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Contents

Foreword

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1 Scope

The present document describes the physical channels for evolved UTRA.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 36.201: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description".

[3] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

[4] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[5] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements".

[6] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".

[7] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[8] 3GPP TS 36.321, "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".

[9] 3GPP TS 36.331, "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) Protocol specification"

[10] 3GPP TS 36.304, "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode"

3 Symbols and abbreviations

3.1 Symbols

For the purposes of the present document, the following symbols apply:

(k,l)	Resource element with frequency-domain index k and time-domain index l
$a_{k,l}^{(p)}$	Value of resource element (k,l) [for antenna port p]
D	Matrix for supporting cyclic delay diversity

D_{RA}	Density of random access opportunities per radio frame
f_0	Carrier frequency
f_{RA}	PRACH resource frequency index within the considered time-domain location
$f_{\mathrm{PRB,hop}}^{\mathrm{PRACH}}$	PRACH frequency hopping offset, expressed as a number of resource blocks
$l_{\mathrm{NPDCCHStart}}$	Start symbol in slot 0 for NPDCCH
$l_{\mathrm{NPDSCHStart}}$	Start symbol in slot 0 for NPDSCH
$M_{\mathrm{sc}}^{\mathrm{PSBCH}}$	Bandwidth for PSBCH transmission, expressed as a number of subcarriers
$M_{\mathrm{RB}}^{\mathrm{PSBCH}}$	Bandwidth for PSBCH transmission, expressed as a number of resource blocks
$M_{\mathrm{sc}}^{\mathrm{PSCCH}}$	Bandwidth for PSCCH transmission, expressed as a number of subcarriers
$M_{\mathrm{RB}}^{\mathrm{PSCCH}}$	Bandwidth for PSCCH transmission, expressed as a number of resource blocks
$M_{\mathrm{sc}}^{\mathrm{PSDCH}}$	Bandwidth for PSDCH transmission, expressed as a number of subcarriers
$M_{\mathrm{RB}}^{\mathrm{PSDCH}}$	Bandwidth for PSDCH transmission, expressed as a number of resource blocks
$M_{\mathrm{sc}}^{\mathrm{PSSCH}}$	Scheduled bandwidth for PSSCH transmission, expressed as a number of subcarriers
$M_{\mathrm{RB}}^{\mathrm{PSSCH}}$	Scheduled bandwidth for PSSCH transmission, expressed as a number of resource blocks
$M_{\mathrm{sc}}^{\mathrm{PUSCH}}$	Scheduled bandwidth for uplink transmission, expressed as a number of subcarriers
$M_{\mathrm{RB}}^{\mathrm{PUSCH}}$	Scheduled bandwidth for uplink transmission, expressed as a number of resource blocks
$M_{\mathrm{rep}}^{\mathrm{NPUSCH}}$	Scheduled number of repetitions of a NPUSCH transmission
$M_{\mathrm{rep}}^{\mathrm{NPDSCH}}$	Scheduled number of repetitions of a NPDSCH transmission
$M_{\mathrm{sc}}^{\mathrm{NPUSCH}}$	Scheduled bandwidth for uplink NPUSCH transmission, expressed as a number of subcarriers
$M_{\mathrm{identical}}^{\mathrm{NPUSCH}}$	Number of repetitions of identical slots for NPUSCH
$M_{\mathrm{bit}}^{(q)}$	Number of coded bits to transmit on a physical channel [for codeword q]
$M_{\mathrm{symb}}^{(q)}$	Number of modulation symbols to transmit on a physical channel [for codeword q]
$M_{\mathrm{symb}}^{\mathrm{layer}}$	Number of modulation symbols to transmit per layer for a physical channel
$M_{\mathrm{symb}}^{\mathrm{ap}}$	Number of modulation symbols to transmit per antenna port for a physical channel
N	A constant equal to 2048 for $\Delta f = 15\,\mathrm{kHz}$, 4096 for $\Delta f = 7.5\,\mathrm{kHz}$ and 8192 for $\Delta f = 3.75\,\mathrm{kHz}$
$N_{\mathrm{CP},l}$	Downlink cyclic prefix length for OFDM symbol l in a slot
N_{CS}	Cyclic shift value used for random access preamble generation
$N_{\mathrm{cs}}^{(1)}$	Number of cyclic shifts used for PUCCH formats 1/1a/1b in a resource block with a mix of formats 1/1a/1b and 2/2a/2b
$N_{\mathrm{RB}}^{(2)}$	Bandwidth available for use by PUCCH formats 2/2a/2b, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$
$N_{\mathrm{RB}}^{\mathrm{HO}}$	The offset used for PUSCH frequency hopping, expressed in number of resource blocks (set by higher layers)
$N_{\mathrm{ID}}^{\mathrm{cell}}$	Physical layer cell identity
$N_{\mathrm{ID}}^{\mathrm{Ncell}}$	Narrowband physical layer cell identity
$N_{\mathrm{ID}}^{\mathrm{MBSFN}}$	MBSFN area identity
$N_{\mathrm{ID}}^{\mathrm{SL}}$	Physical layer sidelink synchronization identity
$N_{\mathrm{ID}}^{\mathrm{PRS}}$	Positioning reference signal identity
$N_{\mathrm{RB}}^{\mathrm{DL}}$	Downlink bandwidth configuration, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$
$N_{\mathrm{RB}}^{\mathrm{min,\,DL}}$	Smallest downlink bandwidth configuration, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$
$N_{\mathrm{RB}}^{\mathrm{max,\,DL}}$	Largest downlink bandwidth configuration, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$
$N_{\mathrm{RB}}^{\mathrm{UL}}$	Uplink bandwidth configuration, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$
$N_{\mathrm{RB}}^{\mathrm{min,\,UL}}$	Smallest uplink bandwidth configuration, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$
$N_{\mathrm{RB}}^{\mathrm{max,\,UL}}$	Largest uplink bandwidth configuration, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$

$N_{\mathrm{RB}}^{\mathrm{SL}}$	Sidelink bandwidth configuration, expressed in multiples of $N_{\mathrm{sc}}^{\mathrm{RB}}$
N_{SF}	Number of scheduled subframes for NPDSCH transmission
$N_{\mathrm{symb}}^{\mathrm{NPSS}}$	Number of symbols for NPSS in a subframe
$N_{\mathrm{symb}}^{\mathrm{NSSS}}$	Number of symbols for NSSS in a subframe
$N_{\mathrm{sc}}^{\mathrm{RU}}$	Number of consecutive subcarriers in an UL resource unit for NB-IoT
$N_{\mathrm{seq}}^{\mathrm{RU}}$	Number of reference signal sequences available for the UL resource unit size
N_{RU}	Number of scheduled UL resource units for NB-IoT
$N_{\mathrm{NB}}^{\mathrm{UL}}$	Total number of uplink narrowbands
$N_{\mathrm{WB}}^{\mathrm{UL}}$	Total number of uplink widebands
$N_{\mathrm{sc}}^{\mathrm{UL}}$	Number of subcarriers in the frequency domain for NB-IoT
N_{acc}	Number of consecutive absolute subframes over which the scrambling sequence stays the same
$N_{\mathrm{abs}}^{\mathrm{PUSCH}}$	Total number of absolute subframes a PUSCH with repetition spans , expressed as a number of absolute subframes
$N_{\mathrm{rep}}^{\mathrm{PUSCH}}$	Number of repetititions of a PUSCH transmission
$N_{\mathrm{NB}}^{\mathrm{ch,UL}}$	Number of consecutive absolute subframes over which PUCCH or PUSCH stays at the same narrowband before hopping to another narrowband, expressed as a number of absolute subframes
$f_{\mathrm{NB,hop}}^{\mathrm{PUSCH}}$	Narrowband offset between one narrowband and the next narrowband a PUSCH hops to, expressed as a number of uplink narrowbands
$N_{\mathrm{abs}}^{\mathrm{PUCCH}}$	Total number of absolute subframes a PUCCH with repetition spans, expressed as a number of absolute subframes
$N_{\mathrm{rep}}^{\mathrm{PUCCH}}$	Number of repetititions of a PUCCH transmission
$N_{\mathrm{rep}}^{\mathrm{PRACH}}$	Number of PRACH repetitions per preamble transmission attempt
$N_{\mathrm{sf}}^{\mathrm{RA}}$	Number of subframes allowed for preamble transmission within a 1024-frame interval
$N_{\mathrm{start}}^{\mathrm{PRACH}}$	PRACH starting subframe periodicity
$N_{\mathrm{rep}}^{\mathrm{NPRACH}}$	Number of NPRACH repetitions per preamble transmission attempt
$N_{\mathrm{period}}^{\mathrm{NPRACH}}$	NPRACH resource periodicity
$N_{\mathrm{scoffset}}^{\mathrm{NPRACH}}$	Frequency location of the first sub-carrier allocated to NPRACH
$N_{\mathrm{sc}}^{\mathrm{NPRACH}}$	Number of sub-carriers allocated to NPRACH
$N_{\mathrm{sc\_cont}}^{\mathrm{NPRACH}}$	Number of starting sub-carriers allocated for UE initiated random access
$N_{\mathrm{start}}^{\mathrm{NPRACH}}$	NPRACH starting subframe
$N_{\mathrm{MSG3}}^{\mathrm{NPRACH}}$	Fraction for starting subcarrier index for UE support for multi-tone msg3 transmission
$N_{\mathrm{gap,period}}$	Periodicity for NPDSCH/NPDCCH gaps
$N_{\mathrm{gap,duration}}$	Duration for NPDSCH/NPDCCH gaps
$N_{\mathrm{gap,threshold}}$	Threshold for applying NPDDCH/NPDCCH gaps
$N_{\mathrm{NB}}^{\mathrm{DL}}$	Total number of downlink narrowbands
$N_{\mathrm{WB}}^{\mathrm{DL}}$	Total number of downlink widebands
$N_{\mathrm{abs}}^{\mathrm{PDSCH}}$	Total number of absolute subframes a PDSCH with repetition spans, expressed as a number of absolute subframes
$N_{\mathrm{rep}}^{\mathrm{PDSCH}}$	Number of repetititions of a PDSCH transmission
$N_{\mathrm{NB}}^{\mathrm{ch,DL}}$	Number of consecutive absolute subframes over which MPDCCH or PDSCH stays at the same narrowband before hopping to another narrowband, expressed as a number of absolute subframes
$N_{\mathrm{NB,hop}}^{\mathrm{ch,DL}}$	Number of narrowbands over which MPDCCH or PDSCH frequency hops