TSG-RAN Working Group1 meeting #3
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Agenda Item:

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Title: **Proposal for the Use of DTX in TDD**

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1. Introduction

Discontinuous transmission (DTX) offers the possibility to adapt to differences between the available channel bit rate of allocated dedicated physical channels and the total bit rate after transport channel multiplexing. This is enabled by turning off the data transmission for certain periods of time when nothing is to be transmitted. These periods can be assigned within one burst. Alternatively, an allocated resource unit need not be filled with data in each frame of a connection.
In this document, the possibility of using discontinuous transmission in up- and downlink is proposed for TDD Mode. Advantages of DTX for TDD and the actual implementation, especially the resulting burst structure, are described.

2. Application and Implementation of DTX in TDD Mode

Primarily, the use of DTX within TDD Mode offers some advantages with regards to more flexibility in the matching of transmitted data to available resource units and the handling of variable data rates.
Two methods of DTX are introduced which are described in more detail in the following.

2.1. Methods of Using DTX

In the following, the basic principle of both DTX methods is described for one single resource unit. Section 2.2. refers to the case if multiple resource units are assigned to one Coded Composite Transport Channel which implies a combination of the two methods.

2.1.1. DTX by Power-Off Periods within a Burst

Power-off periods are assigned within the burst, i.e. the data blocks of the burst are not used completely. Thus, the data that has to be transmitted within one burst determines the length of the power-off periods, so that an optimum adaptation of the available resources is obtained.
By this way, it is not necessary to change the spreading factor on a frame basis in order to adapt to different amounts of data. Furthermore, the detection of the TFCI is very straightforward as the spreading factor for one link remains constant.
The use of this method of DTX efficiently supports the use of spreading factors smaller than 16 as the probability that a resource unit cannot be completely filled with data increases for smaller spreading factors.

In the following, the burst structure resulting from the power-off periods within the burst is described. The transmitted data is grouped before and after the midamble, as data located directly adjacent to the midamble is well protected.
Power-off periods within the data parts do not occur. Consequently, the resulting burst can be understood as a shorter form of the original burst (without DTX). The power of the data parts and the

midamble does not differ from the original burst. This structure is very favourable with regards to the requirements of power amplification devices.
As it is illustrated in figure 1, the partition of the data does not have to be made in a symmetric way. The size of the data parts is variable, depending on the amount of data to be transmitted.

Figure 1 Burst structure for DTX

Blind detection is well supported by the depicted structure. As an asymmetric assignment of the data parts is possible, different services can be assigned to different sides of the midamble and can be conveniently separated and detected.

2.1.2. DTX by Discarding Resource Units

A complete resource unit is renounced within one or several frames of the connection, i.e. no data is transmitted in the respective frames. As the resource units including midamble codes stay allocated within these frames, this method should be preferred for RT services when the link would be maintained anyway and releasing the connection would not be efficient.

However, the midamble is transmitted nevertheless, i.e. only the data parts are renounced. Besides, TFCI and TPC can be transmitted as well, if needed.
If TFCI and/or TPC have to be transmitted, it is necessary to transmit the midamble. If no TPC and/or TFCI transmission is required it is useful to transmit the midamble nevertheless, for example as a timing advance reference.
This scheme results in a burst structure with a midamble and no data parts, except for TFCI and/or TPC, if required.

2.2. DTX in Case of Multiple Resource Units

DTX is done for each Coded Composite Transport Channel separately.
If multiple slots or codes are assigned to one Coded Composite Transport Channel, the two methods described in section 2.1.1. and 2.1.2. are combined, depending on if a TFCI is used or not.
In case of TFCI transmission, DTX is not applied to each resource unit, but only to a number of resource units that are not or not completely needed. That is, in each frame, an arbitrary number of allocated resource units can be full or empty, depending on the data that has to be transmitted. DTX within one burst as illustrated in figure 1 can only be applied in one resource unit per frame *and* Coded Composite Transport Channel.
However, if blind detection is preferred and no TFCI has to be transmitted, the use of DTX as illustrated in figure 1 is possible in all resource units.

If within a frame of a multislot transmission empty resource units due to DTX are occurring, only one reference time slot maintains the transmission of the midamble (and of TFCI and/or TPC, if needed).

3. Conclusions

Discontinuous transmission was shown to enable a flexible adaptation of transmitted data to the available resource units. Two different types of DTX were introduced which support this scheme efficiently.
In order to make use of the advantages of DTX in up- and in downlink, it is proposed for both directions in TDD Mode. In case of uplink, DTX decreases the power consumption of the UE due to the power-off periods when no data is transmitted.
Regarding ODMA, the implementation of DTX in up- and downlink would also ease the implementation of relay functions within mobile terminals as no difference between transmit and receive functionality is made in this respect.

Proposed Text for 3GPP RAN WG1 S1.21

7.2.2.3 Burst Structure when Using DTX

Discontinuous transmission (DTX) is applied in up- and downlink when the total bit rate after transport channel multiplexing differs from the total channel bit rate of the allocated dedicated physical channels.

Two different methods of DTX are possible. In the following, the basic principles of both are described for one single resource unit.
As first method, power-off periods can be introduced within one burst. The transmitted data is placed directly adjacent to the midamble according to figure 10. The separation of the data to the left and to the right side of the midamble does not have to be symmetric and the size of the data parts is variable, depending on the data that has to be transmitted. Further power-off periods within the data parts do not occur.

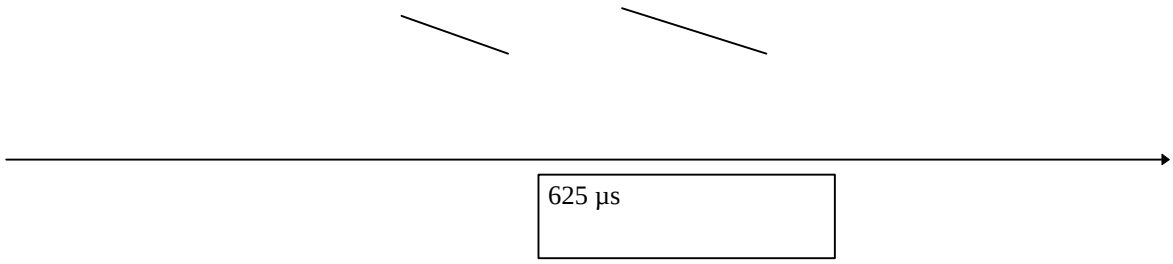

Figure 10 Burst structure for DTX

As a second method, an allocated resource unit need not be used in each frame of a connection, i.e. an empty resource unit with no data at all can be transmitted in a frame. This is especially useful for RT services, in cases where the release of the connection would not be efficient.
The midamble is transmitted nevertheless, i.e. only the data parts are renounced. Besides, TFCI and TPC can be transmitted as well, if needed.
This scheme results in a burst structure with a midamble and no data parts, except for TFCI and/or TPC, if required.

DTX is done for each Coded Composite Transport Channel separately.
If multiple slots or codes are assigned to one Coded Composite Transport Channel, the two methods described before are combined, depending on if a TFCI is used or not.
In case of TFCI transmission, DTX is not applied to each resource unit, but only to a number of resource units that are not or not completely needed. That is, in each frame, an arbitrary number of allocated resource units can be full or empty, depending on the data that has to be transmitted. DTX within one burst as illustrated in figure 10 can only be applied in one resource unit per frame *and* Coded Composite Transport Channel.
However, if blind detection is preferred and no TFCI has to be transmitted, the use of DTX as illustrated in figure 10 is possible in all resource units.

If within a frame of a multislot transmission empty resource units due to DTX are occurring, only one reference time slot maintains the transmission of the midamble (and of TFCI and/or TPC, if needed).