Radio Environment Database considering Primary User Activity in Time Domain

1431019

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	1431019
	Radio Environment Database considering Primary User Activity in Time Domain

(SU: Secondary User)

(PU: Primary User)

PU

PU   ON/OFF

LAN

ON

PU

PU

(SU: Secondary User)

(PU: Primary User)

PU

PU   ON/OFF

LAN

ON

PU

PU

Abstract

Recently, with the fast development of wireless communication technology, cognitive radio (CR) has been recognized as a promising solution to address the problem of impending spectrum scarity for improving the utilization of spectrum for various wireless applications [1], [2]. In a CR system, it allows the Secondary Users (SUs) to opportunistically utilize the temporal and/or spatial unused spectrum holes without harmful interference to Primary Users (PUs). While SUs can occupy avaliable spectrum holes as long as the corresponding PU is in active, they must immediately evacuate the band as soon as the corresponding PU appears. One of the main chanllenges is to intelligently determine ongoing PU activity to avoid interferece toward PU. SUs can evacuate the band without affecting PU 's activity and opportunistically access the spectrum to maximize the spectrum usage if the information about PU can be obtained in advance. Hence, more information about PU leads to more effective spectrum usage for SUs, and an external device for provding information of PU is necessary. One of the main chanllenges is to intelligently determine ongoing PU activity to avoid interferece toward PU. SUs can evacuate the band without affecting PU 's activity and opportunistically access the spectrum to maximize the spectrum usage if the information about PU can be obtained in advance. Hence, more information about PU leads to more effective spectrum usage for SUs, and an external device for providing information of PU is necessary.

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Chapter 1

Introduction

In chapter 1, present spectrum scarcity problem as the background of this thesis and technology proposed for solution is described. Aslo, the overview of this thesis and purpose is described.

1.1 Background

Due to the rapid development of wireless communication systems, a demand on sprectrum resource for communication has increased explosively. Because the data rate and perfomance of the wireless communication system, such as mobile phone, are improved, it leads to a serious sprectrum scarcity problem.

From Fig. 1.1, reference [1] predicts that Global mobile data traffic will increase nearly tenfold between 2014 and 2019 and mobile data traffic will grow at a compound annual growth rate (CAGR) of 57 percent from 2014 to 2019, reaching 24.3 exabytes per month by 2019. In addition to the increasement of the data traffic, a fixed resource allocation method as the
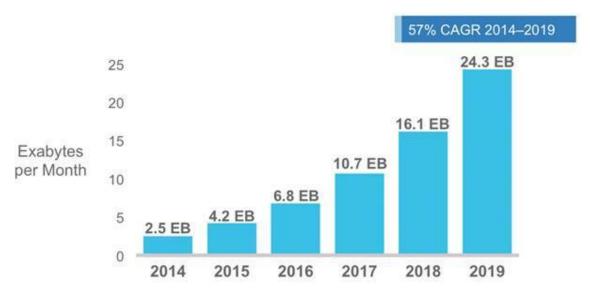

Figure 1.1: Cisco Forecasts 24.3 Exabytes per Month of Mobile Data Traffic by 2019

current spectrum allocation policy, which is utilized for avoiding harmful interference toward licensed systems with each other, is also considered as a major reason for the scarcity of the

spectrum resource. As a reason, almost linear increasing demand on necessary bandwidth for communication leads to a difficult allocation for new systems. From Fig. 1.2 reported from Ministry of Internal Affairs and Communications(MIC) in Japan government, it is shown that most of the spectrum resources has already been allocated. Thus, the lack of spectrum resources has become a serious problem.
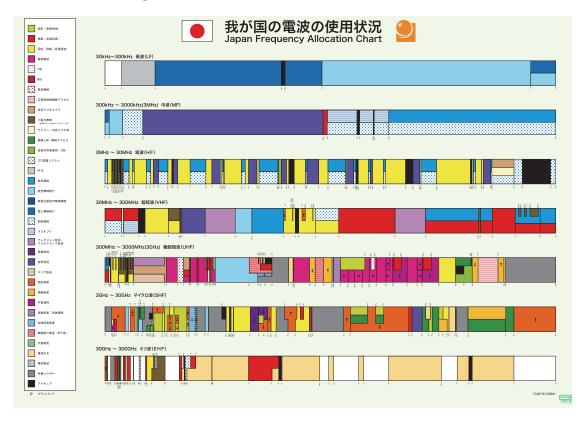

Figure 1.2: Japanese Frequency Allocation Chart.

Since the finite spectrum resources are not able to fulfill the expoential growth of demand on traffic, it is necessary to review the present spectrum policy with fixed resource allocation for the next generation wireless communication sysytems and a efficient spectrum utilization turns to be a key problem.

There are 2 main methods to ensure the bandwidth for new systems. Firstly, a spectrum arrangement on the whole wireless communication systems is utilized to extend available bandwidth. In 2011, an arrangement on television broadcasting is executed with switching to digital television broadcasing. However, it is not available for supporting the expoential growth of the data traffic and the number of systems. Second, an efficient and dynamic utilization method of bandwidth is considered to extend the probability for the future wireless communication systems, which is attracted attention as effective solution to the shortage of spectrum resources.

According to the report [2] from Federal Communications Commission(FCC), actual spectrum usage on the licensed band is lack of balance in both temporal and spatial domain and instantaneous usage efficiency remains at 15%   80% even under crowd environment, such as

urban areas, which means that an unused White Space(WS) exists even under temporal and spatial varying envrionment. However, it is not allowed to utilize White Space by other licensed or unlicensed systems based on current radio regulations.

Cognitive Radio(CR)[4] has been recognized as a promising solution to address the problem for improving the utilizetion of spectrum for various wireless applications.

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Acknowledgments

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Appendix

From the next page, the program source is attached.