Novel WLL Architecture Based on Color Pixel Multiple Access Implemented on a Terrestrial Video Network as the Overlay

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ABSTRACT

Light waves of different wavelengths and frequencies manifest in various colors. Color can be formulated electronically by video processing technologies for the purpose of multimedia, image processing and entertainment. Optoelectronic devices like DWDM use optical signals of various wavelengths for conveying data symbols from one end to other. The big question is: Is it feasible to implement color synthesized by the video systems for the purpose of telecommunications? In this paper we propose the ‘Color Pixel Multiple Access’ scheme for the radio access network and Color Pixel Multiplexing for core network, by implementing electronic color as a tool for addressing and bearing data overhead. The present day video systems that can generate millions of colors, in its electronic form have been utilized to set up a wireless network, serving mobile stations or computers as its nodes. The state of the art Wireless Local Loop deployments are based on the traditional cellular technologies. However there are limitations in terms of intricacy, cost and time to deploy. In this paper, the authors introduce a Wireless Local Loop architecture employing the proposed CPMA technique on existing overlay video/television network. Further we corroborate the advantages.

Keywords: Color Circle, Color Pixel Multiple Access, Home Location Register, Mobility Management, Radio Access Network (Ran), Wireless Local Loop

INTRODUCTION

In telephone networks, the leg between the local exchange and the subscriber’s equipment in called the local loop. Traditionally, the last mile reach has been realized by copper. With increasing number of subscribers and the cost of laying the copper cables or fibers, this has been replaced by wireless connectivity in many places. Hence it is referred to as Wireless Local Loop (3GPP2 S.R0024). The WLL technology should not restrict service support to telephone
service only, but must enable broadband multimedia services, such as high speed internet, iTV, telelearning, telemedicine etc.

Local Multipoint Distribution System (LMDS), Satellite systems, stratospheric platforms, Digital Enhanced Cordless Telecommunications (DECT), Personal Access Communications System (PACS) and Personal Handy phone System (PHS) are generally chosen as possible WLL technologies.

Most of the WLL networks implement the traditional cellular access technologies, namely W-CDMA, TDMA, GSM or CDMA. These technologies were developed to support full scale roaming and hence involve complex process of mobility management. In a WLL network, mobility management is not the key player. But since they are deployed using the state of the art mobile network technologies, all the associated cost and intricacy of deployment and operations exist hence, it is time to look beyond the state of the art to realize a technology more compatible with the requirements of WLL and to achieve substantial optimization of resources.

In this paper, we discuss a network architecture employing a new Multiple Access technology which aims the following:

1. Realise a network which is less dependent on the layer 7 processes for mobility management. This in effect will reduce the signalling bandwidth requirement and cost of the network equipment as they will need lesser interaction with the network;
2. Reduce the cost of the mobile node, as interaction between the handset and the network for mobility management and other associated layer 7 processes reduces substantially;
3. Re-use the already existing cable TV network as an overlay network for transport backbone. The WLL operator will need to subscribe for a Television channel which acts as a carrier for voice and data. The wireless access will be ‘last mile’ and Near Line-of-Sight operations. The aim is to avoid the channel impairments due to the physical effect which magnifies with distance and obstructions. The high level schematic is in Figure 1. The colour server (Sanyal, 2006) is an active element in the network which is responsible for colour processing and for acting the addressing and signalling related processes for the mobile nodes;
4. Implementation of CPMA for voice coding required for wireless communication networks. However, this is covered in (Sanyal, 2007) and not in the scope of this paper.

The paper is organized as follows. First, we set out a brief introduction of the proposed Multiple Access Methodology called Color Pixel Multiple Access (Sanyal, 2009). Then we discuss the network architecture in light of CPMA. Afterwards we introduces the system model. Followed by a discussion on the various technicalities and calculation including the SNR calculation. Next we discuss briefly the conversion methodology of Color information to voice signals and vice versa.

The section afterwards brings out the pros/cons over the state of the art and then we finally conclude the paper.

COLOUR PIXEL MULTIPLE ACCESS

Color is the perceptual result of light having wavelength from 400 to 700 nm. The question is, whether the color, generated by the electronic video systems and perceived by the human retina can be utilized to render individual / discrete identities to millions of network nodes which can eventually form a mobile or computer network.

In the proposed access scheme, each user in the color plane is identified by a specific color (i.e. a combination of Hue and saturation level) and pixel in the video frame. As in Figure 2, a band of saturation level is spread across the color vector, a sub-band of which is meant for signaling and the remaining for bearer traffic. The coordinate of the Mobile Station in the color circle is determined while provisioning it...
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