WCDMA Physical Layer Verification of Node B System in BMS

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Abstract

In this paper, the system architecture of BENQ Mobile System Inc. (BMS) Node B prototype is introduced. The relationship between wideband code division multiple access (WCDMA) transport channels and physical channels will be briefly described, and the method for physical layer verification in WCDMA is studied. Finally, the result of the verification procedure is given.

Keywords: WDCMA, 3GPP, Node B, BTS.

1. Introduction

In the past, Mobile communication mainly focuses on the function of voice communication, such like AMPS, and GSM. But today WCDMA does not only focus on the voice application, but also data communication, such like audio, video, and other multimedia. WCDMA is one of the wideband digital cellular technologies that are used for the third generation wireless communication and the technology is much more complex than the second generation wireless communication technologies. Besides, a single provider alone cannot deliver the wide range of comprehensive technology and services encompassed by mobile communications. With this in mind, BMS is committed to aggressive research and development of 2G/3G Base Transceiver System (BTS) and related products, as well as establishing strategic ODM/OEM partnerships to provide select wireless infrastructure makers with value-added products and services.

For WCDMA, the Node B is a term in the third Generation Partnership Project (3GPP) specifications, and the Node B plays the same position as BTS in GSM. Moreover, the general term “Base Station” can replace both of them. The function diagram of the Node B and interfaces is illustrated in Fig. 1. In the figure, UE means the User Equipment. UTRAN means Universal Terrestrial Radio Access Network that handles all radio related functionality and Node B handles the data flow conversion between Uu and Iub. Besides, the Node B takes part in radio resource management and the Radio Network Controller (RNC) controls and owns the radio resources [1].

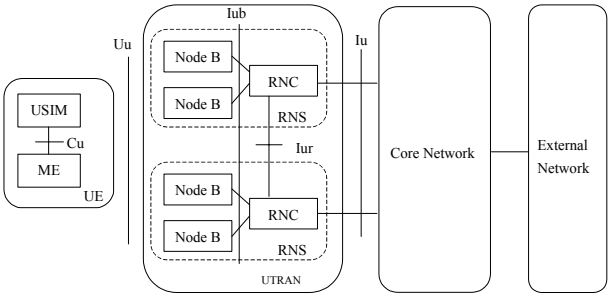

Fig. 1 The UMTS system architecture

In the following sections, we will mainly focus on the Node B physical layer. In Section 2, the PHY architecture of BMS’s Node B will be introduced. The

PHY architecture consists five types of logical modules for data processing and one module for management. In Section 3, the transport channels and physical channels will be described. And the relationship between them will be mentioned. Moreover, several physical layer procedures will be introduced. In Section 4, we will put our emphasis on the physical layer verification steps, and we will point out these verification results, too. In Section 5, some conclusions will be made and future plan will be mentioned.

2. The PHY architecture of the Node B

The PHY consists of five data processing modules and one management module. These data processing modules are divided according to the data processing rate: sampling rate processing module (SARP), chip rate processing module (CRP), slot rate processing module (SLRP), frame rate processing module (FRP), and packet rate processing module (PRP). And the management module is radio link & cell management (RLCM). The PHY architecture is shown in Fig. 2.

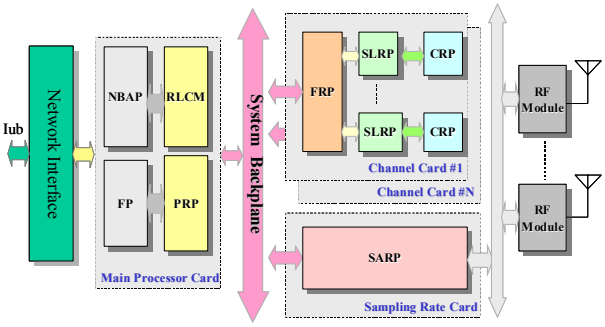

Fig. 2 PHY architecture of the Node B

The following describes the function of each module. SARP can be treated as a digital front-end of the PHY subsystem and it interfaces with ADC and DAC directly. CRP mainly deals with the symbol spreading and de-spreading. Moreover, it also supports chip-level synchronization by using the matched filter. SLRP mainly deals with fast power control, and measurement. FRP mainly deals with multiplexing and channel coding (MCC). PRP is an interface between FP and FRP. And its main task is to route incoming and outgoing transport block sets to where it shall be. RLCM is an interface between NBAP and FRP. And its main task is to manage resources on channel cards in Node B [2].

3. The physical layer verification of Node B

Before describing the physical layer verification procedure, the transport and physical channels and their relationship will be briefly described. The Node B deals with physical channels which form the physical existence of the Uu interface between the UE part and UTRAN part. And the RNC deals with transport channels which carry various information flows over the Uu interface and the physical elements. Fig. 3 illustrates the channels diagram. And the mapping relationship between transport channels and physical channels is listed in Fig. 4.

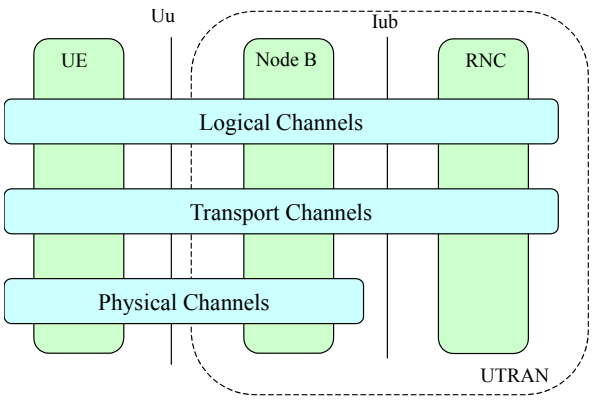

Fig. 3 The UTRAN channels diagram

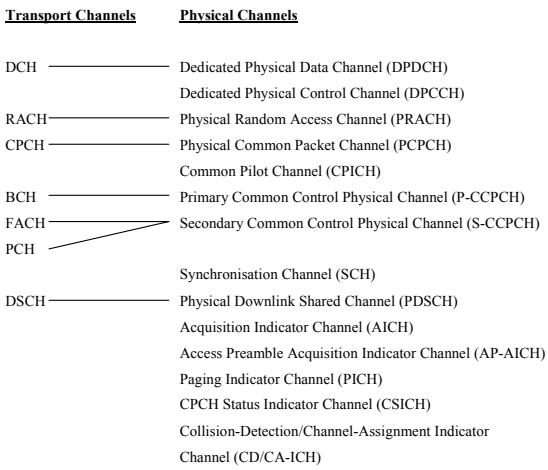

Fig. 4 Transport channel to physical channel mapping

Though there are lots of physical channels, we focus on several basic physical channels for the purpose of physical layer verification in Node B. These channels are CPICH, SCH(PSCH & SSCH), PCCPCH, PRACH, AICH, SCCPCH, DPDCH, and DPCCH [3]. And these channels will group several important procedures which are necessary for the connection and communication between UE and UTRAN. CPICH, SCH(PSCH & SSCH), PCCPCH will group the cell search procedure that UE searches for a cell and determines the downlink scrambling code and frame synchronization. PRACH and AICH will group the random access procedure that is typically used to register the UE after power-on to the network or to perform location update after moving form one location area to anther or to initiate a call. SCCPCH can carry paging information which network wishes to initiate the connection. Moreover, SCCPCH can carry control information to the UE about the response to the random access message. Downlink (DL) and Uplink (UL) DPDCH and DPCCH constitute the dedicated data transmission, and these dedicated data may be encoded voice, video, or other user information [4].

4. The verification steps and results

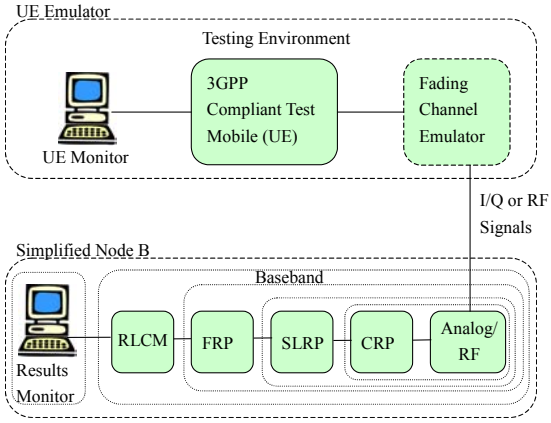

Fig. 5 The physical layer verification steps

Fig. 5 shows the diagram for the verification steps. According to this diagram, the physical layer verification will be separated into four steps and they are defined below:

(1) CRP level integration test

(2) CRP + SLRP level integration test

(3) CRP + SLRP + FRP level integration test

(4) CRP + SLRP +FRP + RLCM level integration test

We do the CRP level integration test first. After the step has been finished, we will do the step (2). And the whole physical layer verification finishes until the four steps are passed. Fig. 6 illustrates the physical layer procedure verification. These procedures in Fig, 6 will be verified according to the above four steps in Fig. 5

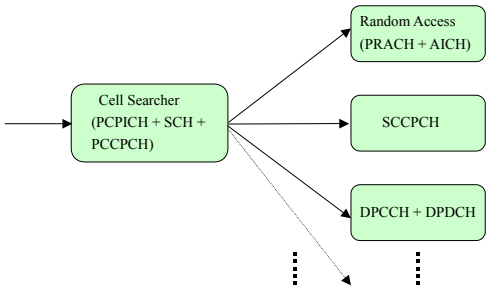

Fig. 6. The physical layer procedure verification

We firstly verify the cell search procedure among

these procedures which are listed in Fig. 6. This is because UE has to synchronize with the Node B (UTRAN) in timing and get Node B (UTRAN) system information firstly. And these things will be done in the cell search procedure. After finishing the cell search procedure, we can do other procedures. For BMS Node B prototype, the above procedures are passed. We take the procedure of DPCCH + DPDCH as an example. For the DL DPCCH + DPDCH, the transport channel data is gotten by decoding the physical channel data. This will be done by the UE emulator and the transport channel data is compared with the source data sent form the Node B. And the comparison is shown in the "UE Monitor" which run in one PC. Similarly, the comparison results for UL DPCCH + DPDCH procedure can be shown in the "Results Monitor" which is another PC.

5. Conclusion

In this paper, the physical layer procedures are introduced. These verification steps are described, too. These verification steps are suitable for BMS Node B prototype, and the verification spirit is applicable for other design in 3G systems. The spirit of the verification can be expressed by the word "Bottom-Up". Only when the lower level (high data processing rate) has been passed, we can do the next step. Though these physical layer procedures verification have been finished, there are other testings such like the base station conformance testing and the field test which are needed to do[5]. These testings will be done in the future.

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