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UE Radio Access Capabilities
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3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

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Foreword

This Technical Report has been produced by the 3GPP.

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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1 Scope

The present document identifies the parameters of the access stratum part of the UE radio access capabilities. Furthermore, the possible combinations of these values are defined.

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.

3 Abbreviations

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

UE	User Equipment
UMTS	Universal Mobile Telecommunication System
UTRAN	UMTS Terrestrial Radio Access Network

4 UE radio access capability parameters

In the following the UE radio capability parameters are defined. In addition the relevant RRC configuration parameters are shown when applicable. When using the RRC configuration parameters, UTRAN needs to respect the UE capabilities. Only parameters for which there is a need to set different values for different UEs are considered as UE capability parameters. Therefore, the capabilities that are the same for all UEs, including baseline capabilities, are not listed here.

UTRAN is responsible for the respect of the UE capabilities when configuring the RBs. Actions in the UE when capabilities are in conflict with a UTRAN request are specified in RRC.

4.1 PDCP parameters

Header compression algorithm supported

Defines whether header compression algorithms will be supported by the UE. If it will be supported it will be the RFC 2507 as specified in TS 25.323.

4.2 BMC parameters

No UE radio access capability parameters identified

4.3 RLC parameters

NOTE: It is FFS whether some of the RLC functions should be considered as UE capabilities.

Total RLC AM buffer size

The total buffer size across all RLC AM entities puts requirements on memory.

UTRAN controls that the UE capability can be fulfilled through the following parameters:

1. The number of RLC AM entities configured (no explicit RRC parameter)
2. UL PU size
3. Transmission window size (#PUs)
4. Receiving window size (FFS whether this is configurable)

The following criterion must be fulfilled in the configuration:

$$\sum_{i=1}^{\#RLC_AM_entities} Transmission_window_size_i \bullet UL_PU_size_i + \sum_{i=1}^{\#RLC_AM_entities} Receiving_window_size_i \bullet DL_PU_size_i \leq Total_RLC_buffer_size$$

where *i* is the RLC "entity number"

Maximum number of AM entities

The number of AM entities affect the main part of the total processing and memory capacity to be shared between different RLC machines.

4.4 MAC parameters

No capability parameters identified.

4.5 PHY parameters

4.5.1 Transport channel parameters in downlink

Maximum sum of number of bits of all transport blocks received in TTIs that end within the same arbitrary interval of length T<10 ms

This parameter is defined as

$\Sigma_i(N_i)$

where N_i is defined as the number of bits in transport block #i, and the sum is over all transport blocks received in TTIs that end within the same 10 ms interval. All transport blocks that are to be simultaneously received by the UE on DCH, FACH, PCH and DSCH transport channels are included in the parameter.

A UE does not need to support a TFC within the TFCS for which the sum of *Number of Transport Blocks* * *Transport Block size* over all simultaneous transport channels is larger than what the UE capability indicates.

Maximum sum of number of bits of all convolutionally coded transport blocks received in TTIs that end within the same arbitrary interval of length T<10 ms.

This parameter is defined similar to the parameter above, but the sum includes only convolutionally coded transport blocks.

Maximum sum of number of bits of all turbo coded transport blocks received in TTIs that end within the same arbitrary interval of length T<10 ms.

This parameter is defined similar to the parameter above, but the sum includes only turbo coded transport blocks.

Maximum number of simultaneous transport channels

This is defined as the maximum number of Transport Channels that should be possible to process simultaneously, not taking into account the rate of each Transport Channel.

The number of simultaneous transport channels affects how the total memory space and processing capacity can be shared among the transport channels.

A UE does not need to support more simultaneous transport channels than the UE capability allows for.

Maximum number of simultaneous CCTrCH

CCTrCH should be interpreted as CCTrCH of any type, i.e. consisting of DCH, FACH or DSCH.

Maximum total number of transport blocks received within TTIs that end within the same 10 ms interval

All transport blocks that are to be simultaneously received by the UE on DCH, FACH, PCH and DSCH transport channels are included in the parameter.

Relates to processing requirements for CRC in downlink.

A UE does not need to support a TFC within the TFCS for which the sum of *Number of Transport Blocks* is larger than what the UE capability indicates.

Maximum number of TFC in the TFCS

The maximum number of TFC in a TFCS sets the size of the TFCI to TFCS mapping table to be handled by the UE.

Maximum number of TF

The maximum total number of downlink transport formats the UE can store.

Support for turbo decoding

Defines whether turbo decoding is supported or not

The UTRAN configuration parameter is *Type of channel coding* which is part of the Transport format set (TFS) of each transport channel.

4.5.2 Transport channel parameters in uplink

Maximum sum of number of bits of all transport blocks transmitted in TTIs that start at the same time

This parameter is defined as

$\Sigma_i(N_i)$

where N_i is defined as the number of bits in transport block #i, and the sum is over all transport blocks received in TTIs that end at the same time

This parameter is related to memory requirements for uplink data received from MAC before it can be transmitted over the radio interface. As shown in Figure 2 the worst case occurs for the maximum TTI.

A UE does not need to support a TFC within the TFCS for which the sum of *Number of Transport Blocks* * *Transport Block size* over all simultaneous transport channels is larger than what the UE capability indicates.

Maximum sum of number of bits of all convolutionally coded transport blocks transmitted in TTIs that start at the same time

This parameter is defined similar to the parameter above, but the sum includes only convolutionally coded transport blocks.

Maximum sum of number of bits of all turbo coded transport blocks transmitted in TTIs that start at the same time

This parameter is defined similar to the parameter above, but the sum includes only turbo coded transport blocks.

Maximum number of simultaneous transport channels

The number of simultaneous transport channels affects how the total memory space and processing capacity can be shared among the transport channels.

UTRAN shall not set up more simultaneous transport channels than the UE capability allows for.

Maximum number of simultaneous CCTrCH

TDD only. For FDD there is always only one CCTrCH at a time.

Maximum total number of transport blocks transmitted within TTIs that start at the same time

Relates to processing requirements for CRC in uplink.

A UE does not need to support the TFC within the TFCS for which the sum of *Number of Transport Blocks* is larger than what the UE capability allows for.

Maximum number of TFC in the TFCS

The maximum number of TFC in a TFCS sets the size of the TFCI to TFCS mapping table to be handled by the UE.

Maximum number of TF

The maximum total number of uplink transport formats the UE can store.

Support for turbo encoding

Defines whether turbo encoding is supported or not

The UTRAN configuration parameter is *Type of channel coding* which is part of the Transport format set (TFS) of each transport channel.

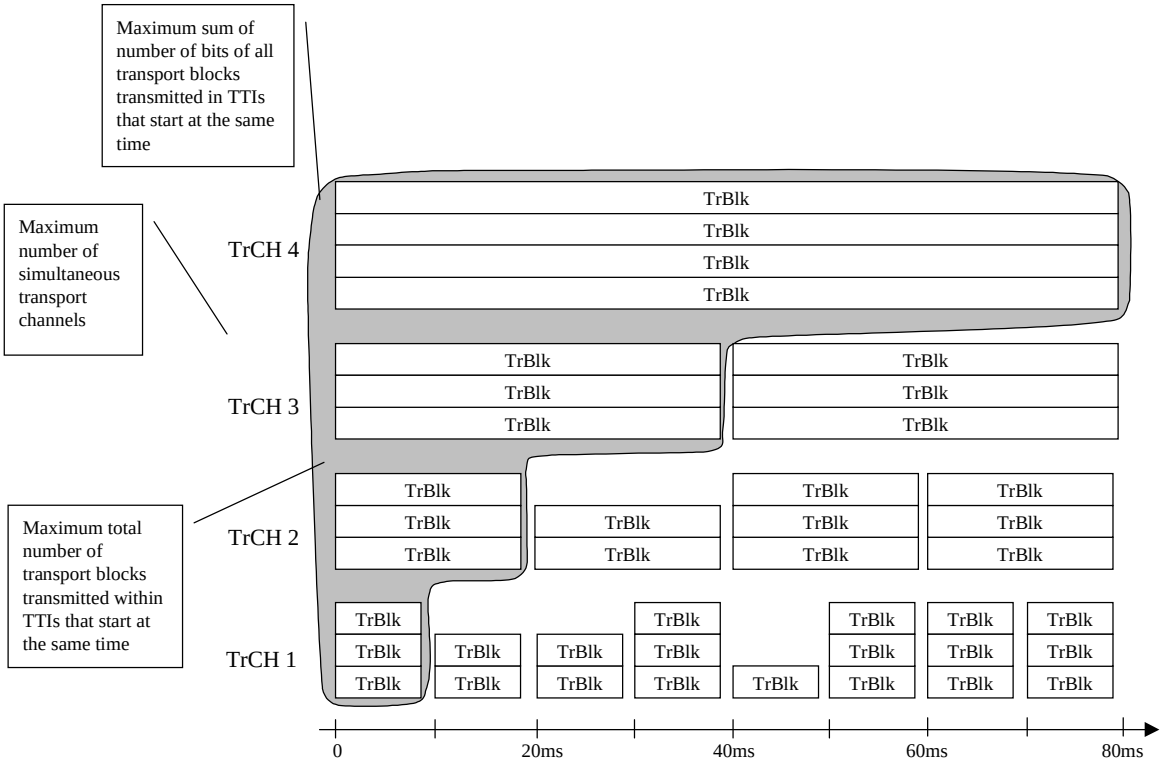


Figure 2: UE transport channel processing limitations in uplink

4.5.3 FDD Physical channel parameters in downlink

Maximum number of DPCH/PDSCH codes to be simultaneously received

Defines the number of codes the UE is capable of receiving in parallel. For DPCH in soft/softer handover, each DPCH is only calculated once in this capability. The capability does not include codes used for S-CCPCH.

Maximum number of physical channel bits received in any 10 ms interval (DPCH, PDSCH, S-CCPCH)

Defines the number of physical channel bits the UE is capable of receiving. For DPCH in soft/softer handover, each DPCH is only calculated once in this capability.

The number of DPCH channel bits indicates the capability for normal, un-compressed mode.

Support for SF 512

Spreading factor 512 should not be mandatory for all UEs.

The corresponding configuration parameter is *Spreading factor* which is part of *Downlink DPCH info*.

Support of PDSCH

Support of PDSCH is only required for some RAB realisations, and is therefore a UE capability.

The corresponding configuration parameter is *Downlink transport channel type*, which is part of *RB mapping info*.

Simultaneous reception of SCCPCH and DPCH/PDSCH

Simultaneous reception of SCCPCH and DPCH/PDSCH, i.e. simultaneous reception of FACH and DCH/DSCH is required for e.g. DRAC procedure, but it should not be mandatory for all UEs (e.g. speech only UEs). The PDSCH part of this capability is only relevant if the UE supports PDSCH, as covered by the capability "Support of PDSCH".

There is no specific configuration parameter.

Maximum number of simultaneous S-CCPCH radio links

Defines the maximum number of radio links on which the UE is capable of receiving S-CCPCH simultaneously.

4.5.4 FDD physical channel parameters in uplink

Maximum number of DPDCH bits per 10 ms

This capability combines the 'Max number of DPDCH' and 'Minimum SF' capabilities into one capability. Note that no flexibility is lost due to this, as multiple DPDCH is only used for SF=4, i.e. when the number of DPDCH bits exceed a certain value.

Support of PCPCH

Support of PCPCH is only required for some RAB realisations, and is therefore a UE capability.

There is no specific configuration parameter.

4.5.5 TDD physical channel parameters in downlink

Maximum number of timeslots per frame

Defines the maximum number of timeslots per frame that the UE can receive.

Maximum number of physical channels per frame

This parameter defines how many physical channels can be received during one frame. The distribution of the received physical channels on the received timeslots can be arbitrary.

Minimum SF

Defines the minimum SF supported by the UE.

Support of PDSCH

Defines whether PDSCH is supported or not.

4.5.6 TDD physical channel parameters in uplink

Maximum Number of timeslots per frame

Defines the maximum number of timeslots per frame that the UE can transmit.

Maximum number of physical channels per timeslot

Defines the maximum number physical channels transmitted in parallel during one timeslot.

Minimum SF

Defines the minimum SF supported by the UE.

Support of PUSCH

Defines whether PUSCH is supported or not.

4.5.7 RF parameters

UE power class

The value is fixed per UE and is not related to any configuration parameter.

Radio frequency bands

Defines the uplink and downlink frequency bands supported by the UE.

Configuration parameters are *UTRA RF Channel numbers* for uplink and downlink, which are part of *Frequency info*.

Tx/Rx frequency separation

Defines the uplink/downlink frequency separations supported by the UE.

Configuration parameters are *UTRA RF Channel numbers* for uplink and downlink, which are part of *Frequency info*.

Chip rate capability

Chip rates supported by the UE.

Corresponding configuration parameter is *chip rate, which* is part of *Frequency info*.

4.6 Multi-mode related parameters

Support of UTRA FDD/TDD

Defines whether UTRA FDD and/or TDD are supported.

There is no explicit configuration parameter.

4.7 Multi-RAT related parameters

Support of GSM

Defines whether GSM is supported or not.

There is no explicit configuration parameter.

Support of multi-carrier

Defines whether multi-carrier is supported or not.

There is no explicit configuration parameter.

4.8 LCS related parameters

Standalone location method(s) supported

Defines if a UE can measure its location by some means unrelated to UTRAN (e.g. if the UE has access to a standalone GPS receiver)

OTDOA UE based method supported

Defines if a UE supports the OTDOA UE based schemes.

Network Assisted GPS support

Defines if a UE supports either of the two types of assisted GPS schemes, namely "Network based", "UE based", "Both", or "none".

GPS reference time capable

Defines if a UE has the capability to measure GPS reference time as defined in 25.215.

Support for IPDL

Defines if a UE has the capability to use IPDL to enhance its "SFN-SFN observed time difference –type 2" measurement.

4.9 Measurement related capabilities

Need for downlink compressed mode

Defines whether the UE needs compressed mode in the downlink in order to perform inter-frequency measurements.

Need for uplink compressed mode

Defines whether the UE needs compressed mode in the uplink in order to perform inter-frequency measurements.

5 Possible UE radio access capability parameter settings

5.1 Value ranges

Table 1: UE radio access capability parameter value ranges

		UE radio access capability parameter	Value range
PDCP parameters		Header compression algorithm supported	Yes/No
RLC parameters		Total RLC AM buffer size	2,10,50,100,150,500,1000 kBytes
		Maximum number of AM entities	2,3,4,8,16,32
PHY parameters	Transport channel parameters in downlink	Maximum sum of number of bits of all transport blocks received in TTIs that end within the same arbitrary interval of length T<10 ms	640, 1280, 2560, 3840, 5120, 6400, 7680, 8960, 10240, 20480, 40960, 81920, 163840
		Maximum sum of number of bits of all convolutionally coded transport blocks received in TTIs that end within the same arbitrary interval of length T<10 ms	640, 1280, 2560, 3840, 5120, 6400, 7680, 8960, 10240, 20480, 40960, 81920, 163840
		Maximum sum of number of bits of all turbo coded transport blocks received in TTIs that end within the same arbitrary interval of length T<10 ms	640, 1280, 2560, 3840, 5120, 6400, 7680, 8960, 10240, 20480, 40960, 81920, 163840
		Maximum number of simultaneous transport channels	4, 8, 16, 32
		Maximum number of simultaneous CCTrCH	1, 2, 3, 4, 5, 6, 7, 8
		Maximum total number of transport blocks received within TTIs that end within the same 10 ms interval	4, 8, 16, 32, 48, 64, 96, 128, 256, 512
		Maximum number of TFC in the TFCS	16, 32, 48, 64, 96, 128, 256, 512, 1024
		Maximum number of TF	32, 64, 128, 256, 512, 1024
		Support for turbo decoding	Yes/No
	Transport channel parameters in uplink	Maximum sum of number of bits of all transport blocks transmitted in TTIs that start at the same time	640, 1280, 2560, 3840, 5120, 6400, 7680, 8960, 10240, 20480, 40960, 81920, 163840
		Maximum sum of number of bits of all convolutionally coded transport blocks transmitted in TTIs that start at the same time	640, 1280, 2560, 3840, 5120, 6400, 7680, 8960, 10240, 20480, 40960, 81920, 163840
		Maximum sum of number of bits of all turbo coded transport blocks transmitted in TTIs that start at the same time	640, 1280, 2560, 3840, 5120, 6400, 7680, 8960, 10240, 20480, 40960, 81920, 163840
		Maximum number of simultaneous transport channels	2, 4, 8, 16, 32
		Maximum number of simultaneous CCTrCH of DCH type (TDD only)	1, 2, 3, 4, 5, 6, 7, 8
		Maximum total number of transport blocks transmitted within TTIs that start at the same time	2, 4, 8, 16, 32, 48, 64, 96, 128, 256, 512
		Maximum number of TFC in the TFCS	4, 8, 16, 32, 48, 64, 96, 128, 256, 512, 1024
		Maximum number of TF	32, 64, 128, 256, 512, 1024
		Support for turbo encoding	Yes/No
	FDD Physical channel parameters in downlink	Maximum number of DPCH/PDSCH codes to be simultaneously received	1, 2, 3, 4, 5, 6, 7, 8

		Maximum number of physical channel bits received in any 10 ms interval (DPCH, PDSCH, S-CCPCH)	300, 600, 1200, 2400, 4800, 9600, 19200, 28800, 38400, 48000, 57600, 67200
		Support for SF 512	Yes/No
		Support of PDSCH	Yes/No
		Simultaneous reception of SCCPCH and DPCH	Yes/No
		Maximum number of simultaneous S-CCPCH radio links	1 NOTE: Only the value 1 is part of R99
	FDD Physical channel parameters in uplink	Maximum number of DPDCH bits transmitted per 10 ms	150, 300, 600, 1200, 2400, 4800, 960, 19200, 28800, 38400, 48000, 57600
		Support of PCPCH	Yes/No
	TDD physical channel parameters in downlink	Maximum number of timeslots per frame	1..14
		Maximum number of physical channels per frame	1,2,3..,224
		Minimum SF	16, 1
		Support of PDSCH	Yes/No
	TDD physical channel parameters in uplink	Maximum Number of timeslots per frame	1..14
		Maximum number of physical channels per timeslot	1, 2
		Minimum SF	16,8,4,2,1
		Support of PUSCH	Yes/No
RF parameters	FDD RF parameters	UE power class (25.101 section 6.2.1)	3, 4 NOTE: Only power classes 3 and 4 are part of R99
		Tx/Rx frequency separation (25.101 section 5.3) . NOTE: Not applicable if UE is not operating in frequency band a	190 MHz 174.8-205.2 MHz 134.8-245.2 MHz
RF parameters	TDD RF parameters	UE power class (25.102)	2,3 NOTE: Only power classes 2 and 3 are part of R99
		Radio frequency bands (25.102)	a), b), c), a+b), a+c), a+b+c)
		Chip rate capability (25.102)	3.84,1.28
Multi-mode related parameters		Support of UTRA FDD/TDD	FDD, TDD, FDD+TDD
Multi-RAT related parameters		Support of GSM	Yes/No
		Support of multi-carrier	Yes/No
LCS related parameters		Standalone location method(s) supported	Yes/No
		Network assisted GPS support	Network based / UE based / Both/ None
		GPS reference time capable	Yes/No
		Support for IPDL	Yes/No
		Support for OTDOA UE based method	Yes/No
Measurement related capabilities		Need for downlink compressed mode	Yes/No (per frequency band, UTRA mode and RAT)
		Need for uplink compressed mode	Yes/No (per frequency band, UTRA mode and RAT)

5.2 Reference UE radio access capability combinations

Based on required UE radio access capabilities to support reference RABs as defined in section 6, this section lists reference UE Radio Access capability combinations. Section 5.2.1 defines reference combinations of UE

radio access capability parameters common for UL and DL. Section 5.2.2 and 5.2.3 define reference combinations of UE radio access capability parameters that are separate for DL and UL respectively. A reference combination for common UL and DL parameters, one combination for UL parameters and one combination for DL parameters together relate to a UE with a certain implementation complexity, that allows support for one or several combined reference RABs. Combinations for UL and DL can be chosen independently. Different combinations have different levels of implementation complexity.

For defined reference RABs, it is possible to require a UE to meet a certain reference UE radio access capability combination. Each UE needs to have capabilities complying with a given reference radio access capability combination. Each individual radio access capability parameter as defined in Section 5.1 shall be signalled.

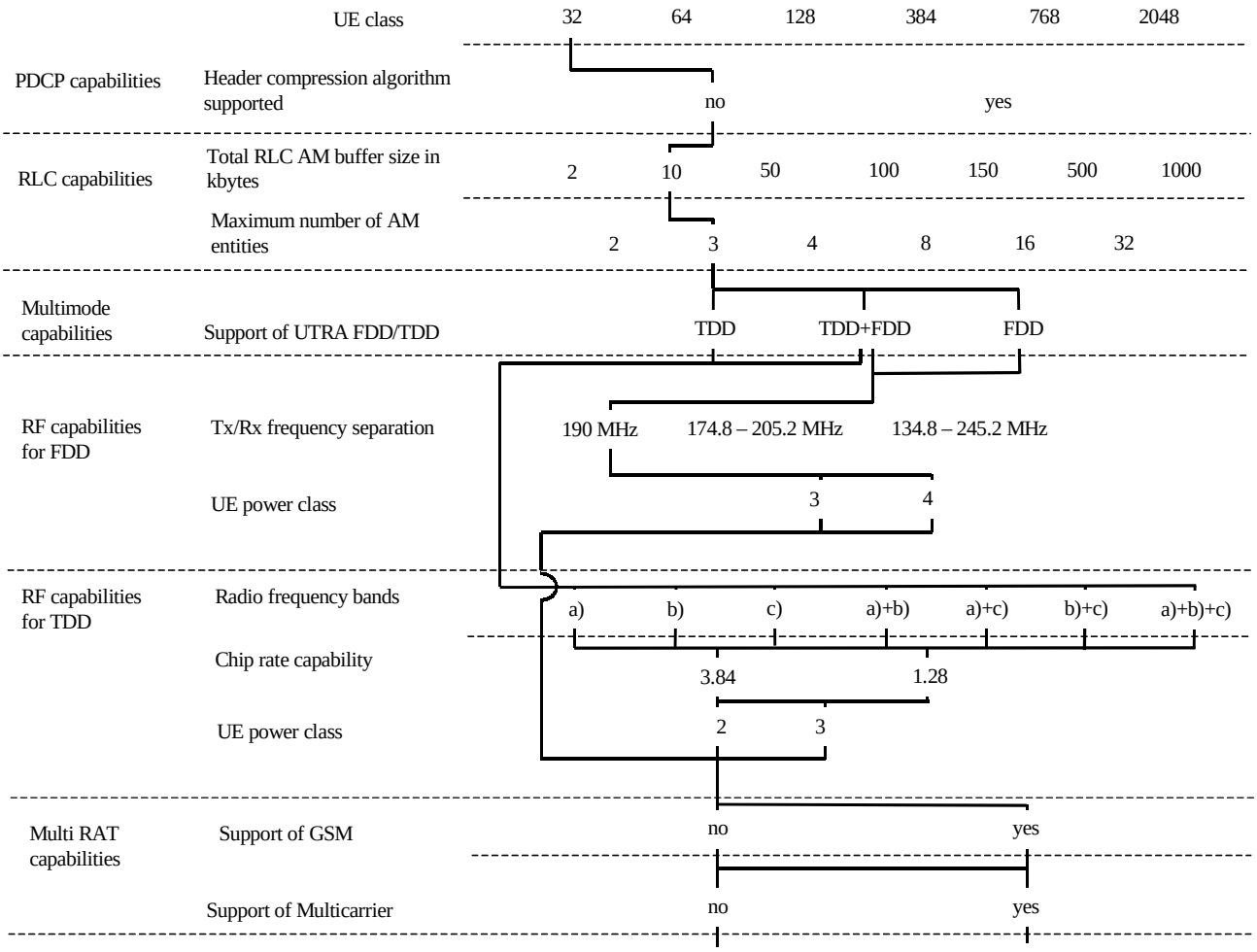
The reference combination numbers shall not be used in the signalling of UE radio access capabilities between the UE and UTRAN. Reference UE radio access capability combinations provide default configurations that should be used as a basis for conformance testing against reference RABs.

Allowed values of UE capability parameters are limited by the defined range and granularity of values in Section 5.1. Values might change depending on further definition of reference RABs for testing.

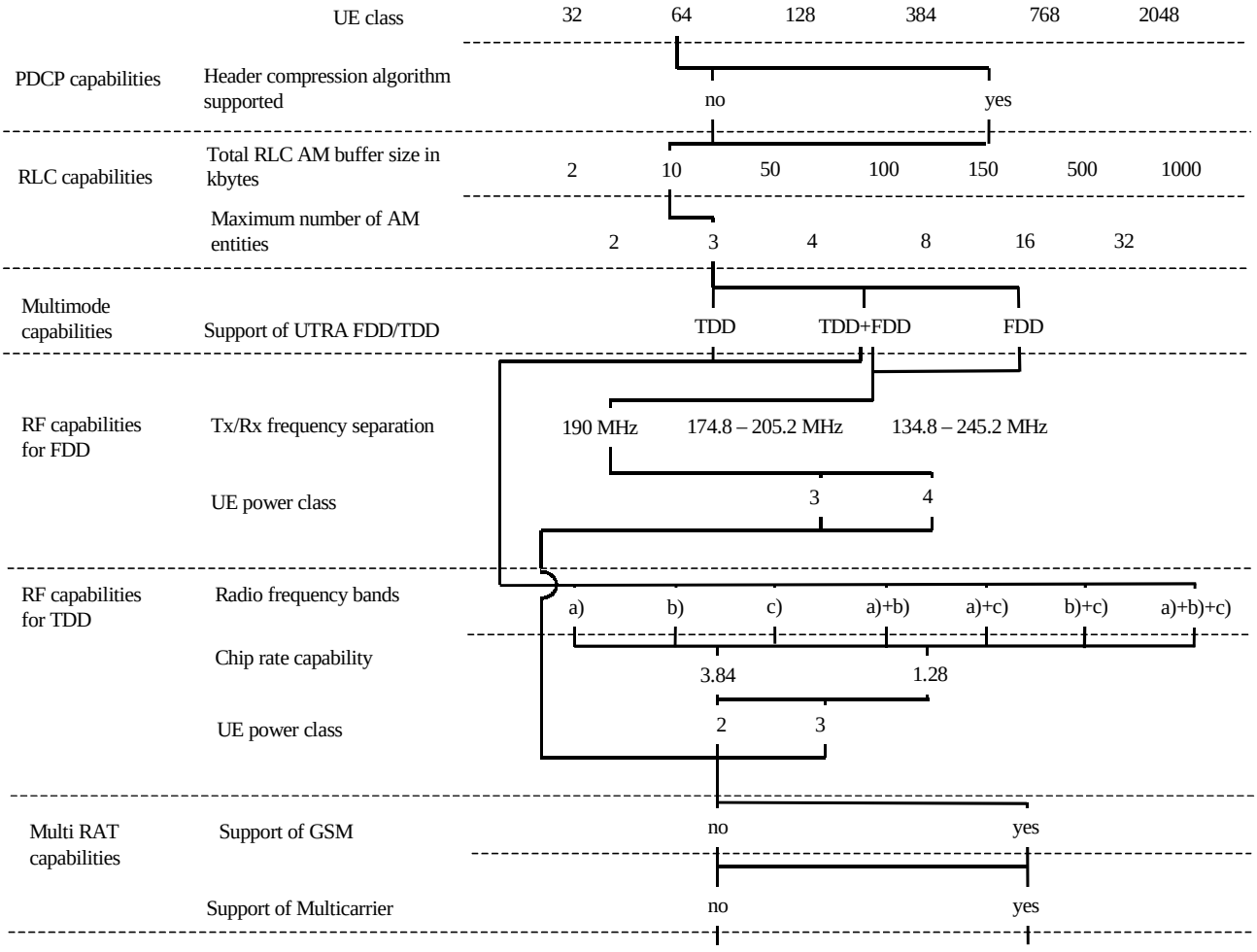
5.2.1 Combinations of common UE Radio Access Parameters for UL and DL

NOTE: It is FFS whether LCS capabilities and measurement-related capabilities need to be included in the combinations. These capabilities are independent from the supported RABs.

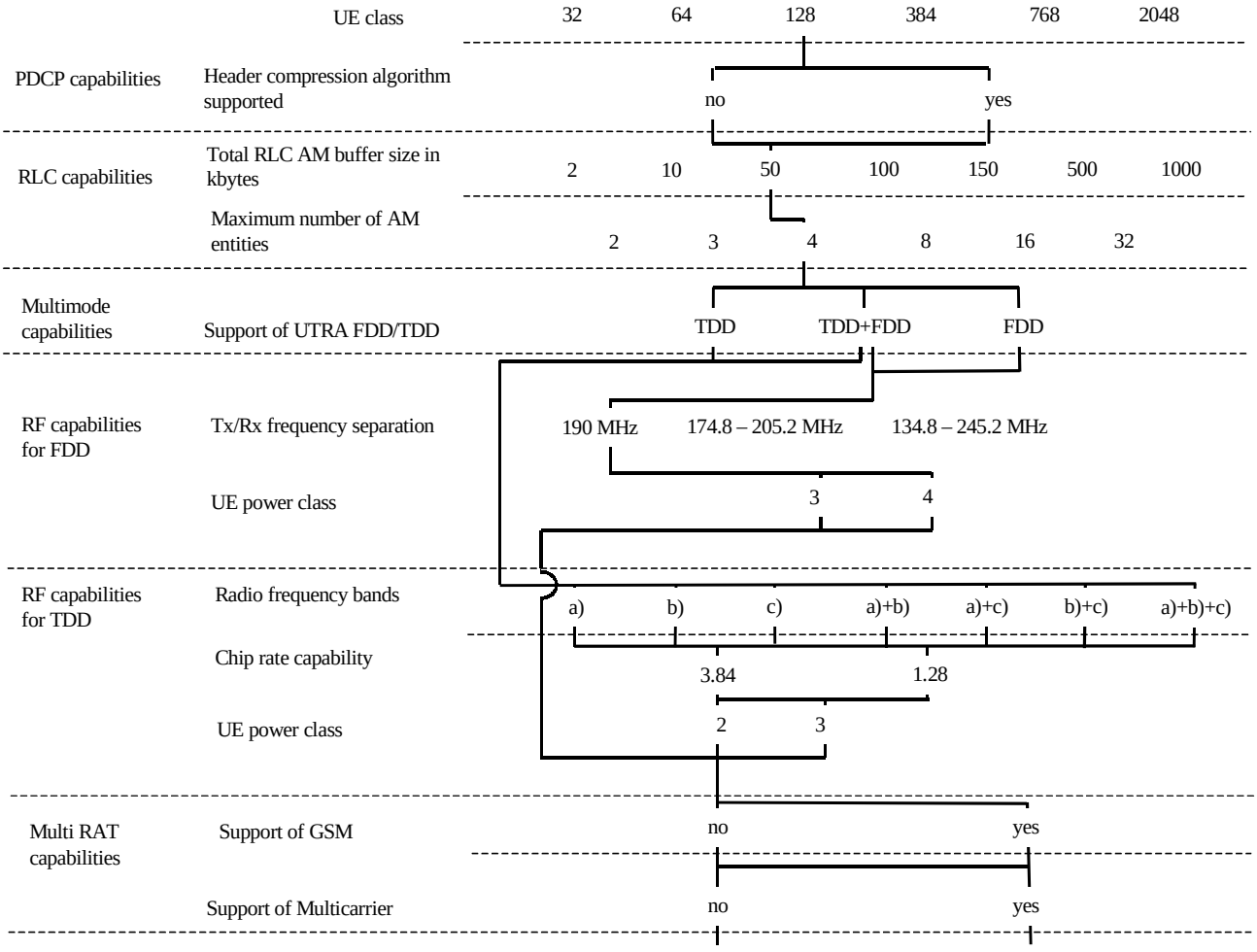
Common UE Radio Access Capability Parameters for UL and DL for 32 kbps class



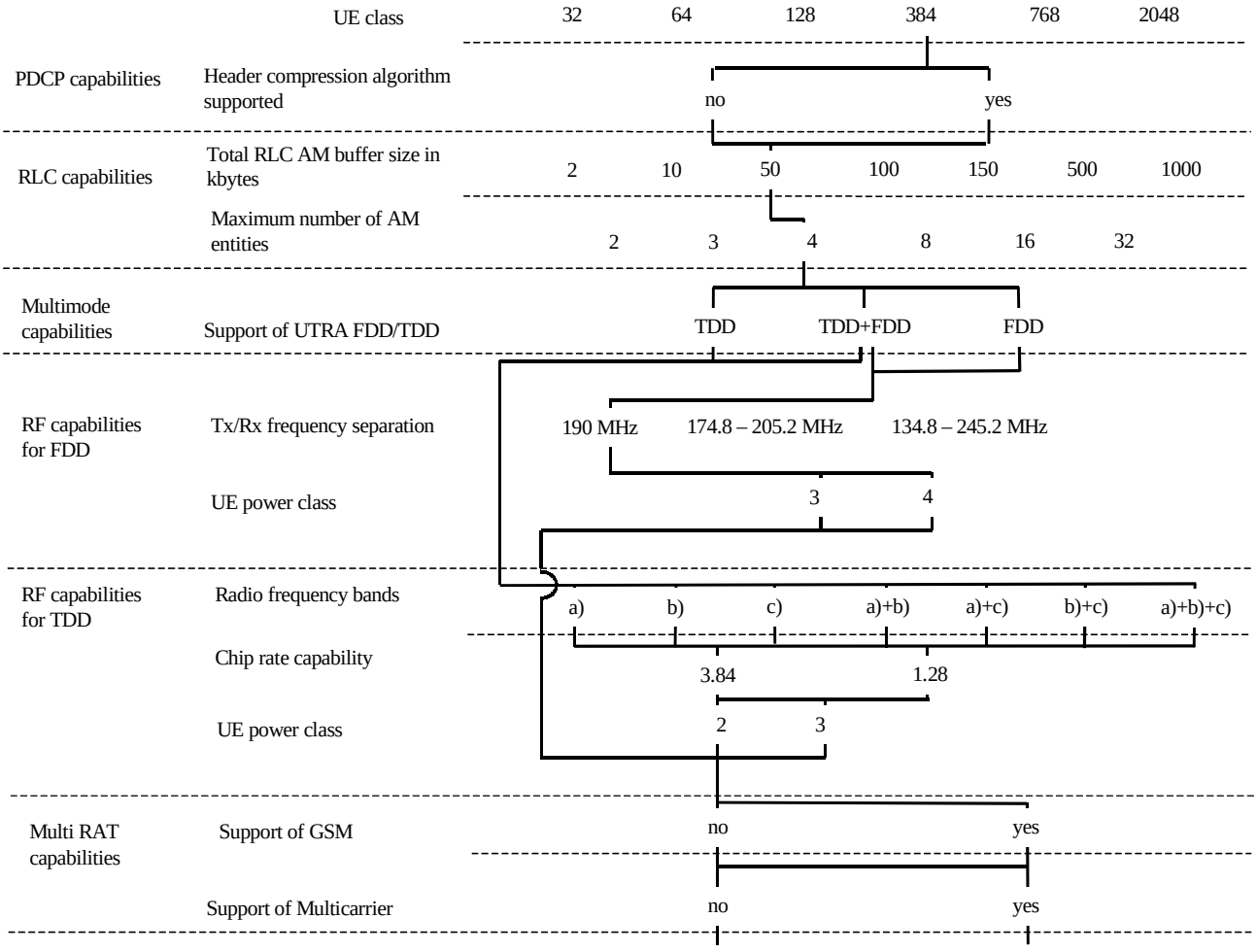
Common UE Radio Access Capability Parameters for UL and DL for 64 kbps class



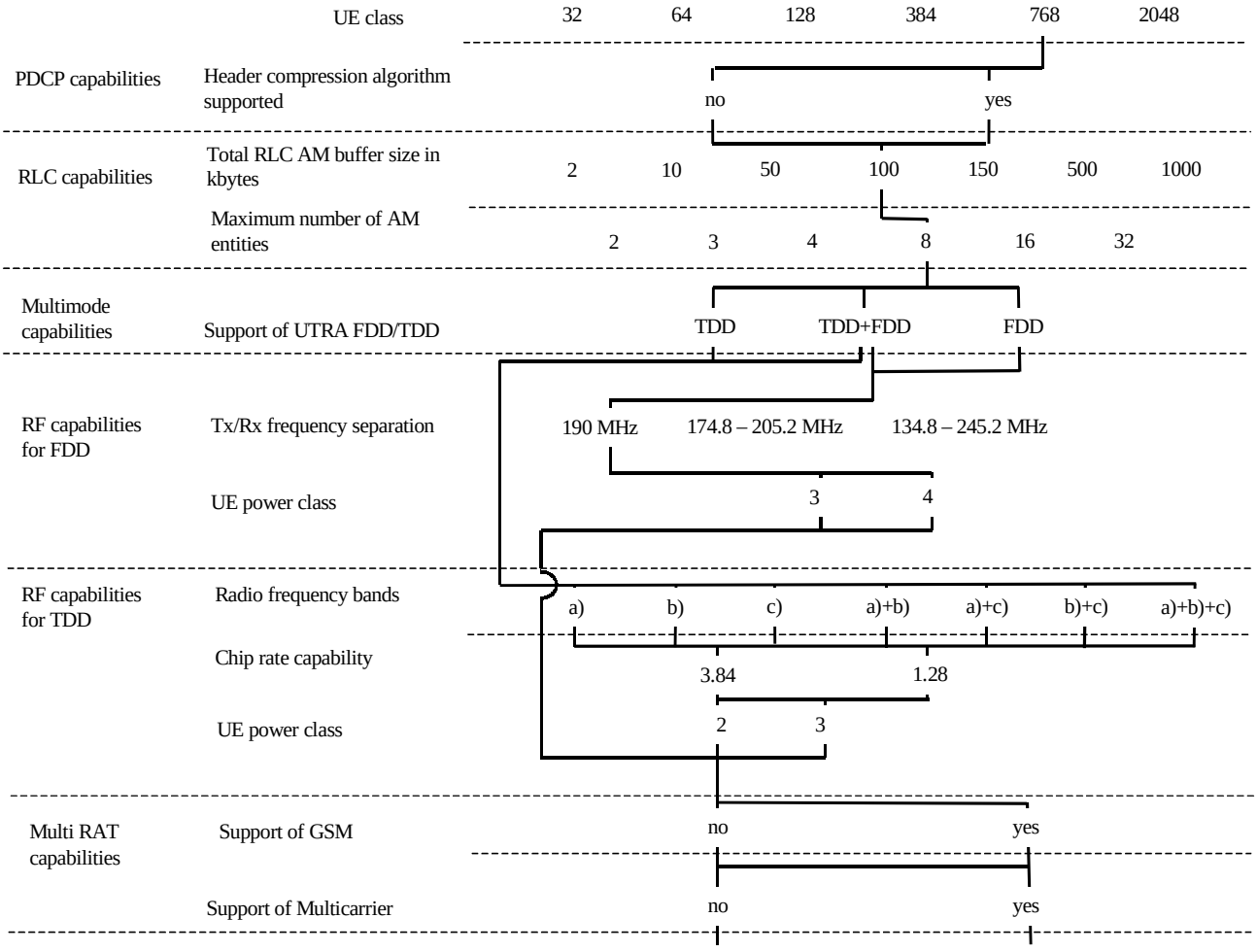
Common UE Radio Access Capability Parameters for UL and DL for 128 kbps class



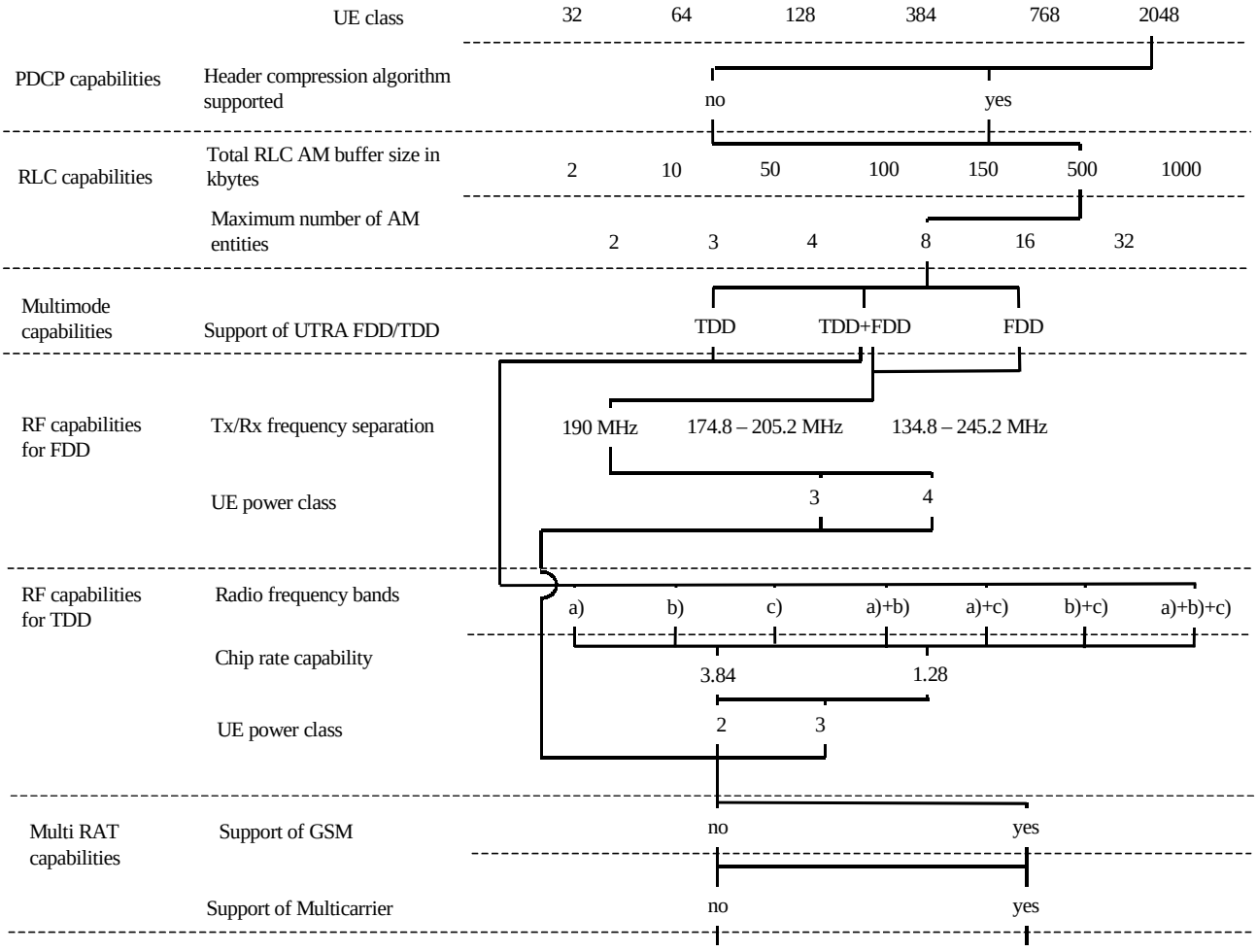
Common UE Radio Access Capability Parameters for UL and DL for 384 kbps class



Common UE Radio Access Capability Parameters for UL and DL for 768 kbps class

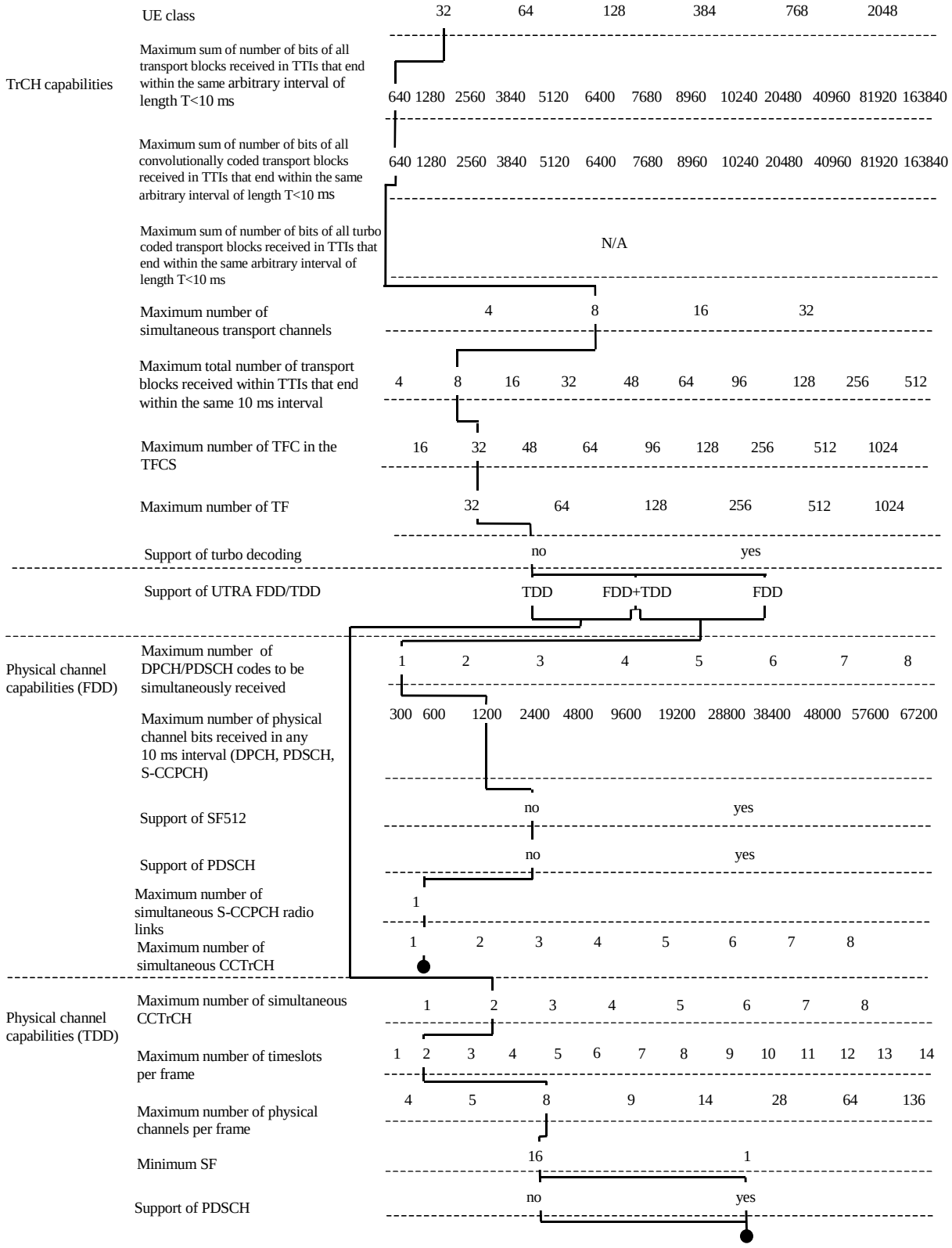


Common UE Radio Access Capability Parameters for UL and DL for 2048 kbps class

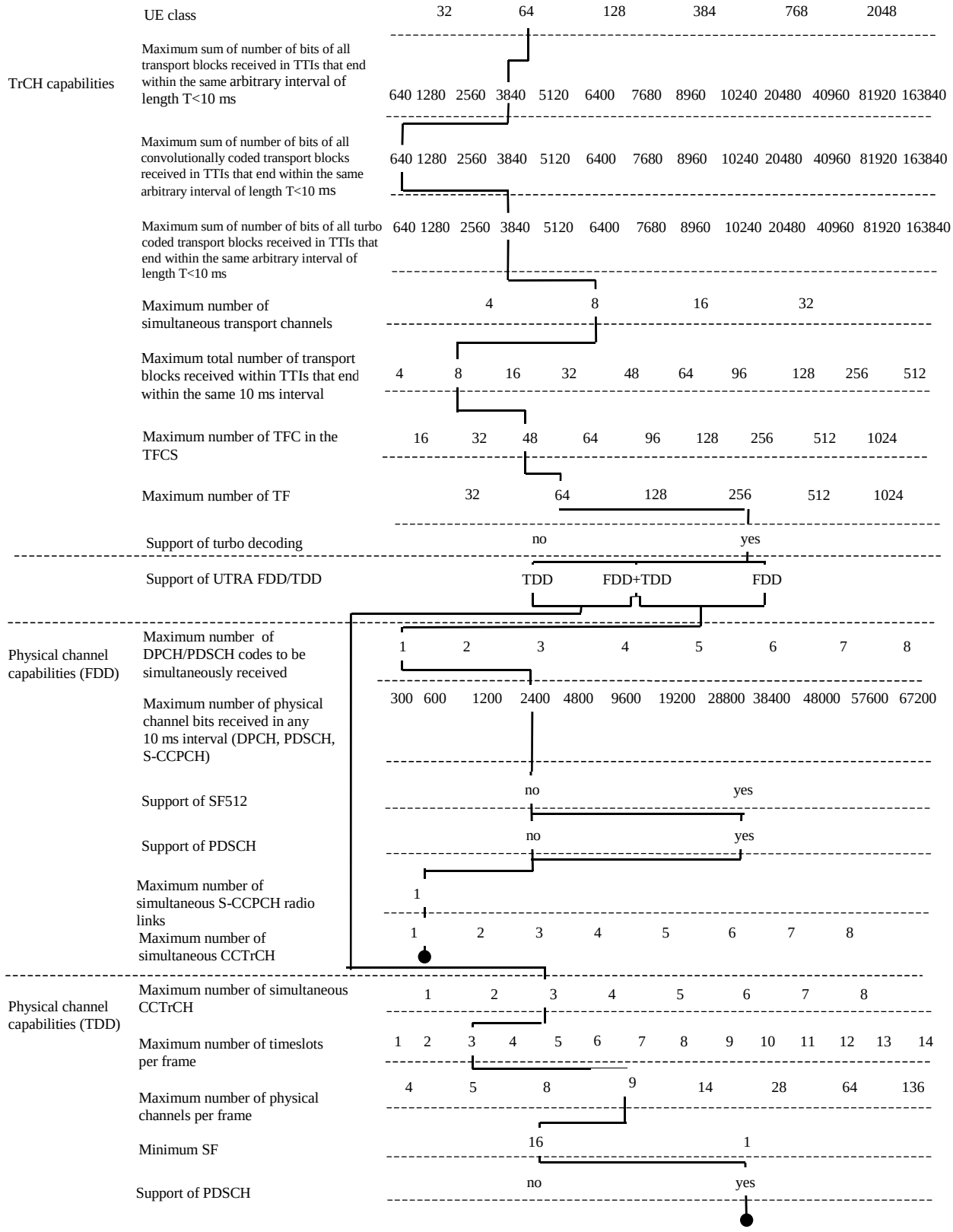


5.2.2 Combinations of UE Radio Access Parameters for DL

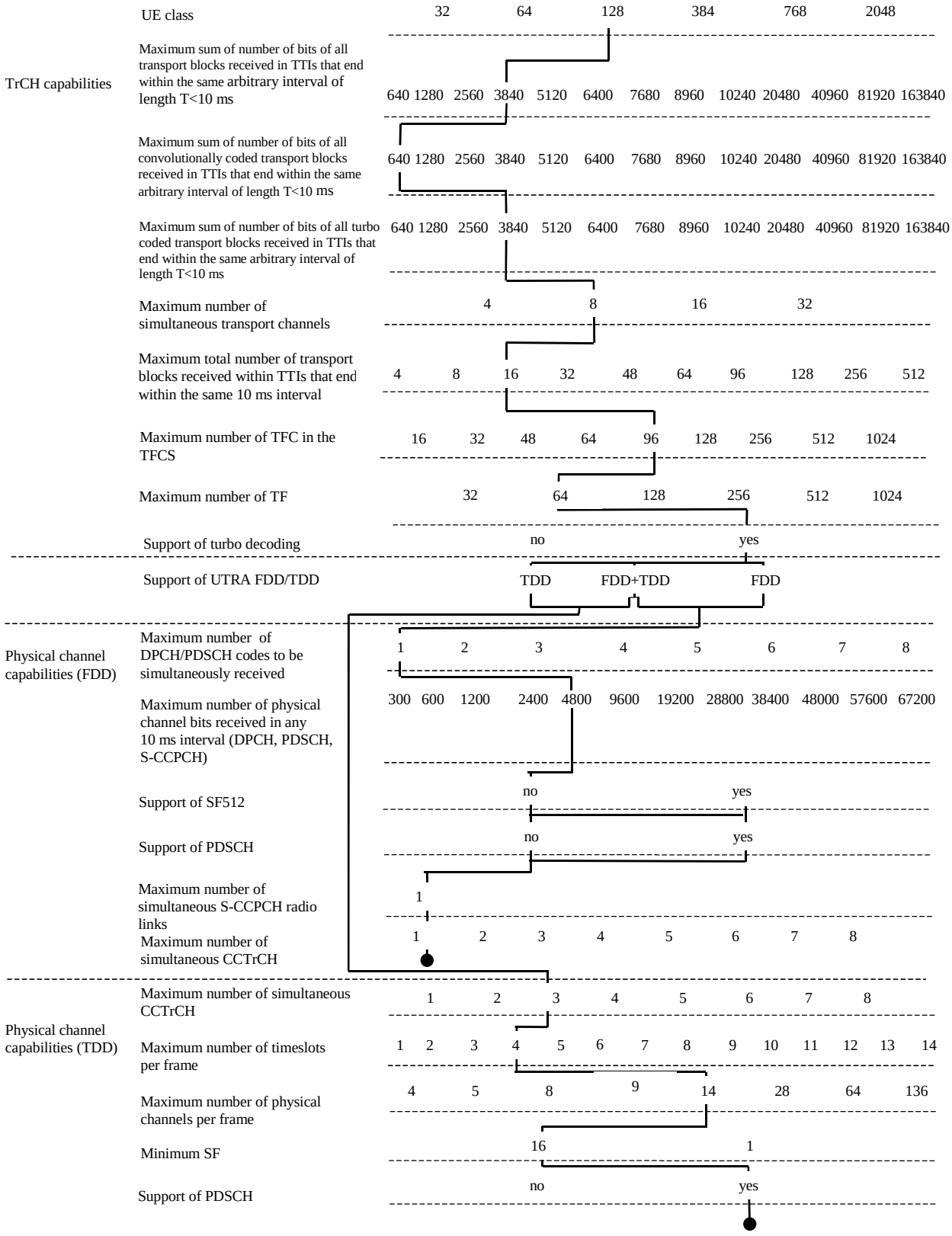
UE Radio Access Capability Parameters for DL 32 kbit class



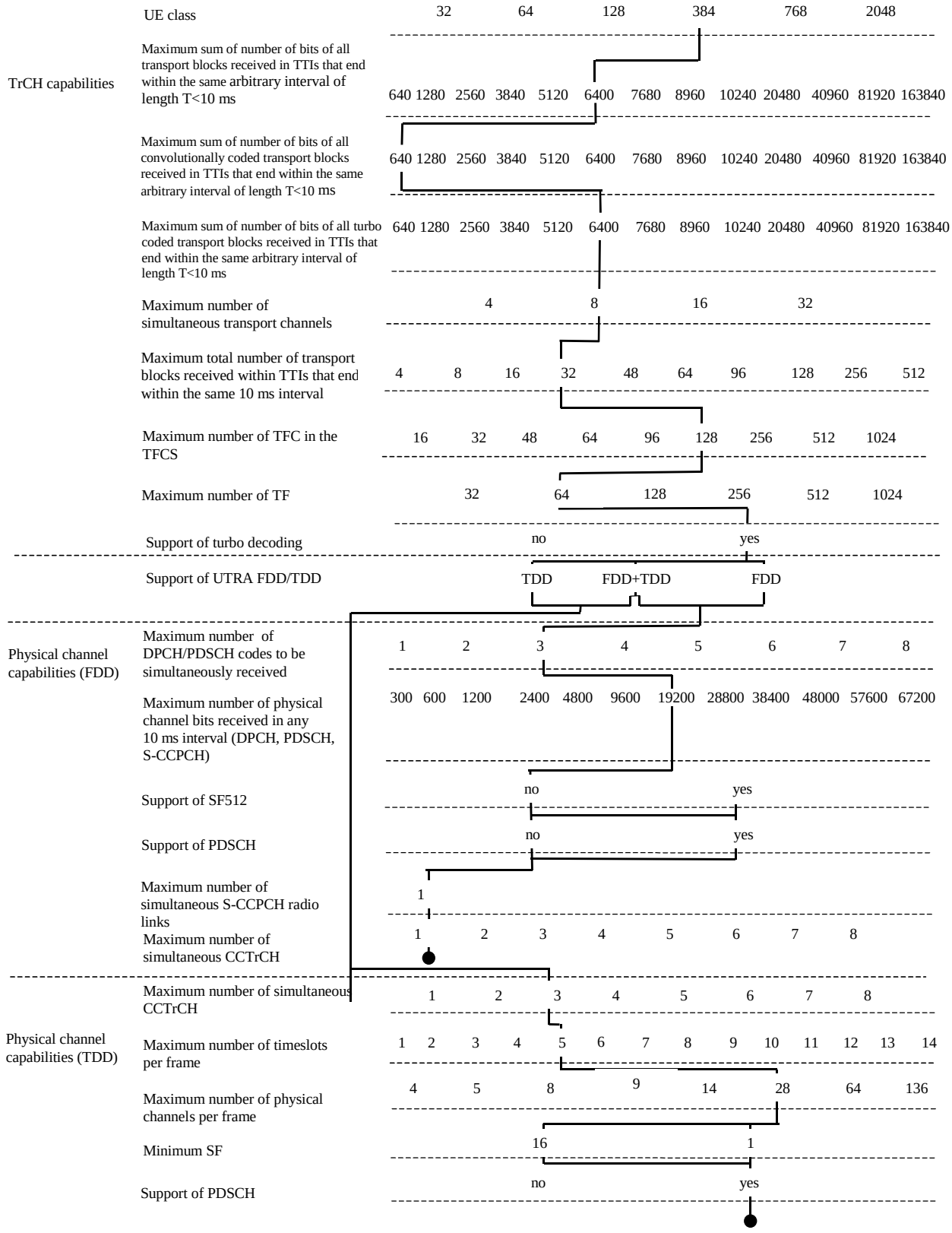
UE Radio Access Capability Parameters for DL 64 kbit class



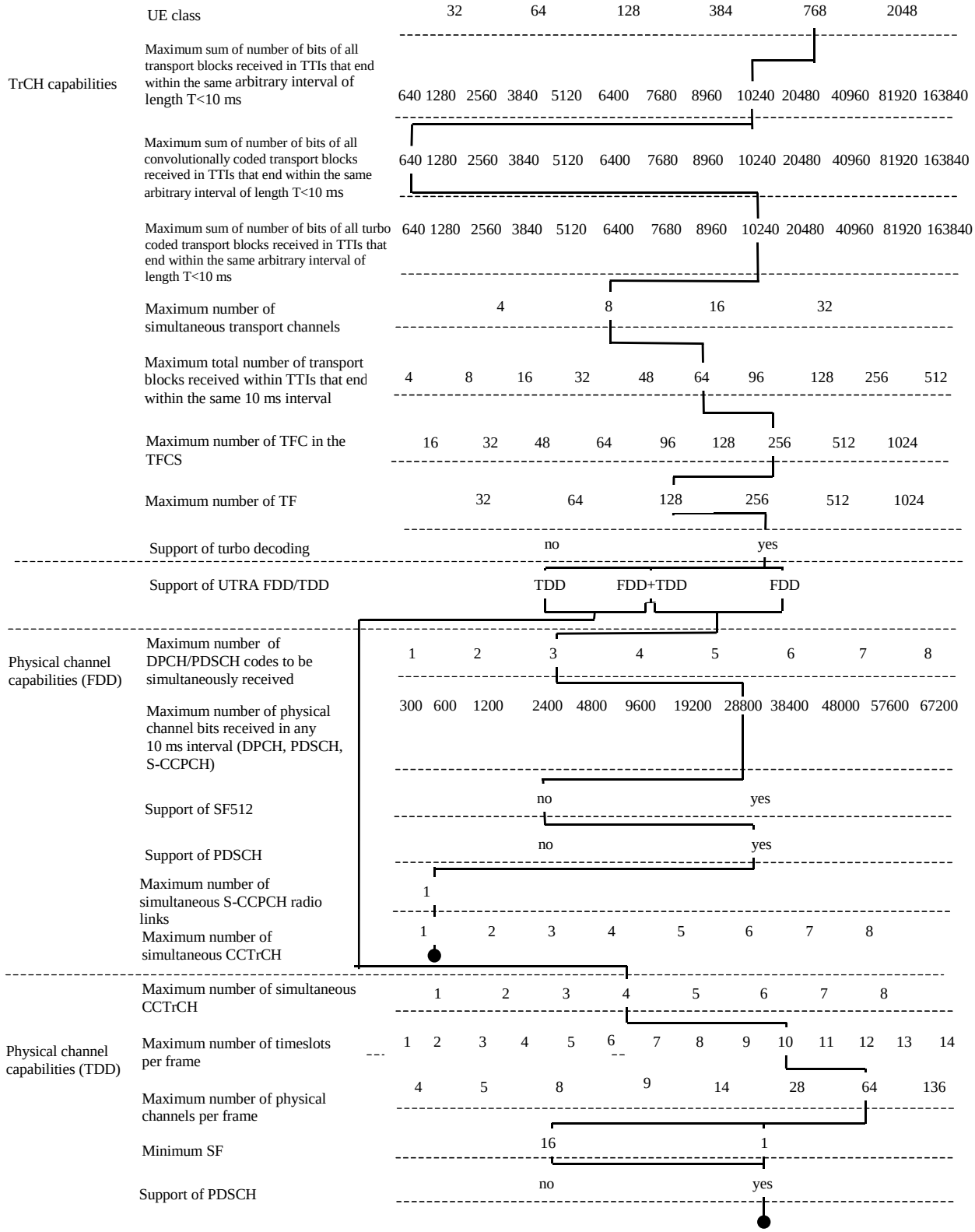
UE Radio Access Capability Parameters for DL 128 kbit class



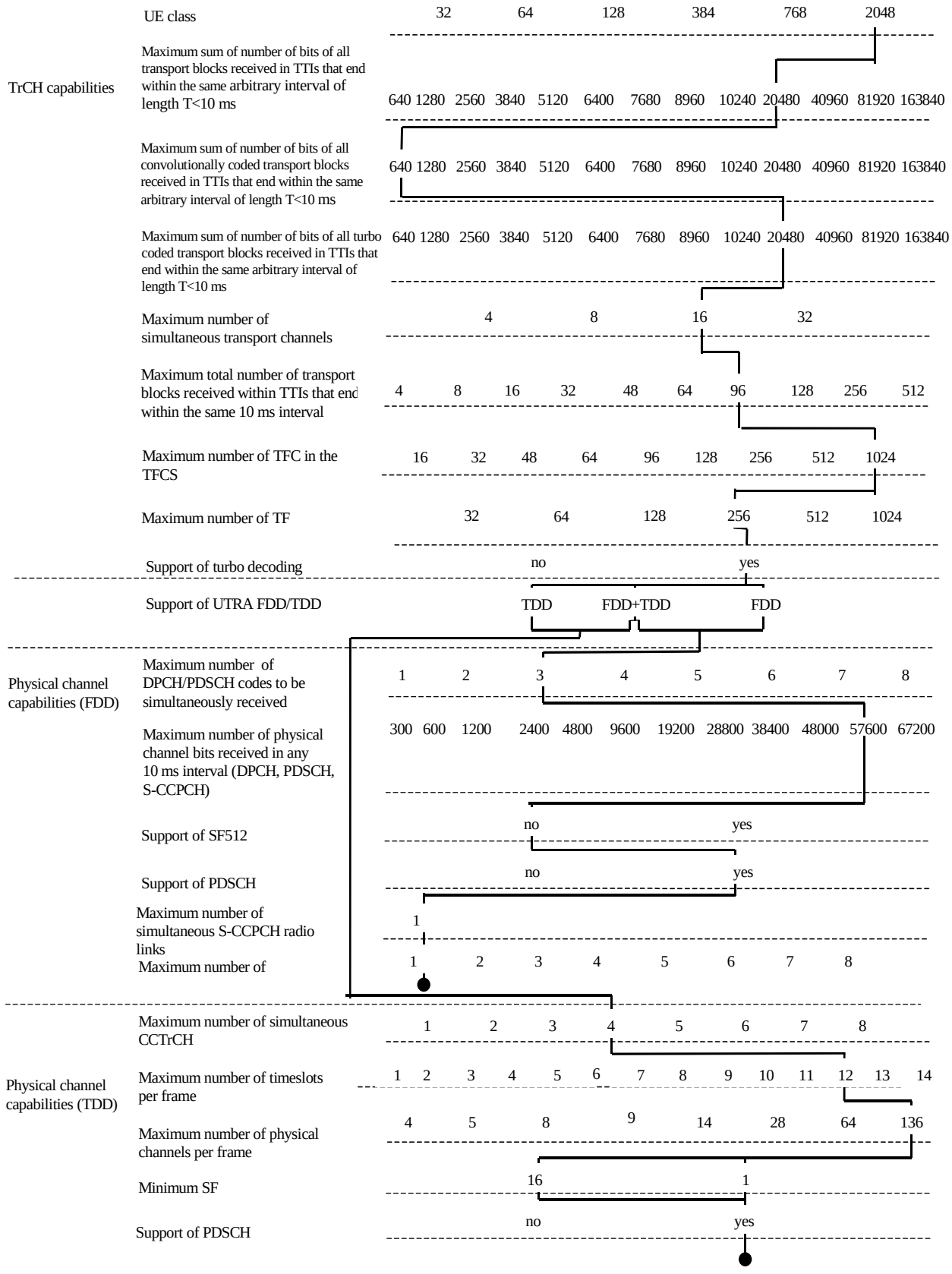
UE Radio Access Capability Parameters for DL 384 kbit class



UE Radio Access Capability Parameters for DL 768 kbit class

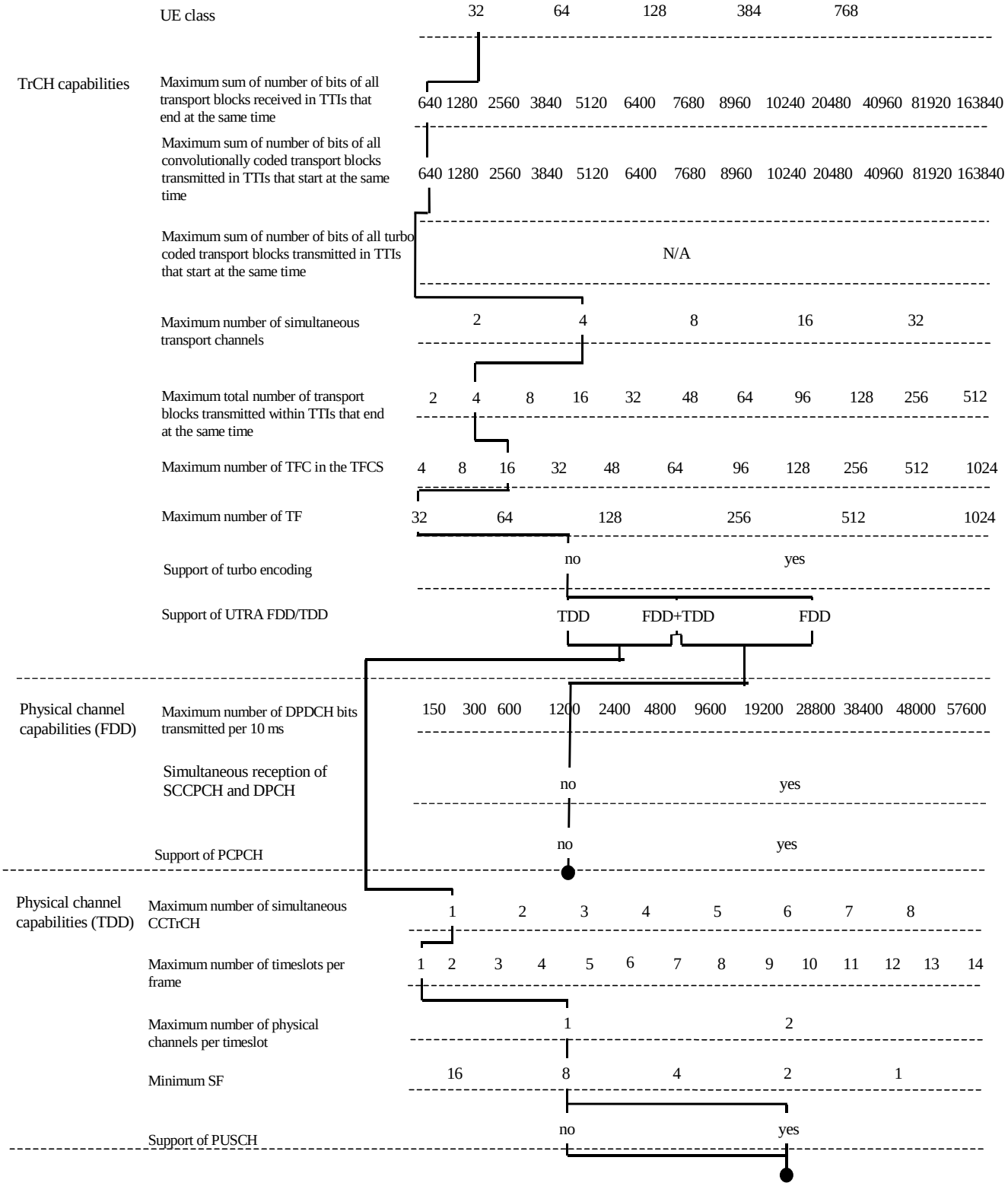


UE Radio Access Capability Parameters for DL 2048 kbit class

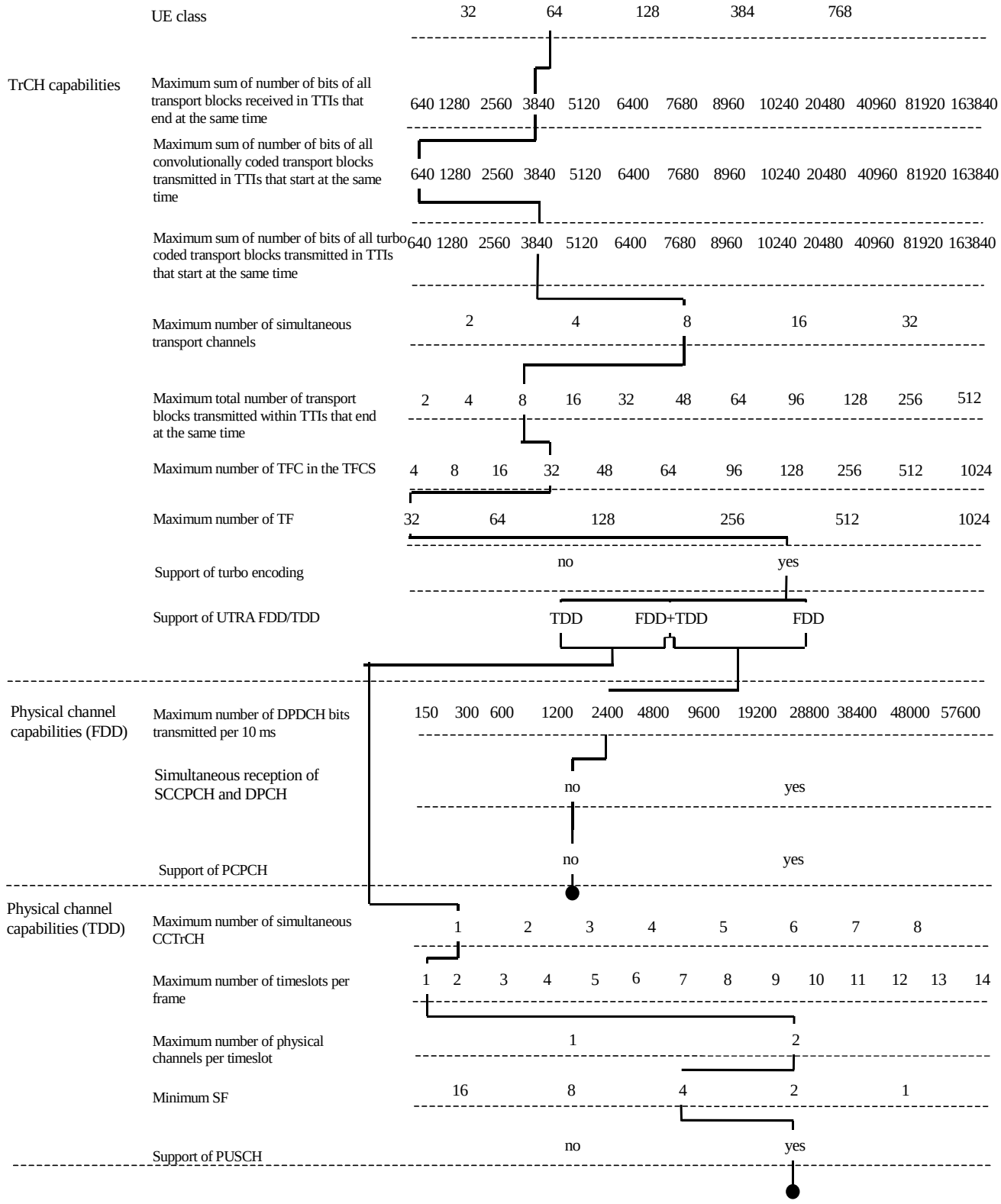


5.2.3 Combinations of UE Radio Access Parameters for UL

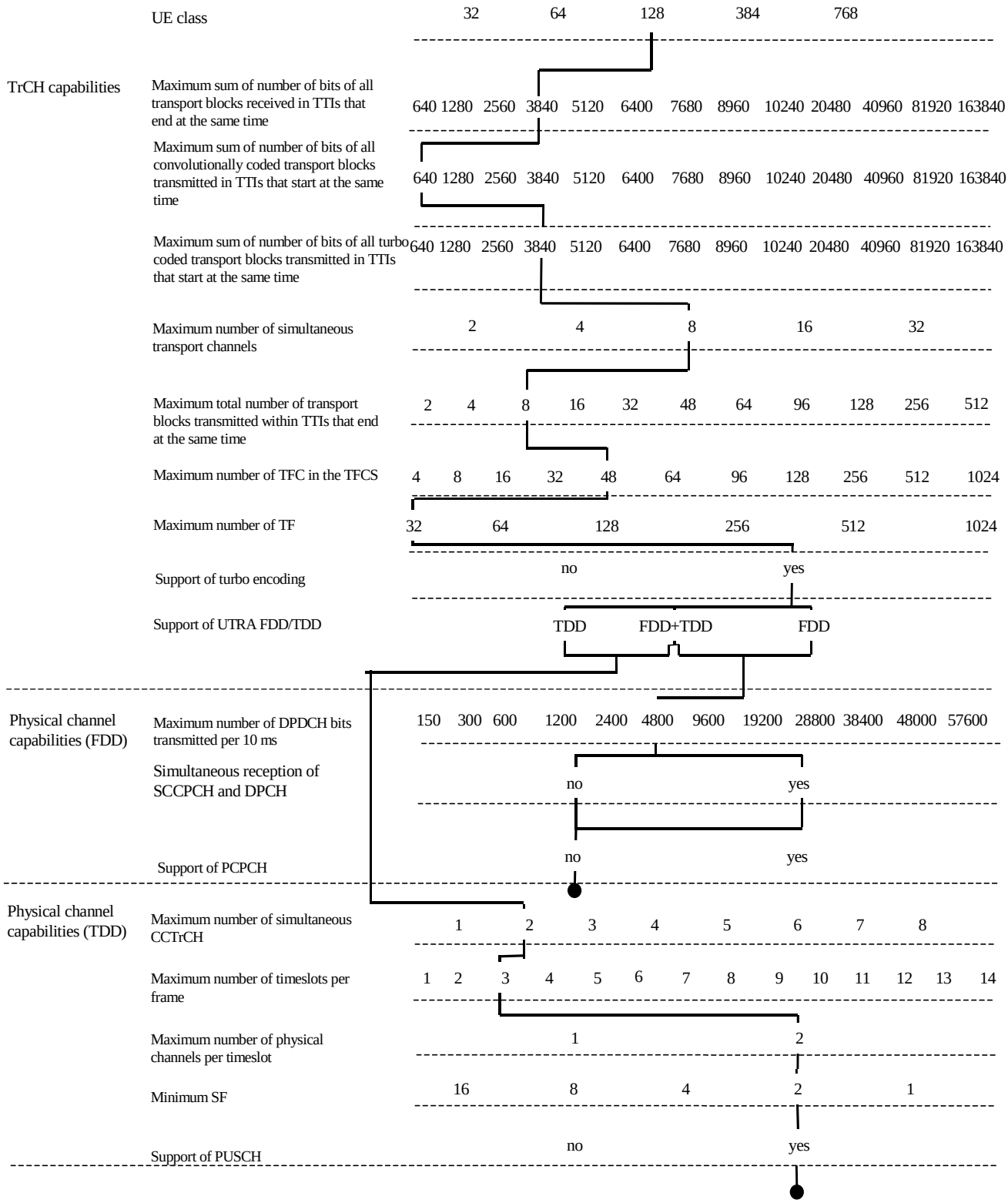
UE Radio Access Capability Parameters for UL 32 kbit class



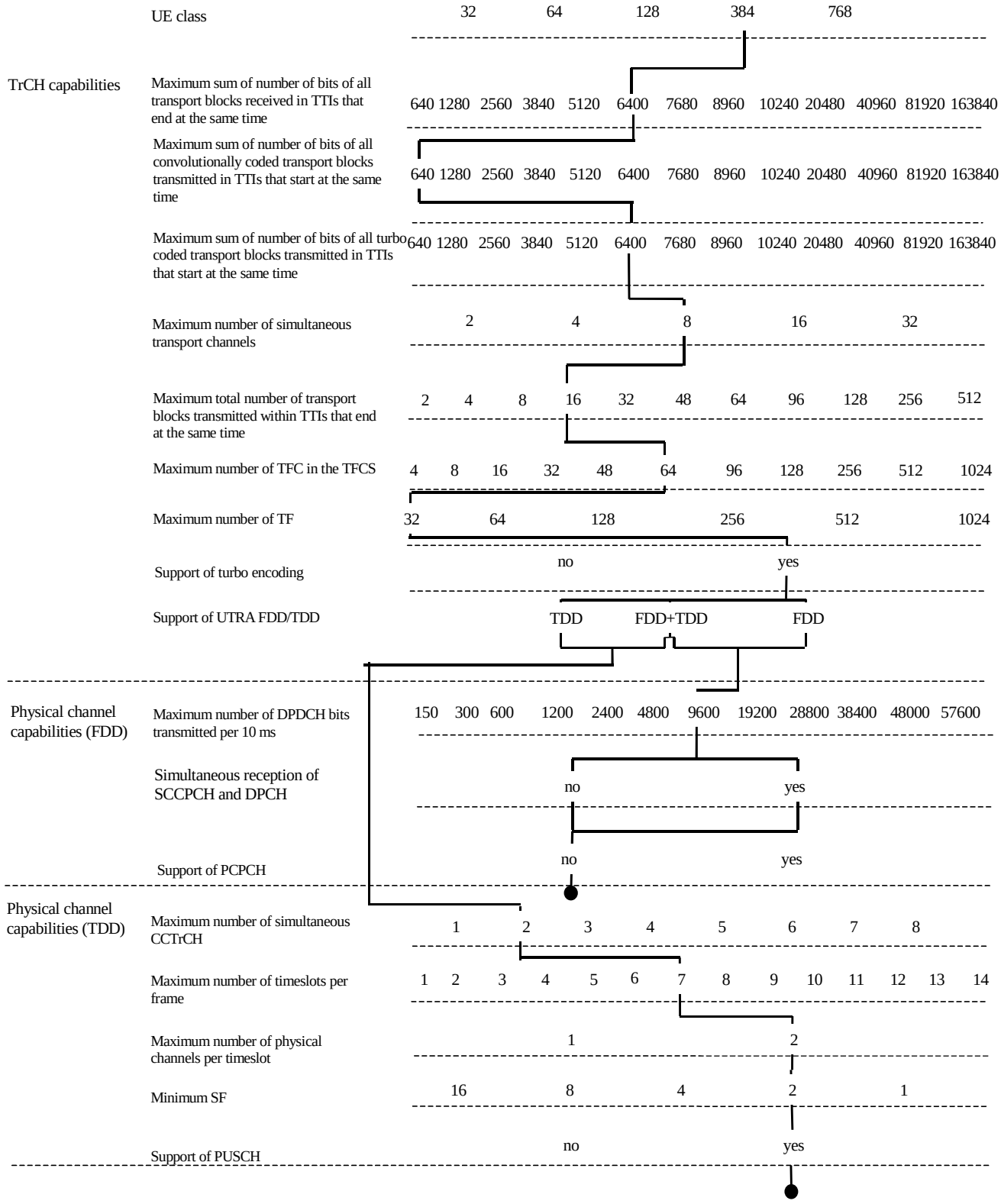
UE Radio Access Capability Parameters for UL 64 kbit class



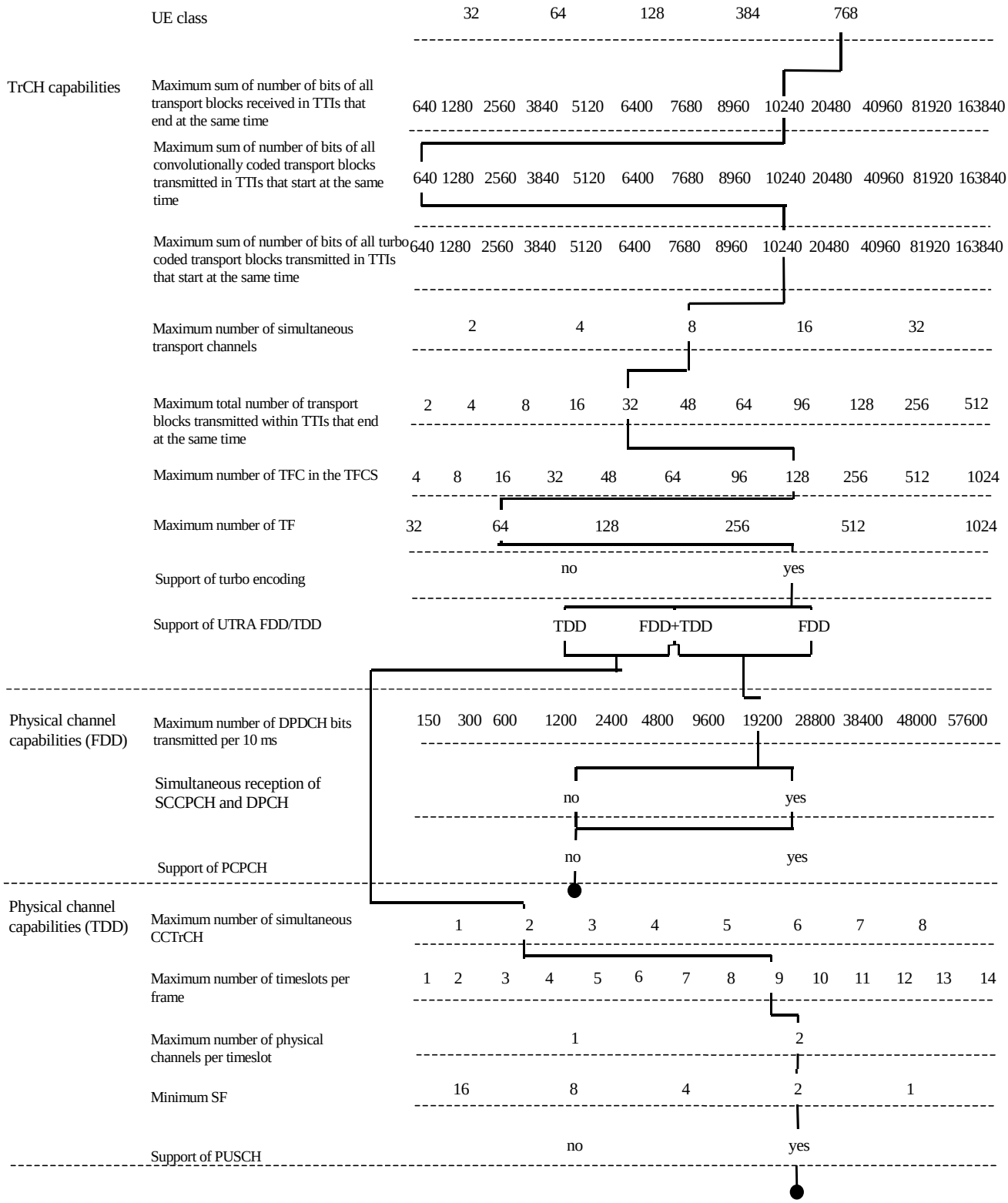
UE Radio Access Capability Parameters for UL 128 kbit class



UE Radio Access Capability Parameters for UL 384 kbit class



UE Radio Access Capability Parameters for UL 768 kbit class



6 Usage of UE radio access capabilities

NOTE: The rationale for the parameter combination settings will be explained here.

6.1 Examples of reference radio access bearers

In Table 6.1 reference RAB A-F are defined with their main characteristics that impact the required UE Radio Access capabilities. These reference RABs shall be seen as example RABs covered by the reference UE radio access capability combinations defined in Section 5.2.

Table 6.1: Reference RABs

Reference RAB	A	B	C	D	E	F
RAB characteristics and mapping to DCH	Conversational speech 4.75-12.2 kbps (20 ms TTI) All AMR modes + rate ctrl, but max. 4 at a time	Conversational 64 kbps (40 ms TTI)	Streaming max. 57.6 kbps (40 ms TTI)	Interactive/ Background max. 32 kbps (10 ms TTI)	Interactive/ Background max. 64 kbps (10 ms TTI)	Interactive/ Background max. 384 kbps (10 ms TTI)
DCH carrying DCCH (rate, TTI)	3.2kpbs, 40ms	6.4kbps, 20ms	6.4kbps, 20ms	12.8kbps, 10ms	12.8kbps, 10ms	12.8kpbs, 10ms

6.2 Example mappings between reference RABs and capability combinations

The following examples show how the reference RABs of Table 6.1 can be mapped to the reference UE radio access capability combinations that are listed in Section 5.

Table 6.2: Example mappings between capability combinations and RAB combinations

Reference UE radio access capability combinations	Examples of supported reference RAB combination
32kbps class	One at the time of the following: - A - C
64kbps class	One at the time of the following: - B - C - E - A and D simultaneously - The RAB combination supported by 32kbps class
128kbps class	One at the time of the following: - 2 times E - A and E simultaneously - A and B simultaneously - A and C simultaneously - The RAB combination supported by 64kbps class
384kbps class	One at the time of the following: - 2 times B - A and F simultaneously - The RAB combination supported by 128kbps class
762kbps class	One at the time of the following: - 2 times F in DL. 1 times F in UL - 2 times B and F simultaneously - The RAB combination supported by 384kbps class
2048kbps class	One at the time of the following: - 6 times F in DL - The RAB combination supported by 762kbps class

7 Mandatory UE radio access capabilities

NOTE: In this section features and requirements that are mandatory for UEs (capabilities that do not need to be signalled) will be listed for information. The normative descriptions are part of the respective specifications.

Annex A:
Change history

Change history					
TSG-RAN#	Version	CR	Tdoc RAN	New Version	Subject/Comment

History

Document history		
V0.1.0	November 1999	First version agreed at RAN-WG2#8, including parameters and value ranges for some of these
V1.0.0	December 1999	Version agreed at RAN-WG2#9, including changes on parameter list and values to most parameters
V1.0.2	March 2000	Version agreed at TSG-RAN WG2 #11
V2.0.0	March 2000	Version agreed at TSG-RAN WG2 #11, with editorial changes by secretary