Standards Project: T1E1.4 : VDSL

Title: Power Down in Multi-carrier Transmission

Source:

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Date: September 22-26, 1997 - Minneapolis

Distribution to: T1E1.4

ABSTRACT

When during modem operation, data transport over the modem is interrupted for some time, the modem can go in a power down operation mode where its power consumption is only a fraction as compared to the power consumption in normal operation. In this contribution we consider power down mode operation in multi-carrier systems where a fast transition from power down mode to normal operation mode (power up) is mandatory.

In the described method, the transmission of all but one carrier is halted. The remaining modulated carrier ensures synchronization between transmitter and receiver. In addition, it provides a data channel enabling a fast power up.

NOTICE

1. INTRODUCTION

In case the traffic profile of the services supported over an V(A)DSL modem can be characterized as the exchange of chunks of data separated by long times periods (long as compared to the symbol period) where no data is to be transmitted over the copper line, powering down several functional blocks of the modem during the non-active time periods can reduce considerably power consumption. Especially for VDSL deployment from the ONU, power dissipation is a major concern. However, QOS requirements can impose constraints on the transition time from power down to normal operation mode.

To illustrate the above imagine the following situations:

-an end-user who has temporarily aborted this tele-working activity and has left the VDSL connection to the ONU open. He resumes his activity after several minutes.

-a web browser based application: here periods of user data transfer are interrupted by non-active periods that can last several seconds (= thousands of DMT symbol periods).

In the both cases, a modem which was put in power down mode must resume operation within a few milliseconds at the moment new date transfer is requested. A complete reinitialisation of the modem which can take several tens of seconds is intolerable. A fast transition from power down operation mode to normal operation mode is mandatory.

This requirement imposes that during power down-mode the modem maintains

1) synchronization (of the symbol timing, framing, RS coding, interleaving)

2) the modem measures periodically the channel, and noise environment and takes appropriate action in case the modem parameters have to be modified as result of the changing channel environment

2. POWER DOWN MODE IN A MULTICARRIER SYSTEM

Power down operation can easily be achieved in a multi-carrier transmission system. When the modem detects that no user data traffic has been transmitted in the downstream nor received from the upstream for a given time period, it can request a transition from normal operation mode to power down mode. The request for power down is initiated provided that period of non-activity exceeds the transmission delay experienced by the interleaved data path. This ensures that no user data is present in the interleaver/de-interleaver memory for the downstream channel. For the upstream, a mechanism must be provided to prevent that useful data is still present in the interleaver/deinterleaver path.

When no user data is presented to the modem, idle ATM cells are transported over the link. Hence, non-activity can easily be detected at the TC layer. Operations software will indicate for how long idle cells have to be (continuously) transmitted before the request for power down is generated. A power down request must be rejected when on of the following conditions are met:

        1) V(A)OC or EOC message exchange is in progress
        2) Actions between the NT and LT are in progress on the physical layer (e.g. bit swap action, rate adaptation action, EOC command execution).

Power down will be negotiated between the transmitter and receiver. Power down message requests will be transported over an operations channel.

In a multi-carrier system all but one carrier can halt transmission. The remaining carrier (pilot) [1] is required for timing synchronization between transmitter and receiver. This carrier must be modulated in order to provide an operations channel. In case case new user data is received at either side of the modem, power up can be indicated to the receiver over the operations channel. As during power down the modem remains synchronized, fast power up (several tens of DMT symbol periods) can be achieved.

In power down only a single carrier is modulated. Therefore, a number of functional bloks in the digital part of the modem can be put in non-active mode. In addition, the power consumption of the analog part of the modem can be reduced significantly.

3. CONCLUSION

In this contribution we have considered power down in multi-carrier systems. It has been shown how the requirement for a fast power up can be met by using a single carrier (pilot) to maintain synchronization. The carrier must transport an operations channel in order to negotiate power up. During power down, the power consumption of the modem is only a fraction of the power consumption during normal mode operation.

4. REFERENCES

[1] Spruyt P.,"Modulation of the pilot tone", ANSI T1E1.4 Committee Contribution No. 97-051, Clearwater Beach (FL), May'97.