Agenda item :
Source : Ad-hoc 11 chairman[1]
Title : Ad-hoc 11 Physical Layer capabilities report
Document for : Approval

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1. Rationale

During the WG1 meeting #2 in Yokohama, concerns were raised by several operators that if parts of the physical layer specification are not mandatory (for example, items like downlink transmit diversity and site selection diversity for the UE) it could harm network performance and operation.
As an outcome of the discussion, the group identified the need to provide indications in the specifications documents whether a physical layer capability is mandatory or not (both in the UE and in the network side).
Within ad-hoc 11, several parties have issued different requirements. In Section 2, this document gives a summary of the requirements presented during the ad-hoc 11 discussion. Section 3 is dedicated to the collection of tables related to the items in the S1.xx specification documents, in order to identify if their implementation is service dependent or not and to indicate whether they are optional or mandatory.

2. Requirements

From Tdoc. TSGW1#2(99)040 "UE PHYSICAL LAYER CAPABILITIES FOR UTRA (UMTS TERRESTRIAL RADIO ACCESS)" by TIM/CSELT, Vodafone, France Telecom, T-Mobil, Telia, Omnitel, Mannesmann Mobilfunk

1) It is critical for operators to be able to plan and dimension a system with a clear view of what physical layer capabilities or features will be standard in the initial phase. It would be highly inefficient or even impossible to plan for a vast pool of UE optional physical layer capabilities. In a similar way, performance and roaming could be severely compromised if a terminal not supporting some features enters a network whose planning is based on "optional" features (for example, Tx antenna diversity and site selection diversity). In fact system planning and dimensioning have to be based on the 'worse case' MS and if the set of available options is too large the impact on the complexity of the planning phase as well as on the cost of the overall system would be inacceptable.
2) Features affecting layer 1 must be supported by ALL UE.

From document "Principles for UE Capabilities" by NTT Docomo

1) IMT-2000 terminals will be required same size and cost as that of the second-generation terminals.
2) The requirement of very small speech-service terminals that is highly competitive with the second generation is quite important.
3) Due to the short time scales for commercial service launch in Japan, only the technical proposals and descriptions that are defined in detail in the present can be specified.
4) Various improved techniques will be specified and commercialised additionally in the future, e.g. half-rate speech codec in the 2nd generation systems, thus it is essential to define classification of the terminals with phased approach.

From document TSG T#2 (99) 057 "Draft Proposed WI for Terminal capabilities" by NEC Technologies

1) It should be possible to produce UE's with different service capabilities, for example voice only UE's should be allowed as well as multimedia terminals.
2) When UE's provide compatible service capabilities (for example two UE's support voice) they should be assured of successful interworking.

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3) We do not burden UE with the need to support mandatory implementation capabilities that are not needed to support its target service capability.

From Giovanni Romano's mail (March 9, 1999, subject: Re: Ad-hoc 11: physical layer capabilities - first draft")

More in general, I would state the following principle:
different implementation options of the same (optional) feature would lead to incompatibility between UE and network; for example, if the network is providing feedback Tx antenna diversity and the UE supports only open loop Tx antenna diversity, the two entities will not be able to interwork successfully and exploit the Tx antenna diversity gain. This shall be avoided.

3. Way forward

Different requirements have been indicated during the discussion. Mainly there are two positions that can be summarised as:

- it should be possible to have terminals with different service capabilities; in particular, it should be possible to have simple terminals (small size and small cost);
- features and capabilities affecting layer 1 must be supported by all UE.

To finalise the work within ad-hoc 11 it is proposed to focus the activities on service independent capabilities, in order to identify the implementation capabilities that all UE implementations support.

Concerning service dependent capabilities, at this stage the following conclusion could be indicated:
When UE's provide compatible service capabilities (for example two UE's support voice) they should be assured of successful interworking. Moreover, different implementation options of the same (optional) feature would lead to incompatibility between UE and network. Therefore, this shall be avoided.

4. Report

Two classes of physical layer capabilities have been identified:
- service independent capabilities
- service dependent capabilities

In case of service independent capabilities, this report provides a table (see annex), whose rows are items taken from the S1.xx documents.
The table is organised as follows:

			Proposal from …		Proposal from …		
Capability FDD	Doc	Para	NE	UE	NE	UE	General Comments

NE stands for Network Equipment and UE stands for User Equipment (terminal). Under each column the indication M stands for mandatory, O stands for optional.
In the table, proposals from different companies are compared.
Note that NTT Docomo presented a proposal were the column on network side was not modified from report version 1; this column has been indicated under NTT Docomo in this report.
Some parties indicated that capabilities affecting physical layer performance should be mandatory in the terminal or removed from the specification documents. Other parties disagree with this approach and indicate that it should be possible to introduce features in a second phase of network operation or to allow different features to coexist.
No proposals have been presented on document S1.31.
A question was raised by Mr. Kato on the scrambling codes to be used in case of multiuser detection for the FDD component.
Where different proposals have been presented, the discussion is to be finalised during WG1 meeting #3.

5. Conclusions

In the ad-hoc group it was not possible to achieve a complete agreement on physical layer capabilities.

It was decided to split the report between service independent and service dependent capabilities. A table providing indications for service independent capabilities is given in this report.
It was not possible to achieve a complete agreement on service independent capabilities. Major differences are related to the implementation of capabilities in the terminal side. Issue like DL Tx antenna diversity, DTX, support of paging channel, site selection diversity require further clarifications.

6. Recommendations

The group agreed the following recommendations to be forwarded to WG1 for approval:
Service independent capabilities
- add a new section to S1.02 “UE capabilities” in order to indicate what has to be mandatory in the terminal
- add a section (or an indication within each section) whether an item described in the S1.xx documents is mandatory or not (both network and terminal side)

The text to be inserted in the S1.xx specification should be taken from the table in this report, once agreed by the meeting.
Service dependent capabilities
It is recommended to include the following statement in S1.01 “General description”:
When UE's provide compatible service capabilities (for example two UE's support voice) they should be assured of successful interworking. Moreover, different implementation options of the same (optional) feature would lead to incompatibility between UE and network. Therefore, this shall be avoided.

			Proposal from NTT DoCoMo		Proposal from Ericsson		Proposal from CSELT		Proposal from …		
Capability FDD	Doc	Para	NE	UE	NE	UE	NE	UE	NE	UE	General Comments
Transport channels	S1.11	4									
FAUSCH	S1.11	4.1.2			O	O					Not in release 99 Philips: service dependent Proposal: remove
DCH	S1.11	4.1.1	M	M			M	M			
BCH	S1.11	4.2.1	M	M			M	M			
FACH	S1.11	4.2.2	M	M			M	M			
PCH	S1.11	4.2.3	M	O~~M~~			M	M			NTT DoCoMo and Philips indicate this item as service dependent If the paging channel is optional at the mobile, no mobile terminated calls are possible Proposal: M-M
RACH	S1.11	4.2.4	M	M			M	M			
DSCH	S1.11	4.2.5									Service dependent Proposal: remove from table
DSCH control	S1.11	4.2.6									Service dependent Proposal: remove from table
Physical traffic channels	S1.11	5									
Superframe format	S1.11	5.2.1, 5.3.1	M	M			M	M			
Frame format	S1.11	5.2.1, 5.3.1	M	M			M	M			
Slot format	S1.11	5.2.1, 5.3.1	M	M			M	M			
DPDCH format	S1.11	5.2.1 5.3.1									Service dependent Proposal: remove from table
DPCCH format	S1.11	5.2.1, 5.3.1	M	M			M	M			
Pilot bit pattern	S1.11	5.2.1, 5.3.1	M	M			M	M			
TPC bit pattern	S1.11	5.2.1, 5.3.1	M	M			M	M			
DL Tx antenna diversity Feedback mode	S1.11	5.2.1 5.3.1.1 5.3.2.1.1	O	~~¥~~O ~~M~~	O	?	O	M			Samsung: service dependent – O Philips: mandatory for some classes of terminals
	S1.14	8									
DL Tx antenna diversity Open loop	S1.11	5.3.1.2	O	~~¥~~O ~~M~~	O	?	O	M			Samsung: service dependent (proposal M in UE)

			Proposal from NTT DoCoMo		Proposal from Ericsson		Proposal from CSELT		Proposal from …		
Capability FDD	Doc	Para	NE	UE	NE	UE	NE	UE	NE	UE	General Comments
Physical common channels	S1.11	5									
RACH format	S1.11	5.2.2.1	M	M			M	M			
Primary Common Control Physical Channel (CCPCH) format	S1.11	5.3.2.1	M	M			M	M			
Secondary Common Control Physical Channel format	S1.11	5.3.2.2	M	M			M	M			
Synchronisation Channel format	S1.11	5.3.2.3	M	M			M	M			
Acquisition Indication Channel (AICH)	S1.11	5.3.2.6	M	O~~M~~			M	M			NTT DoCoMo indicates this item as service dependent From ad-hoc#3 discussion it seems that AICH is part of the random access mechanism Philips and Samsung: part of RACH - M Proposal: M-M
Physical Downlink Shared Channel format	S1.11	5.3.2.5									Service dependent Proposal: remove from table
Acquisition Indication Channel (AICH)	S1.11	5.3.2.6									Service dependent Proposal: remove from table
Mapping of transport channels to physical channels	S1.11	6	M	M			M	M			
Timing relationship between physical channels	S1.11	7									no input available

			Proposal from NTT DoCoMo		Proposal from Ericsson		Proposal from CSELT		Proposal from …		
Capability FDD	Doc	Para	NE	UE	NE	UE	NE	UE	NE	UE	General Comments
Transport channel coding/ multiplexing	S1.12	7.2	M	M (for registration) O(other services)(?) – question: do single service UEs have to support the complete scheme?	M	O	M	?			Service dependent Philips: support of basic scheme: M Proposal: remove from table
CRC calculation	S1.12	7.2.1	M	M (for registration) O(other services)			M	M			Service dependent Proposal: remove from table
Channel coding Convolutional cod	S1.12	7.2.2	M	M (for registration) O(other services)	M	M	M	M			Service dependent Proposal: remove from table
Channel coding Turbo coding	S1.12	7.2.2	M	M (for registration) O(other services)	M	O	M				Service dependent Proposal: remove from table
1st interleaving	S1.12	7.2.3	M	M			M	M			Service dependent Proposal: remove from table
Rate matching	S1.12	7.2.4	M	M (for registration) O(other services) (?) – question: do single service UEs have to support the complete scheme?			M	?			Service dependent Proposal: remove from table
Rate matching algorithm	S1.12	7.2.4.1	M	M (for registration) O(other services)			M	M			Service dependent Proposal: remove from table
Downlink DTX	S1.12	7.2.5	M	OM			M	M			Service dependent It has impact on network capacity (voice activity factor) Proposal: M-M
Transport channel multiplexing	S1.12	7.2.6	M	M (for registration) O(other services)			M	M			Service dependent Proposal: remove from table
2nd interleaver	S1.12	7.2.7	M	M (for registration) O(other services)			M	M			Ad-hoc 4: always present
Multirate transmission	S1.12	7.2.8		O?							Service dependent No proposals for network side Proposal: remove from table
Rate detection	S1.12	7.2.9		M(for registration) O(other services)?							Service dependent No proposals for network side Proposal: remove from table
Coding procedure	S1.12	7.2.10		M(for registration) O(other services)?							Service dependent No proposals for network side Proposal: remove from table
Bit transmission sequence	S1.12	7.2.11	M	M			M	M			
Coding of TFCI	S1.12	7.3.1	M	M(for registration) O(other services)			M	M			Service dependent Proposal: remove from table
Coding of slotted mode	S1.12	7.4		O?							Service dependent No proposals for network side Proposal: remove from table

			Proposal from NTT DoCoMo		Proposal from CSELT		Proposal from …		
Capability FDD	Doc	Para	NE	UE	NE	UE	NE	UE	General Comments
Uplink spreading and modulation	S1.13	6							
Spreading	S1.13	6.2	M	M(for registration) O(other services) ~~for the spreading factors to be supported by all UE O for multicode~~	M	M			S1.13 provides two figures basically illustrating two things: The way the spreading function is performed How to perform multicode transmission (this is service dependent)
Code generation and allocation	S1.13	6.3	M	M	M	M			
Channelization codes	S1.13	6.3.1	M	M	M	M			
Table 1: correspondence between symbol rate and spreading code types	S1.13	6.3.1		4.096 Mcps: M ~~other chip rates: ? SF values in square brackets: ffs~~					M for 4.096 Mchip/s
Scrambling codes	S1.13	6.3.2	M	M(for registration) O(other services)	M	M			not clear: does it mean that there are no scrambling codes for "other service" terminals? I think scrambling codes are service independent (the same scheme is always adopted) Suggestion: M-M
Random access codes	S1.13	6.3.3	M	M(for registration) O(other services)	M	M			not clear: if RACH has to be supported by all terminals, then RACH codes are mandatory in the terminal. Suggestion: M-M
Modulation chip rate	S1.13	6.4.1		4.096 Mcps: M other chip rate:O~~?~~					M for 4.096 Mchip/s
Pulse shaping	S1.13	6.4.2	M	M	M	M			
Modulation	S1.13	6.4.3	M	M	M	M			
Downlink spreading and modulation	S1.13	7							
Spreading	S1.13	7.1	M	M(for registration) O(other services) ~~for the spreading factors to be supported by all UE O for multicode~~	M	M			S1.13 provides two figures basically illustrating two things: The way the spreading function is performed How to perform multicode transmission
Code generation and allocation	S1.13	7.2	M	M	M	M			
Channelization codes	S1.13	7.2.1	M	M	M	M			
Scrambling codes	S1.13	7.2.2	M	M	M	M			
Synchronisation codes	S1.13	7.2.3	M	M	M	M			
Code allocation	S1.13	7.2.3.2	M	M	M	M			
Modulation chip rate	S1.13	7.3.1							M for 4.096 Mchip/s
Pulse shaping	S1.13	7.3.2	M		M	M			
Modulation	S1.13	7.3.3	M		M	M			

General comment: are chip rates other than 4.096 to be included in release 99?

			Proposal from NTT DoCoMo		Proposal from CSELT		Proposal from …		
Capability FDD	Doc	Para	NE	UE	NE	UE	NE	UE	General Comments
Cell search	S1.14	4.1	M	M	M	M			
Primary CCPCH synchronisation	S1.14	4.2	M	M	M	M			
Secondary CCPCH synchronisation	S1.14	4.3	M	M	M	M			
PRACH synchronisation	S1.14	4.4	M	M	M	M			
DPCCH/DPDCH synchronisation	S1.14	4.5	M	M	M	M			
Power control	S1.14	5							
PRACH	S1.14	5.1.1	M	M	M	M			
Uplink DPCCH/DPDCH	S1.14	5.1.2	M	M	M	M			
Downlink primary CCPCH	S1.14	5.2.1	M	M	M	M			
Downlink secondary CCPCH	S1.14	5.2.2	M	M	M	M			
Downlink DPCCH/DPDCH	S.14	5.2.3	M	M	M	M			
Site selection diversity transmit power control	S.14	5.2.3.4	O	O~~M~~	O	M			NTT DoCoMo indicates this item as service dependent
Random Access procedure	S.14	6	M	M	M	M			
Transmission stop and resumption control	S1.14	7	M	O~~M~~	M	M			NTT DoCoMo indicates this item as service dependent
Feedback mode transmit diversity	S.14	8	O	O~~M~~	O	M			NTT DoCoMo indicates this item as service dependent
Reverse link synchronous transmission	S1.14	9	?	O~~?~~	?	?			NTT DoCoMo indicates this item as service dependent No proposal for the network side

			Proposal from NTT DoCoMo		Proposal from CSELT		Proposal from …		
Capability TDD	Doc	Para	NE	UE	NE	UE	NE	UE	General Comments
Transport channels	S1.21	6							
DCH	S1.21	6.1.1	M	M	M	M			
ODCH	S1.21	6.1.1	O	O	O	M			NTT DoCoMo indicates this item as service dependent Proposal: remove from table
BCH	S1.21	6.1.2	M	M	M	M			
PCH	S1.21	6.1.2	M	O	M	M			NTT DoCoMo indicates this item as service dependent If the paging channel is optional at the mobile, no mobile terminated calls are possible Proposal: M-M
FACH	S1.21	6.1.2	M	M	M	M			
RACH	S1.21	6.1.2	M	M	M	M			
ORACH	S1.21	6.1.2	O	O	O	M			NTT DoCoMo indicates this item as service dependent Proposal: remove from table
SCH	S1.21	6.1.2	M	M	M	M			
Physical traffic channels	S1.21	7							
Superframe format	S1.21	7	M	M	M	M			
Frame structure	S1.21	7.1	M	M	M	M			
Burst types	S1.21	7.2.2	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent and proposes in the UE side: M(for registration) O(other services)
Transmission of TFCI	S1.21	7.2.2.1	f.f.s.	O	f.f.s.	f.f.s.			NTT DoCoMo indicates this item as service dependent No proposal for network side Remove form table?
Burst structure when using DTX	S1.21	7.2.2.3	f.f.s.	O	f.f.s.	f.f.s.			NTT DoCoMo indicates this item as service dependent No text in S1.21
Transmission of TPC	S1.21	7.2.2.4	f.f.s	O	f.f.s	f.f.s.			NTT DoCoMo indicates this item as service dependent No text in S1.21
Training sequences for spread bursts	S1.21	7.2.3	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent (if there is a difference between registration and other services) and proposes for the UE M(for registration) O(other services) Training sequences are used to perform coherent demodulation, independently of the service Proposal: M-M
Midamble transmit power	S1.21	7.2.3.3	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent (if there is a difference between registration and other services) and proposes for the UE M(for registration) O(other services)

			Proposal from NTT DoCoMo		Proposal from CSELT		Proposal from …		
Capability TDD	Doc	Para	NE	UE	NE	UE	NE	UE	General Comments
Common control physical channel (CCPCH)	S1.21	7.3							
Downlink CCPCH spreading codes	S1.21	7.3.1.1	M	M	M	M			
Downlink CCPCH burst types	S1.21	7.3.1.2	M	M	M	M			
Downlink CCPCH training sequences for spread bursts	S1.21	7.3.1.3	M	M	M	M			
Physical random access (PRACH)	S1.21	7.3.2							
Spreading codes	S1.21	7.3.2.1	M	M	M	M			
Burst types	S1.21	7.3.2.2	M	M	M	M			
Training sequences for access bursts	S1.21	7.3.2.3	M	M	M	M			
The physical synchronisation channel	S1.21	7.4	M	M	M	M			
Mapping of transport channels to physical channels	S1.21	8	M	M	M	M			

			Proposal from NTT DoCoMo		Proposal from CSELT		Proposal from …		
Capability TDD	Doc	Para	NE	UE	NE	UE	NE	UE	General Comments
Transport channel coding/multiplexing	S1.22	7.2	M	M/O	M				NTT DoCoMo indicates this item as service dependent (if there is a difference between registration and other services) and proposes for the UE M(for registration) O(other services) Service dependent Proposal: remove from table
CRC calculation	S1.22	7.2.1	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent (if there is a difference between registration and other services) and proposes for the UE M(for registration) O(other services) Service dependent Proposal: remove from table
Channel coding	S1.22	7.2.2	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent (if there is a difference between registration and other services) and proposes for the UE M(for registration) O(other services) Service dependent Proposal: remove from table
1st interleaving	S1.22	7.2.3	M	M	M	M			Service dependent Proposal: remove from table
Rate matching	S1.22	7.2.4	M	M/O	M				NTT DoCoMo indicates this item as service dependent and proposes for the UE M(for registration) O(other services) Service dependent Proposal: remove from table
Rate matching algorithm	S1.22	7.2.4.1	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent and proposes for the UE M(for registration) O(other services) Service dependent Proposal: remove from table
Transport channel multiplexing	S1.22	7.2.5	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent and proposes for the UE M(for registration) O(other services) Service dependent Proposal: remove from table
2nd interleaver	S1.22	7.2.6	M	M/O	M	M			NTT DoCoMo indicates this item as service dependent (if there is a difference between registration and other services) and proposes for the UE M(for registration) O(other services) Service dependent Proposal: remove from table
Downlink discontinuous transmission	S1.22	7.2.7	M	O	M	M			Service dependent It has impact on network capacity (voice activity factor) Proposal: M-M
Multirate transmission	S1.22	7.2.8	?	O	?	?			Service dependent Proposal: remove from table
Rate detection	S1.22	7.2.9	?	O	?	?			Service dependent Proposal: remove from table
Automatic Repeat Request (ARQ)	S1.22	7.3	?	O	?	?			Service dependent Proposal: remove from table
Coding of TFCI	S1.22	7.4.1	M	O	M	M			Service dependent Proposal: remove from table
Slotted mode	S1.22	7.5	?	O	?	?			Service dependent Proposal: remove from table Is it applicable to TDD?

			Proposal from NTT DoCoMo		Proposal from CSELT		Proposal from …		
Capability TDD	Doc	Para	NE	UE	NE	UE	NE	UE	General Comments
General	S1.23	4							
Table 1: basic modulation parameters	S1.23	4							M for 4.096 Mchip/s
Data modulation	S1.23	5							
Symbol rate	S1.23	5.1	M	M	M	M			M for 4.096 Mchip/s
Mapping of bits onto signal point constellation	S1.23	5.2	M	M	M	M			
Pulse shape filtering	S1.23	5.3	M	M	M	M			
Spreading modulation	S1.23	6							
Basic spreading parameters	S1.23	6.1	M	M/O					Service dependent NTT Docomo proposes: M(for registration) O(other services) Proposal remove from table
Spreading codes	S1.23	6.2	M	M	M	M			
Scrambling codes	S1.23	6.3	M	M	M	M			
Spread and scrambled signal of data symbols and data blocks	S1.23	6.4	M	M	M	M			

General comment: are chip rates other than 4.096 to be included in release 99?
Are other chip rates applicable to TDD?

			Proposal from NTT DoCoMo		Proposal from CSELT		Proposal from …		
Capability TDD	Doc	Para	NE	UE	NE	UE	NE	UE	General Comments
Synchronisation of TDD node Bs	S1.24	6.2.1	M	M	M	M			
Synchronisation of ODMA relays	S1.24	6.2.2	?	O	?	?			NTT Docomo indicates this as service dependent Proposal: remove from table
Channel allocation	S1.24	6.3	M	O	M	M			NTT Docomo indicates this as service dependent This is related to resource management
Power control	S1.24	6.4	M	M/O	M	M			NTT Docomo indicates this as service dependent and proposes for UE M(for registration) O(other services) If power control in TDD has a similar function as in FDD, it impacts on system performance Proposal: M-M
Timing advance	S1.24	6.5	M	O	M	M			NTT Docomo indicates this as service dependent
Synchronisation and cell search procedures	S1.24	6.6	M	M	M	M			
ODMA relay probing	S1.24	6.7		O					NTT Docomo indicates this as service dependent Proposal: remove from table
Idling operation	S1.24	6.8	f.f.s.	O	f.f.s.	f.f.s.			NTT Docomo indicates this as service dependent Proposal: remove from table
Discontinuous transmission (DTX) of radio frames	S1.24	6.10	f.f.s.	O	f.f.s.	f.f.s.			NTT Docomo indicates this as service dependent Proposal: remove from table
Forward link transmit diversity	S1.24	6.11	O	O	O	M			NTT Docomo indicates this as service dependent