

TSG RAN WG 2#6
Sophia-Antipolis, France
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TSGR2#6(99)902

Agenda item: 10
Source: Golden Bridge Technology
Title: MAC control of CPCH backoff in TS25.321, MAC Protocol

Document for: Discussion and approval

INTRODUCTION

In TS25.321, the MAC Protocol Specification describes the control of RACH transmissions as an elementary procedure in section 11. This description of RACH transmission control includes a description of backoff algorithm and backoff timers. It appears that a similar elementary procedure is needed in this specification to describe MAC control of CPCH transmission. Though CPCH control shares common concepts with RACH control, there are also significant differences that should be explicitly specified. GBT proposes to initiate discussion of CPCH transmission control by proposing in this contribution a backoff algorithm and defining backoff timers. GBT suggests that this discussion be continued in an email discussion group and reported at RAN2#7.

DISCUSSION

Section 11.2 of TS25.321 is included here as a reference:

11.2 Control of RACH transmissions

[Note: This procedure has to be reviewed for FDD and TDD operation]

The MAC sublayer is in charge of controlling the timing of RACH transmissions on transmission time interval level (i.e. on 10 ms-radio frame level; the timing on access slot level is controlled by L1). MAC controls the timing of each initial preamble ramping cycle as well as successive preamble ramping cycles in case that none or a negative acknowledgement is received. Note that retransmissions in case of erroneously received RACH message part are under control of higher layers (i.e. RLC, or RRC for CCCH data).

The RACH transmissions are performed by the UE as shown in Figure 2. MAC receives the following RACH transmission control parameters from RRC with the CMAC-Config-REQ primitive:

- persistence value P (transmission probability),
- maximum number of preamble ramping cycles M_{\max} ,
- others (ffs., e.g. minimum and maximum number of time units between two preamble ramping cycles).

Based on the persistence value P, the UE decides whether to start the L1 power ramping procedure in the present transmission time interval or not. If transmission is allowed, the L1 preamble power ramping procedure is started. MAC then waits for status indication from L1. If transmission is not allowed, a backoff timer T_{BO1} is started and another attempt is performed after expiry of the timer.

When the preamble has been acknowledged on AICH, the RACH message part is transmitted according to L1 specifications. When no acknowledgement is received, a backoff timer T_{BO2} is started and another preamble ramping cycle is performed. In case that a negative acknowledgement has been received on AICH a backoff timer T_{BO3} is started. After expiry of the timer persistence check is performed again.

The settings of the backoff timers T_{BO1} , T_{BO2} , T_{BO3} is ffs. The setting is an integer number (≥ 1) of transmission time intervals, either fixed or randomly drawn from an interval defined by RACH transmission control parameters received from RRC, which might be updated dynamically, together with update of persistence value.

[Note: The three timers are introduced at this stage mainly to keep the algorithm most general. Possibly T_{BO1} and T_{BO2} can simply be set to their minimum value, which is currently assumed to be 10 ms. However, smaller backoff timing units such as access slot intervals may also be considered. The introduction of random backoff with T_{BO3} could especially be useful when the update time for the persistence value is low, i.e. larger than a radio frame.]

The backoff algorithm encompasses currently both

- (a) a persistency check and
- (b) a backoff time

at both stages,

- initial (i.e. very first) attempt after the request to send RACH data has been received by MAC, and
- subsequent attempt, which is needed in case of the following conditions:
 - (i) after an unsuccessful preamble ramping cycle (No Ack)
 - (ii) after a Nack from L1.

For both stages it is FFS if both (a) and (b) are needed or if one of (a) or (b) is sufficient.

[end of text excerpt from TS25.321]

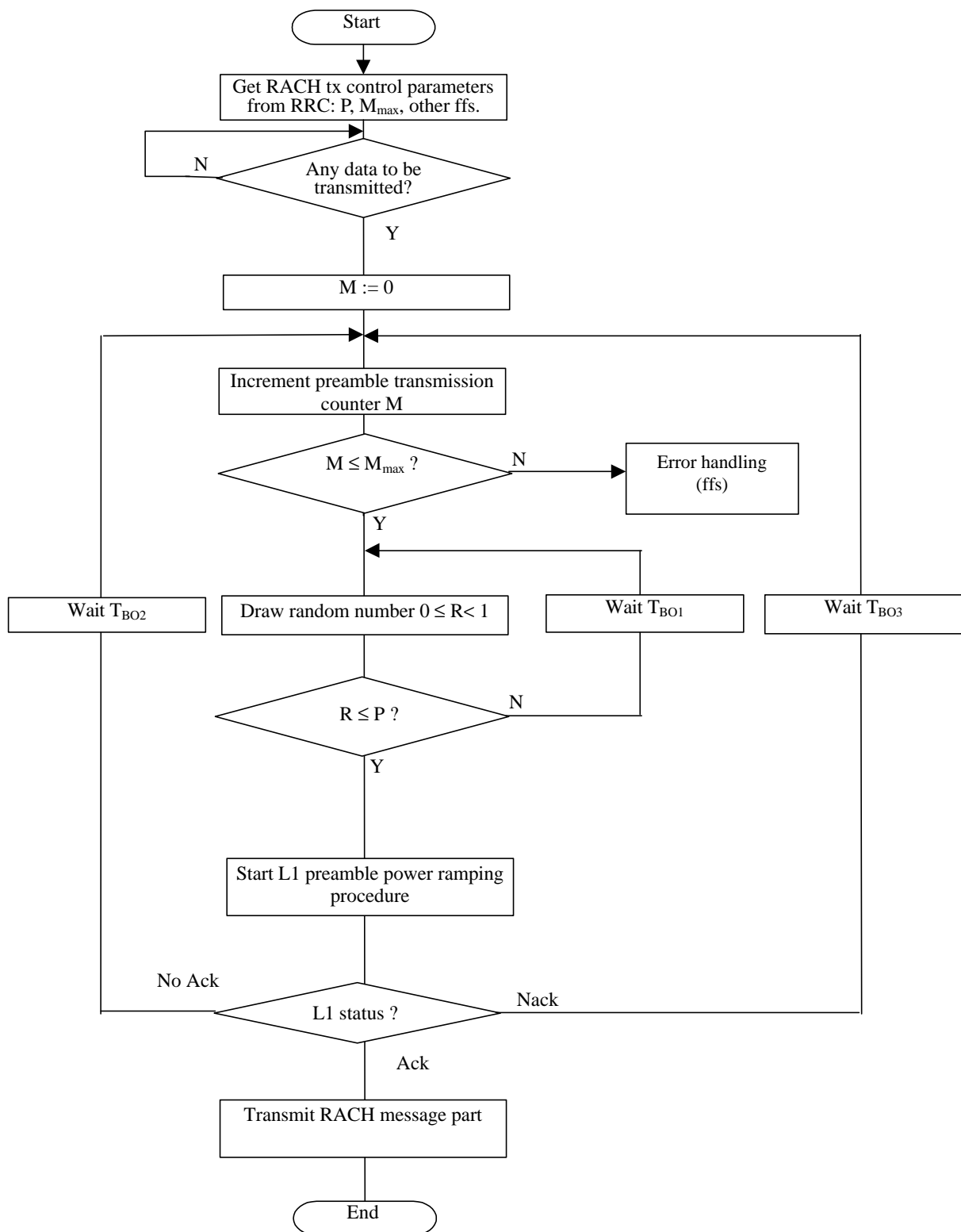


Figure 11.2.1 : RACH transmission control procedure (UE side, informative)

In this RACH control scheme the backoff algorithm is defined by the figure. The actual values to use for the backoff timers are not defined, and seem to be FFS.

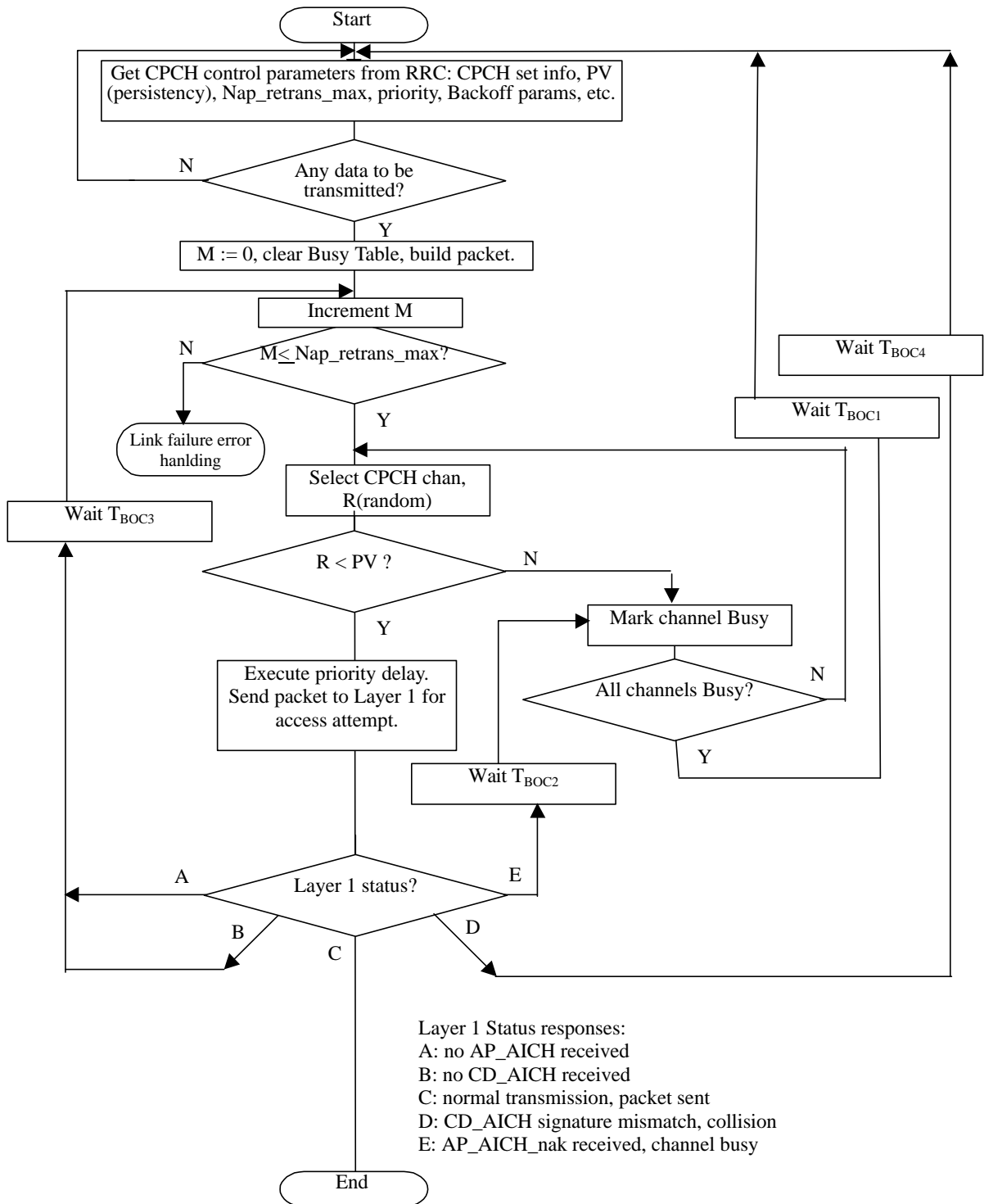


Figure 1. CPCH transmission control procedure (UE side, informative)

Figure 1 presents a similar diagram of a CPCH transmission control scheme which has been adapted from the CPCH access procedure chart presented in [2] R2-99797, CPCH Access Procedures. There are four backoff timers shown in this control scheme.

There are many different characteristics which may apply to the values used to set the CPCH backoff timers. The timer value may be fixed or may be set using a dynamic or pseudo-static network parameter. The timer value may be fixed or may be loaded with a random number which is selected within a range [0, MAX_Delay]. The timer value may be a function of the Persistency Value (PV) which is assigned for the CPCH channel accessed. These are a few the various degrees of freedom to be constrained in selecting backoff timer values.

At this time it is not clear how to best select the characteristics of the CPCH backoff timer values. Eventually it is hoped that simulation results may be used to compare various backoff schemes to justify the selected scheme. From a practical viewpoint, there may not be sufficient time or company resources available to perform the simulation trade study. A more pragmatic approach may be needed.

Some useful general goals to consider when selecting backoff algorithms and timer values were discussed in the report of the RACH backoff email discussion group [3] which was presented at RAN2#5. However the discussion did not lead to any constructive suggestions for RACH backoff timer values. Based on this history, it is proposed to take a slightly different approach for discussion of CPCH backoff. GBT offers the following table as a strawman set of CPCH timer values which may be critiqued and improved to lead eventually to a clear description which may be incorporated into the MAC Protocol specification.

Proposed CPCH Backoff Timer Values			
Timer	Parameter/constant	Fixed/random in range	Modulated by PV
T _{BOC1} (all Busy)	Parameter: NF_bo_all_busy	Random in range	PVavg, gain = 5
T _{BOC2} (channel Busy)	Parameter: NS_bo_busy	Fixed	PVchan, gain = 5
T _{BOC3} (no AICH)	Parameter: NF_bo_no_aich	Fixed	PVchan, gain = 5
T _{BOC4} (collision)	Parameter: NF_bo_collision	Random in range	PVchan, gain = 5

For PV modulation of timer values, the approach taken here is that the timer parameter is the timer value for the PV=1 case (no access restriction). For the PV=0 case (no access), the timer value would be multiplied by the gain. The RRC parameters noted by NF are integer number of frames resulting in time periods equal to (NF * 10) msec. The RRC parameter NS is an integer number of access slots resulting in time periods equal to (NS * 1.33) msec.

Using the information in the above table, timer values would be calculated as follows:

$$T_{\text{BOC1}} = \text{Random}[0, \text{Max1}],$$

$$\text{where Max1} = \text{NF}_{\text{bo_all_busy}} * (1 + 4(1 - \text{PV}_{\text{avg}})),$$

where PV_{avg} is the average of the PVs for all CPCH channels in the CPCH set.

$$T_{\text{BOC2}} = \text{NS}_{\text{bo_busy}} * (1 + 4(1 - \text{PV}_{\text{chan}})),$$

where PV_{chan} is the PV for the busy CPCH.

$$T_{\text{BOC3}} = \text{NF}_{\text{bo_no_aich}} * (1 + 4(1 - \text{PV}_{\text{chan}})),$$

where PV_{chan} is the PV for the CPCH which was unsuccessfully accessed.

$$T_{\text{BOC4}} = \text{Random}[0, \text{Max4}],$$

$$\text{where Max4} = \text{NF}_{\text{bo_collision}} * (1 + 4(1 - \text{PV}_{\text{chan}})),$$

where PV_{chan} is the PV for the CPCH channel which was unsuccessfully accessed.

PROPOSAL

It is proposed that a new section 11.3 Control of CPCH transmission be added to TS25.321 to describe the MAC procedure for control of CPCH backoff and subsequent reaccess attempts.

It is proposed to assign this issue for further study to an email discussion group [CPCH backoff] using this contribution as a starting point for discussion.

REFERENCES

- [1] TSGR2#6(99)712, TS25.321, MAC Protocol Specification
- [2] TSGR2#6(99)797, CPCH Access Procedures
- [3] TSGR2#5(99)527, Report of email discussion of RACH backoff