POWER CONTROL FOR COMMUNICATIONS SYSTEMS UTILIZING HIGH SPEED SHARED CHANNELS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 14/658,398 filed Mar. 16, 2015, which issued as U.S. Pat. No. 9,661,593 on May 23, 2017, which is a continuation of U.S. patent application Ser. No. 14/249,104 filed Apr. 9, 2014, which issued as U.S. Pat. No. 8,983,524 on Mar. 17, 2015, which is a continuation of U.S. patent application Ser. No. 10/688,223 filed Oct. 16, 2003, which issued as U.S. Pat. No. 8,738,062 on May 27, 2014, which claims the benefit of U.S. Provisional Application Ser. No. 60/419,380 filed Oct. 17, 2002, the contents of which are hereby incorporated by reference herein.

FIELD OF THE INVENTION

The present invention relates to methods and apparatus for power control in wireless communication systems and, in particular, systems which use high speed shared channels.

BACKGROUND

Wireless telecommunication systems are well known in the art. In order to provide global connectivity for wireless systems, standards have been developed and are being implemented. One current standard in widespread use is known as Global System for Mobile Telecommunications (GSM). This is considered as a so-called Second Generation mobile radio system standard (2G) and was followed by its revision (2.5G). GPRS and EDGE are examples of 2.5G technologies that offer relatively high speed data service on top of (2G) GSM networks. Each one of these standards sought to improve upon the prior standard with additional features and enhancements. In January 1998, the European Telecommunications Standard Institute-Special Mobile Group (ETSI SMG) agreed on a radio access scheme for Third Generation Radio Systems called Universal Mobile Telecommunications Systems (UMTS). To further implement the UMTS standard, the Third Generation Partnership Project (3GPP) was formed in December 1998. 3GPP continues to work on a common third generational mobile radio standard.

A typical UMTS system architecture in accordance with current 3GPP specifications is depicted in FIG. **1**. The UMTS network architecture includes a Core Network (CN) interconnected with a UMTS Terrestrial Radio Access Network (UTRAN) via an interface known as Iu which is defined in detail in the current publicly available 3GPP specification documents. The UTRAN is configured to provide wireless telecommunication services to users through wireless transmit receive units (WTRUs), known as User Equipments (UEs) in 3GPP, via a radio interface known as Uu. The UTRAN has one or more Radio Network Controllers (RNCs) and base stations, known as Node Bs in 3GPP, which collectively provide for the geographic coverage for wireless communications with UEs. One or more Node Bs are connected to each RNC via an interface known as Iub in 3GPP. The UTRAN may have several groups of Node Bs connected to different RNCs; two are shown in the example depicted in FIG. **1**. Where more than one RNC is provided in a UTRAN, inter-RNC communication is performed via an Iur interface.

Communications external to the network components are performed by the Node Bs on a user level via the Uu interface and the CN on a network level via various CN connections to external systems.

In general, the primary function of base stations, such as Node Bs, is to provide a radio connection between the base stations' network and the WTRUs. Typically a base station emits common channel signals allowing non-connected WTRUs to become synchronized with the base station's timing. In 3GPP, a Node B performs the physical radio connection with the UEs. The Node B receives signals over the Iub interface from the RNC that control the radio signals transmitted by the Node B over the Uu interface.

A CN is responsible for routing information to its correct destination. For example, the CN may route voice traffic from a UE that is received by the UMTS via one of the Node Bs to a public switched telephone network (PSTN) or packet data destined for the Internet. In 3GPP, the CN has six major components: 1) a serving General Packet Radio Service (GPRS) support node; 2) a gateway GPRS support node; 3) a border gateway; 4) a visitor location register; 5) a mobile services switching center; and 6) a gateway mobile services switching center. The serving GPRS support node provides access to packet switched domains, such as the Internet. The gateway GPRS support node is a gateway node for connections to other networks. All data traffic going to other operator's networks or the internet goes through the gateway GPRS support node. The border gateway acts as a firewall to prevent attacks by intruders outside the network on subscribers within the network realm. The visitor location register is a current serving networks 'copy' of subscriber data needed to provide services. This information initially comes from a database which administers mobile subscribers. The mobile services switching center is in charge of 'circuit switched' connections from UMTS terminals to the network. The gateway mobile services switching center implements routing functions required based on current location of subscribers. The gateway mobile services also receives and administers connection requests from subscribers from external networks.

The RNCs generally control internal functions of the UTRAN. The RNCs also provides intermediary services for communications having a local component via a Uu interface connection with a Node B and an external service component via a connection between the CN and an external system, for example overseas calls made from a cell phone in a domestic UMTS.

Typically a RNC oversees multiple base stations, manages radio resources within the geographic area of wireless radio service coverage serviced by the Node Bs and controls the physical radio resources for the Uu interface. In 3GPP, the Iu interface of an RNC provides two connections to the CN: one to a packet switched domain and the other to a circuit switched domain. Other important functions of the RNCs include confidentiality and integrity protection.

Various methods of power control for wireless communication systems are well known in the art. Examples of open and closed loop power control transmitter systems for wireless communication systems are illustrated in FIGS. **2** and **3**, respectively. The purpose of such systems is to rapidly vary transmitter power in the presence of a fading propagation channel and time-varying interference to minimize transmitter power while insuring that data is received at the remote end with acceptable quality.

In communication systems such as Third Generation Partnership Project (3GPP) Time Division Duplex (TDD) and Frequency Division Duplex (FDD) systems, multiple