

ELECTROMAGNETIC SPECTRUM ALLOCATION: WIRELESS NETWORKS

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1 Static Analysis - Collective action

Wireless network is a network set up by using radio signal frequency to communicate among computers and other network devices, due to its easy setup feature and no cabling involved, it have become an important tool in the construction of modern society. New emerging technologies allow users to perform more and more complex tasks, driving an increasing mean bandwidth consumption per user. However, a wireless network has limited capacity to provide information, that is, finite bandwidth; despite that neither, the number of users allowed to connect nor the amount of consumed spectrum are restricted. In order to guarantee an optimal performance is necessary to avoid signal traffic saturation and, at the same time, be able to reach an optimum usage of bandwidth even with a dynamical configuration of users and consumption.

1.1 The commons dilemma

A wireless network has limited capacity to provide information, finite bandwidth. The bandwidth usage in a wireless network is not restricted; neither the number of users allowed nor the amount of consumed spectrum per user. Bandwidth over consumption may saturate the system and eventually collapse it. A congested bandwidth is a very common phenomena that cause delay in the information traffic and sometimes collapse the system, leading to the loss of wireless signal for all the users.

1.2 Biophysical Context (IAD)

Natural infrastructure (NI)

The electromagnetic spectrum or bandwidth available for information traffic consisting of the range of all possible frequencies of electromagnetic radiation. These frequencies represent the amounts of radiant energy released by certain electromagnetic process, consisting of synchronized waves of electric and magnetic fields that propagate at the speed of light through a vacuum.

Hard human infrastructure (NI)

The “bandwidth” is available by different types of private hard human communication infrastructure i.e, electronic devices that have antennas as transmitters and wireless network cards for signal reception.

Attributes of the Community (IAD)

The community in a wireless network system works as a non-cooperative society in which each individual is looking for its own benefit, sometimes following behavioral protocols or sometimes acting improperly.

Social Infrastructure

The structure of a wireless network provides the capability of connection with any user whenever an appropriate electronic device is used. However, communication among users does not show the attributes of users in terms of bandwidth consumption.

Human Infrastructure

Consist of a user as administrator of the network and the rest of users able to connect to the network.

1.3 Rules in Use (IAD)

Position rules

The administrator of the network has the ability to displace a user to improve the performance of the network or remove the user and prevent re-connection definitely if the user is incurring into illegal actions.

Boundary rules

Depending of the technology in the used of electronic device a user can have different boundaries for bandwidth consumption. Users with novel technologies are able to perform more complex task than users with old technology.

Choice rules

Users decide their availability of spectrum within certain ranges by paying fees to the network provider. Other way that users have a choice is in the technology implemented in the electronic device and the type of device used.

Aggregation Rules

When a user is trying to connect, the user has to have the authorization of the network administrator (password).

Scope Rules

Depending of the type of network the administrator can allow or prohibit the use of certain technologies. The administrator is also able to restrict proprieties of the wireless network in order to maintain the system under its control, such as passwords.

Information Rules

Commonly when a user connects to a wireless network is informed of the appropriate use of the resource in terms of allowed activity and restrictions of usage.

Payoff Rules

When an improper act is detected, the administrator can remove the user and restrict re-connection definitely.

1.4 Summary

The lack of well implemented design principles as: clearly defined boundaries, collective-choice arrangement, monitoring, graduated sanctions and conflict-resolution mechanisms; incentives the users to incur in a free-riding strategy. Thus leading to an over-harvested spectrum and at the end incurring in a commons dilemma.