* **IE(s) in SIB5**

Optional speed-dependent cell reselection (4)

- If UseSpeedDepSF **is true and either** TReselectionUTRASFMedium **or** TReselectionUTRASFHigh **in the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.UTRA. **object is not set to 100, the eNB transmits the** *speedStateReselectionPars* **IE in SIB3 and the** *t-ReselectionUTRA-SF* **IE in SIB6**

- If UseSpeedDepSF **is true and either** TReselectionGERANSFMedium **or** TReselectionGERANSFHigh **in the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.GERAN. **object is not set to 100, the eNB transmits the** *speedStateReselectionPars* **IE in SIB3 and the** *t-ReselectionGERAN-SF* **IE in SIB7**

- 3GPP TS 36.331 specifies that SIB1 can include the optional IE *q-QualMin-r9*, in which case a UE takes the cell's signal quality into account (in addition to signal strength) when performing cell selection

- If *q-QualMin-r9* is transmitted, the IE *q-QualMinOffset-r9* may optionally also be transmitted, with a value in the range 1..8

- The TR-196 data model does not include parameters corresponding to either of these IEs

- We suggest that:

  - a Boolean parameter UseQQualMinSIB1 be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, and only if this is set to true shall the HeNB shall transmit the *q-QualMin-r9* IE in SIB1

  - a parameter QQualMinSIB1 be added to the same object, corresponding to the IE *q-QualMin-r9* in SIB1, and that it be a string containing a comma separated list of values, similar to QRxLevMinSIB1 but with each value being in the range -34 to -3 dB

  - a parameter QQualMinOffset of type unsignedint[0:8] be added to the same object, corresponding to the IE *q-QualMinOffset-r9* in SIB1 and that if the value of the parameter is set to 0, the HeNB shall omit the *q-QualMinOffset* IE from SIB1

Antenna port info for intra-freq neighbours

- 3GPP TS 36.331 specifies that SIB3 must include the IE *presenceAntennaPort1*

- The TR-196 data model does not include a parameter corresponding to this IE

- We suggest that a boolean parameter PresenceAntennaPort1 be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, corresponding to the IE *presenceAntennaPort1* in SIB3

Intra-freq allowed measurement bandwidth

- 3GPP TS 36.331 specifies that SIB3 can include the optional IE *allowedMeasBandwidth*, in which case a UE uses that as the measurement bandwidth for intra-frequency cells rather that assuming it is the same as the channel bandwidth of the serving cell

- The TR-196 data model does not include a parameter corresponding to this IE

- We suggest that a parameter AllowedMeasBandwidth be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, corresponding to the IE *allowedMeasBandwidth* in SIB3

- We suggest that if the value of AllowedMeasBandwidth is the same as the configured downlink channel bandwidth of the HeNB, the HeNB may omit the IE *allowedMeasBandwidth* from SIB3

- 3GPP TS 36.331 specifies that SIB3 can optionally include an IE *s-IntraSearch,* which gives the UE a threshold for serving cell RSRP above which the UE does not need to measure intra-freq cells for reselection purposes

- 3GPP TS 36.331 specifies that SIB3 can optionally include the two IE *s-IntraSearchP* and *s-IntraSearchQ*, in which case a UE also takes the serving cell RSRQ into account when deciding whether to search for intra-frequency neighbour cells for cell reselection purposes and uses *s-IntraSearchP* instead of *s-IntraSearch* as the RSRP threshold.

- The only TR-196 parameter related to this is SIntraSearch, in the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object: SIntraSearch corresponds to *s-IntraSearch* in SIB3

- There is no parameter in TR-196 to control whether or not *s-IntraSearch* is transmitted in SIB3

- **We suggest:**
  - Adding a parameter SIntraSearchQ to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, similar to the existing SIntraSearch parameter
  - Adding a Boolean parameter UseSIntraSearch to the same object
  - Adding a Boolean parameter UseSIntraSearchP to the same object
  - If both UseSIntraSearch and UseSIntraSearchP are false, the eNB omits *s-IntraSearch, s-IntraSearchP and s-IntraSearchQ* from SIB3
  - If UseSIntraSearch is true and UseSIntraSearchP is false, the eNB includes the IE *s-IntraSearch* in SIB3, with the value of SIntraSearch, and omits both *s-IntraSearchP* and *s-IntraSearchQ* from SIB3
  - if UseSIntraSearchP is true, then regardless of the value of UseSIntraSearch the eNB includes both *s-IntraSearchP* and *s-IntraSearchQ* in SIB3, with *s-IntraSearchP* taking the value of SIntraSearch and *s-IntraSearchQ* taking the value of SIntraSearchQ, and the eNB omits the IE *s-IntraSearch* from SIB3

Signal quality based intra-freq cell reselection

- 3GPP TS 36.331 specifies that SIB3 can include the optional IE *q-QualMin-r9*, in which case a UE takes a neighbour cell's signal quality into account (in addition to signal strength) when performing cell reselection

- The TR-196 data model does not include a parameter corresponding to this IE

- We suggest that:

  - a parameter QQualMinSIB3 be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, corresponding to the IE *q-QualMin-r9* in SIB3, and that it be a string containing a comma separated list of values (similar to QRxLevMinSIB3), each value being in the range -34 to -3 dB

  - a Boolean parameter UseQQualMinSIB3 be added to the same object, and only if this is set to true shall the HeNB transmit the *q-QualMin-r9* IE in SIB3

- 3GPP TS 36.331 specifies that a CSG cell must, and a non-CSG cell may, transmit the IE *csg-PhysCellIdRange* in SIB4

- We can find no corresponding parameter in the current TR-196 data model

- We therefore suggest:

  - Adding an optional readWrite object, CSGPhysCellIdRange. with minEntries = "0", maxEntries = "1", to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object

  - Adding a parameter Start of type unsignedint (0:503) to the CSGPhysCellIdRange. object

  - Adding a parameter Size of type string to the CSGPhysCellIdRange object, for which valid string values are "1", "4", "8", "12", "16", "24", "32", "48", "64", "84", "96", "128", "168", "252", and "504"

  - If the CSGPhysCellIdRange. object exists, the HeNB transmits the *csg-PhysCellIdRange* IE in SIB4, otherwise it does not

- If the CSGPhysCellIdRange. object exists, the HeNB transmits the *start* IE within the *csg-PhysCellIdRange* IE in SIB4 with the value of the start parameter within the CSGPhysCellIdRange. object

- If the CSGPhysCellIdRange. object exists, and the size parameter within the CSGPhysCellIdRange. object has the value "1", the HeNB omits the *range* IE from the *csg-PhysCellIdRange* IE in SIB4

- If the CSGPhysCellIdRange. object exists, and the size parameter within the CSGPhysCellIdRange. object has a valid value other than "1", the HeNB includes the *range* IE from the *csg-PhysCellIdRange* IE in SIB4 with the corresponding enumerated value

Note: This idea of using a readWrite 'optional' object (minEntries = "0", maxEntries = "1") to represent something that can optionally be configured on a CPE seems natural, but we cannot find any example of it being done in the existing BBF data models. An alternative would be to add several parameters (e.g. useCSGPhysCellIdRange, CSGPhysCellIdRangeStart, and useCSGPhysCellIdRangeSize) directly into the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object.

Antenna information for inter-freq carriers

- 3GPP TS 36.331 specifies that SIB5 must include the IE *presenceAntennaPort1* for each inter-freq carrier

- The TR-196 data model does not include a parameter corresponding to this IE

- We suggest that a boolean parameter PresenceAntennaPort1 be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. object, corresponding to the IE *presenceAntennaPort1* in SIB5

Inter-freq allowed measurement bandwidth

- 3GPP TS 36.331 specifies that SIB5 must include the IE *allowedMeasBandwidth* for each inter-freq carrier

- The TR-196 data model does not include a parameter corresponding to this IE

- We suggest that a parameter AllowedMeasBandwidth be added to the
FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}.
object, corresponding to the IE *allowedMeasBandwidth* in SIB5

MBSFN / TDD config for inter-freq neighbours

- 3GPP TS 36.331 specifies a mandatory IE *neighCellConfig* to be included for each inter-freq carrier frequency in SIB5, providing information about the MBSFN and TDD UL/DL configuration of neighbour cells on that frequency

- The TR-196 data model has a single NeighCellConfig parameter (in the FAPService.{i}.CellConfig.LTE.RAN.PHY.MBSFN. object) but the MBSFN and TDD UL/DL configuration on different inter-freq carriers could be different from each other and different from that on the intra-freq carrier, so a single NeighCellConfig parameter is inadequate

- We therefore suggest:

  - Treating the NeighCellConfig parameter in the FAPService.{i}.CellConfig.LTE.RAN.PHY.MBSFN. object as being for the intra-freq neighbour cells only, and updating the description in TR-196 to reflect that

  - Adding a NeighCellConfig parameter of type unsignedInt[0:3] to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. object, corresponding to the *neighCellConfig* IE in SIB5

- 3GPP TS 36.331 specifies that SIB3 can optionally include an IE *s-NonIntraSearch,* which gives the UE a threshold for serving cell RSRP above which the UE does not need to measure lower priority inter-freq cells or inter-RAT cells for reselection purposes

- 3GPP TS 36.331 specifies that SIB3 can optionally include the two IE *s-NonIntraSearchP* and *s-NonIntraSearchQ*, in which case a UE also takes the serving cell RSRQ into account when deciding whether to search for lower priority inter-freq and inter-RAT cells for cell reselection purposes and uses *s-NonIntraSearchP* instead of *s-NonIntraSearch* as the RSRP threshold.

- The only TR-196 parameter related to this is SNonIntraSearch*,* in the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object: SNonIntraSearch corresponds to *s-NonIntraSearch* in SIB3

- There is no parameter in TR-196 to control whether or not *s-NonIntraSearch* is transmitted in SIB3

- **We suggest:**
  - Adding a parameter SNonIntraSearchQ to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, similar to the existing SNonIntraSearch parameter
  - Adding a Boolean parameter UseSNonIntraSearch to the same object
  - Adding a Boolean parameter UseSNonIntraSearchP to the same object
  - If both UseSNonIntraSearch and UseSNonIntraSearchP are false, the eNB omits *s-NonIntraSearch, s-NonIntraSearchP and s-NonIntraSearchQ* from SIB3
  - If UseSNonIntraSearch is true and UseSNonIntraSearchP is false, the eNB includes the IE *s-NonIntraSearch* in SIB3, with the value of SNonIntraSearch, and omits both *s-NonIntraSearchP* and *s-NonIntraSearchQ* from SIB3
  - if UseSNonIntraSearchP is true, then regardless of the value of UseSNonIntraSearch the eNB includes both *s-NonIntraSearchP* and *s-NonIntraSearchQ* in SIB3, with *s-NonIntraSearchP* taking the value of SNonIntraSearch   and *s-NonIntraSearchQ* taking the value of SNonIntraSearchQ, and the eNB omits the IE *s-NonIntraSearch* from SIB3

Signal quality based inter-freq cell reselection

- 3GPP TS 36.331 specifies that SIB5 can include the optional IE *q-QualMin-r9*, in which case a UE takes a neighbour cell's signal quality into account (in addition to signal strength) when performing cell reselection to inter-frequency LTE cells

- The TR-196 data model does not include a parameter corresponding to this IE

- We suggest that:

  - a parameter QQualMinSIB5 be added to the FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. object, corresponding to the IE *q-QualMin-r9* in SIB5, and that it be a string containing a comma separated list of values (similar to QRxLevMinSIB5), each value being in the range -34 to -3 dB

  - a Boolean parameter UseQQualMinSIB5 be added to the same object, and only if this is set to true shall the HeNB transmit the *q-QualMin-r9* IE for the carrier in question in SIB5

Quality based reselection to lower priority (1)

- 3GPP TS 36.331 specifies that SIB3 can include the optional IE *threshServingLowQ-r9*, in which case a UE takes serving cell signal quality into account when performing cell reselection to a lower priority LTE or inter-RAT frequency

- If *threshServingLowQ-r9* is transmitted in SIB3, the UE also takes in to account neighbour cell signal quality when reselecting to a lower priority LTE frequency, and for this purpose the optional IEs *threshX-HighQ* and *threshX-LowQ* may be transmitted in SIB5

- If *threshServingLowQ-r9* is transmitted in SIB3, the UE also takes in to account neighbour cell signal quality when reselecting to a lower priority UTRA FDD frequency, and for this purpose the optional IEs *threshX-HighQ* and *threshX-LowQ* may be transmitted in SIB6

- The TR-196 data model does not include parameters corresponding to any of the above mentioned IEs, nor parameters to control whether or not they are transmitted

Quality based reselection to lower priority (2)

- **We suggest that:**

  - A parameter ThreshServingLowQ **of type** unsignedInt[0:31] **be added to the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IntraFreq. object, **corresponding to the IE** *threshServingLowQ-r9* in SIB3

  - A boolean **parameter** UseThreshXQ **be added to the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. **object**

  - **Parameters** ThreshXHighQ **and** ThreshXLowQ, **both of type** unsignedInt[0:31] **be added to the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. **object, corresponding to the IEs** *threshX-HighQ-r9* **and** *threshX-LowQ-r9* **respectively in the corresponding carrier IE in SIB5**

  - A boolean **parameter** UseThreshXQ **be added to the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.UTRA.UTRANFDDFreq.{i}. **object**

  - **Parameters** ThreshXHighQ **and** ThreshXLowQ, **both of type** unsignedInt[0:31] **be added to the** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.UTRA.UTRANFDDFreq.{i}. **object, corresponding to the IEs** *threshX-HighQ-r9* **and** *threshX-LowQ-r9* **respectively in the corresponding carrier IE in SIB6**

- If the UseThreshXQ parameter in any FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. object is set to true, the HeNB shall include the IE *threshServingLowQ-r9* in SIB3

- If the UseThreshXQ parameter in any FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.UTRA.UTRANFDDFreq.{i}. object is set to true, the HeNB shall include the IE *threshServingLowQ-r9* in SIB3

- If the UseThreshXQ parameter in a FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.InterFreq.Carrier.{i}. object is set to true, the HeNB shall include the IEs *threshX-HighQ-r9* and *threshX-HighQ-r9* in the corresponding carrier IEs in SIB5

- If the UseThreshXQ parameter in a FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.UTRA.UTRANFDDFreq.{i}. object is set to true, the HeNB shall include the IEs *threshX-HighQ-r9* and *threshX-HighQ-r9* in the corresponding carrier IEs in SIB6

- 3GPP TS 36.331 specifies SIB7 contains an IE carrierFreqsInfoList that includes cell reselection parameters for one or more groups of frequencies

- Each frequency group is represented by a *CarrierFreqsInfoGERAN* IE, which must include (among others) the mandatory IEs *carrierFreqs* and *ncc-permitted*

- The mandatory IE *carrierFreqs* is composed of:
  - *startingARFCN*
  - *bandIndicator*
  - *followingARFCNs (which can be specified as an explicit list of ARFCNs or a number of equally spaced ARFCNs or a variable size bit map of ARFCNs)*

- TR-196 data model includes an object
  FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.GERAN.GERANFreqGroup.{i}.

- Instead of a list of carrier frequencies, this object contains a single BCCHARFCN parameter and a BandIndicator parameter

- The description of BCCHARFCN says that it is the "ARFCN of this cell" whereas the object in which it is contained represents a group of carrier frequencies, not a cell

- The
  FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.GERAN.GERANFreqGroup.{i}.
  object does not include any parameter corresponding to *ncc-permitted*

- **We therefore suggest the following with respect to the TR-196** FAPService.{i}.CellConfig.LTE.RAN.Mobility.IdleMode.IRAT.GERAN.GERANFreqGroup.{i}. **object:**

  - Treating the existing TR-196 parameter BCCHARFCN as corresponding to the *startingARFCN* IE in SIB7 (and modifying its description in TR-196 accordingly)

  - Treating the existingTR-196 parameter BandIndicator as corresponding to the *bandIndicator* IE in SIB7

  - Adding a parameter FollowingARFCNs of type hexBinary(1:16), corresponding to the *variableBitMapOfARFCNs* IE in SIB7, and allowing the HeNB may choose to transmit the information contained in this parameter using any one of the IEs *explicitListOfARFCNs*, *equallySpacedARFCNs* and *variableBitMapOfARFCNs* provided that the chosen is capable of conveying the complete set of IEs defined by FollowingARFCNs

  - Adding a parameter NCCpermitted of type hexBinary(1), corresponding to the *ncc-Permitted* IE in SIB7

- 3GPP TS 361.331 specifies the following optional IEs may be included in SIB2:

  - *ac-BarringforMO-Signalling*

  - *ac-BarringforMO-Data*

  - *ssac-BarringForMMTEL-Voice-r9*

  - *ssac-BarringForMMTEL-Video-r9*

- In each case, the information provided is

  - *ac-BarringFactor*

  - *ac-BarringTime*

  - *ac-BarringForSpecialAC*

- The TR-196 data model does not contain parameters corresponding to any of the above

- We therefore suggest adding the following optional (minEntries = 0, maxEntries = 1), readWrite, objects to the FAPService.{i:}.CellConfig.LTE.RAN.CellRestriction. object:
  - BarringForMOSignalling.
  - BarringForMOData.
  - BarringForMMTELVoice.
  - BarringForMMTELVideo.

- each new object having the following parameters:
  - ACBarringFactor of type string, with valid values "0", "0.05", "0.10", "0.15", "0.20", "0.25", "0.30", "0.40", "0.50", "0.60", "0.70", "0.75", "0.80", "0.85", "0.90", "0.95", and corresponding to the IE *ac-BarringFactor* in SIB2
  - ACBarringTime of type string, with valid values "4", "8", "16", "32", "64", "128", "256", "512", and corresponding to the IE *ac-BarringTime* in SIB2
  - ACBarringForSpecialAC of type hexBinary(1) with valid values being from 00 to 1F, and corresponding to the IE *ac-BarringForSpecialAC* in SIB2

- For each of the new objects, if the object exists, the HeNB transmits the corresponding IE in SIB2, otherwise it does not

Note that again, the kind of optional object suggested here seems not to be used in existing TR-069 data models. An alternative would be to make them readOnly, minEntries = 1, maxEntries = 1, and add additional boolean parameters UseBarringForMOSignalling, UseBarringForMOData, UseBarringForMMTELVoice, and UseBarringForMMTELVideo to the FAPService.{i:}.CellConfig.LTE.RAN.CellRestriction. object to control whether the corresponding IEs are transmitted in SIB2 or not.

Thank you!

+44 773 666 83 31 | info@accelleran.com | www.accelleran.com | @accelleran