Chapter XIV
Turbo Equalizer:
A Solution to 4G Mobiles

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ABSTRACT

Turbo codes exhibit excellent performance gains. Turbo equalization is an iterative equalization and decoding technique. It can achieve equally impressive performance gains for communication systems. Turbo codes are send digital data over channels that require equalization, i.e. those which suffer from inter-symbol interference (ISI). Turbo equalizers have been shown to be successful in mitigating the effects of inter-symbol interference introduced by partial response modems and by dispersive channels for code rates of R>1/2. The performance of iterative equalization and decoding (IED) using an M-*BCJR equalizer is analyzed. Bit error rate (BER), frame error rate simulations and extrinsic information transfer (EXIT) charts are used to study and compare the performances BCJR equalizers on precoded and non-precoded channels. We predict the BER performance of Turbo equalizer using the* M-*BCJR equalizer from EXIT charts and explain the discrepancy between the observed and predicted performances.*

INTRODUCTION

Fourth-generation (4G) mobile systems are expected to provide global roaming across different types of wireless and mobile networks. Communication may be from satellite to mobile networks and to wireless local area networks (WLANs). The main objective of 4G is to overcome the shortcomings and limitations of third-generation (3G) systems, prime amongst which is the issue of available bandwidth. In general, 4G network architecture includes three basic areas of connectivity: PANs (e.g., Bluetooth), WANs (e.g., IEEE 802.11), and

cellular connectivity. In wireless networks, quality of service (QoS) refers to the measure of the performance for a system reflecting its transmission quality and service availability (e.g., 4G is expected to have at least a reliability of 99.99%). Supporting QoS in 4G networks will be a major challenge.

The term 4G is used broadly to include several types of broadband wireless access communication systems, including cellular telephone systems. One of the terms used to describe 4G is MAGIC—Mobile multimedia, Anytime anywhere, Global mobility support, Integrated wireless solution, and Customized personal service. The vision of 4G wireless/mobile systems are of broadband access, seamless global roaming, and Internet/data/voice communication. The 4G system provides facilities to integrate terminals, networks, and applications to satisfy the increasing user demands.

The 4G mobile networks are being developed with two main objectives. One of these objectives is to overcome the shortcomings and limitations of 3G, prime amongst which is the issue of available bandwidth. 4G systems are expected to offer a speed of over 100 Mbps in stationary mode and an average of 20 Mbps for mobile stations, reducing the downlink time of graphics and multimedia components by more than 10 times, compared to currently available 2 Mbps on 3G. The second main objective behind 4G development is to make good use of the achievements in the area of wireless technology. Currently, the 4G system is a research and development initiative based upon 3G, which is having trouble meeting its performance goals. The challenges for development of 4G systems depend upon the evolution of different underlying technologies, standards, and deployment.

Features of 4G

There are some features that are expected to be supported by 4G networks, including:

1. **High Usability and Global Coverage:** 4G networks are expected to fulfill the anytime, anywhere, and any technology requirement.
2. **Broadband Connectivity and QoS:** 4G networks provide higher bandwidths up to 100 Mbps to support multimedia services. End-to-end QoS is required.
3. **High Network Capacity:** 4G network capacity should be at least 10 times that of a 3G network.
4. **Packet-Switched Network:** 4G networks are expected to be entirely packet-switched networks.
5. **Service Personalization:** In order to overcome the saturated mobile communication market, operators will seek new 4G users in widely different locations, occupations, and economic classes. So to meet demands of these diverse users, service providers should design personal and highly customized services for them.

Limitations of 4G

Although the concept of 4G communications shows much promise, there are still limitations that must be addressed. One major limitation is operating area. Although second-generation (2G) networks are becoming more ubiquitous, there are still many areas that are not served. Rural areas and many buildings in metropolitan areas are not being served well by existing wireless networks. This limitation of today's networks will carry over into future generations of wireless systems. Another limitation is cost. The equipment required to implement a next-generation network is still very expensive. Carriers and providers have to plan carefully to make sure that expenses are kept realistic. One technique currently being implemented in Asian networks is a pay-per-use model of services. This model will be difficult to implement in the countries where the public is used to a service-for-free model (e.g., the Internet).