

# Reduce Interference in Wireless Communication System by using Adaptive Transmit Power Control (ATPC)

Roshen T. Ahmed<sup>1</sup>, Kanar R. Tariq<sup>2</sup>

<sup>1</sup>Energy and Renewable Energies Technology Center, University of Technology, Iraq-Baghdad

<sup>2</sup>College of Science & Technology, University of Human Development, Iraq-Sulaymaniyah

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**Abstract:** In wireless communications systems, the problem of attenuation and interference will severely cause a reduction in the received signal strength. Fading can also results in link unavailability. Therefore, there are many mitigation techniques concern in combating some of these issues, such as adaptive transmit power control (ATPC). ATPC use to decrease interference between link and other services, and to increase the link availability.

**Keywords:** Adaptive transmit power control (ATPC), co-channel interference, fractional degradation in performance (FDP), terrestrial microwave link (TML), frequency sharing criteria, high power amplifier (HPA).

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## I. Introduction

This report consists of three parts in relation to adaptive transmit power control (ATPC). Adaptive Transmit Power Control (ATPC) is a feedback control system which temporarily increases transmitter output power during period of fading. Each part will highlight an application of ATPC. In summary the following will be reviewed:

- General Overview for ATPC.
- ATPC in Point-to-Point Microwave Link for Rain Attenuation Problem.
- Spectrum Sharing by ATPC for Low Priority Systems.
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## II. Objectives

The objectives of this paper will be in understanding the concept of ATPC regarding its definition, principles, functions, applications, and how ATPC can be implemented in new wireless communication technology named (HAPS) High Altitude Platform System. Also, the constraints incurred in the implementation of ATPC will be addressed.

## III. General view for ATPC

This section will give the basic ideas for ATPC with its applications & functions. Adaptive Transmit Power Control (ATPC) is a feedback control system which temporarily increases transmitter output power during period of fading. ATPC is used in communications systems, satellite Communication, HAPS, microwave link in Terrestrial Communication [2] and wireless sensor network [4]. ATPC has many Functions which support communication system in maintaining design requirements. Such as, reduce interference to other services, increase link availability, reduces the out-of-band emission by the decrease of HPA gain under clear sky condition and reduce power consumption. Figure 1, shows a typical configuration of Transmitter that employs ATPC in HAPS environment. ATPC is achieved in a variable-gain high power amplifier (HPA) that uses variable attenuator inside the HPA module [5], while table 1 defines the criteria for coordination of microwave fixed services using ATPC.

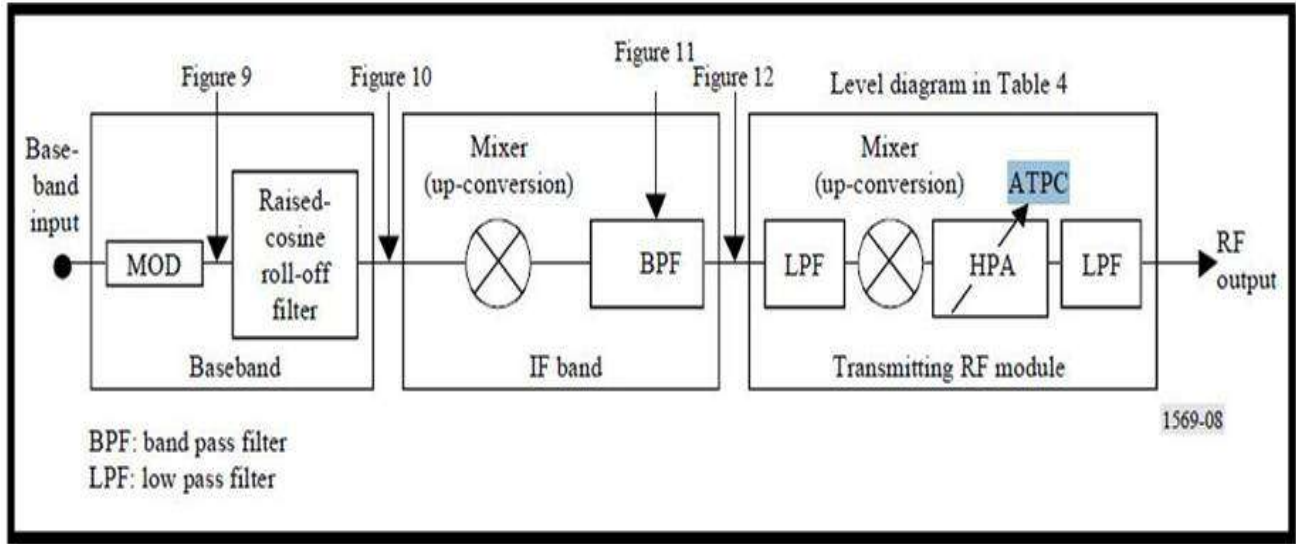


Fig. 1: Typical configuration of a transmitter HAPS-GS.

#### IV. ATPC in Point-to-Point Microwave Link for Rain Attenuation Problem

Point to point microwave system is the backbone link for mobile communication. In tropical region, rain attenuation is the major constraint for implementing micro-wave system above 10 GHz. Such problems in tropical region countries limit the full implementation of the system. Also, as the frequency increase, the rain attenuation will become worse. One solution could be in decreasing the distance could between links, but the implementation cost will be higher since more micro-wave links are required.

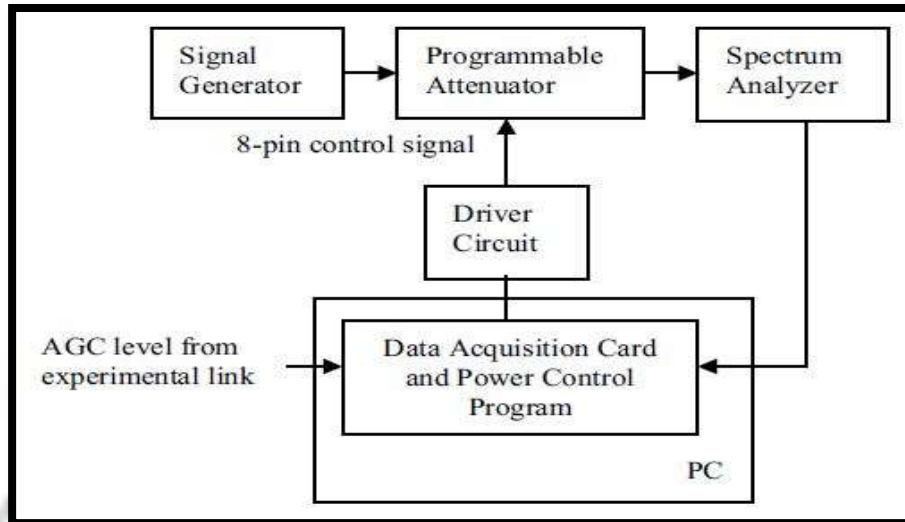
Table 1: ATPC power definitions & limits [5,6]

Level	Definition	Limits
$P_{t_{max}}$	The maximum transmit power that will not be exceeded at any time, used for fade margin and path reliability (outage) computations; and for calculating the C/I into an ATPC receiver.	$\leq +43$ dBm (1 GHz < 10 GHz) $\leq +40$ dBm (> 10 GHz) See Part 3.2.2 of the RALI FX 3.
$P_{t_{coord}}$	The coordinated transmit power selected by the ATPC system licensee as the power to be used in calculating interference into a victim receiver.	Between 0 to 10 dB below $P_{t_{max}}$ ;
$P_{t_{nom}}$	The nominal transmit power level at or below the coordinated power at which the system will operate in normal (unfaded) conditions.	$\leq P_{t_{coord}}$ .
$P_{r_{norm}}$	Normal (unfaded) ATPC link receive level.	As designed with adequate link availability.
$P_{r_{trig}}$	The receive level at which ATPC is activated - ie. ATPC Trigger Level.	At least 10 dB below $P_{r_{norm}}$

The solution for rain attenuation problem at point-to-point microwave link is by introducing adaptive transmits power control (ATPC) in the front-end of radio unit. With ATPC, the transmission power will be varied according to the propagation channel condition external. So, to apply ATPC in the system, the following considerations should be taken into account:

- Nominal power transmission.
- Maximum power transmission.
- Transmit spectrum mask.

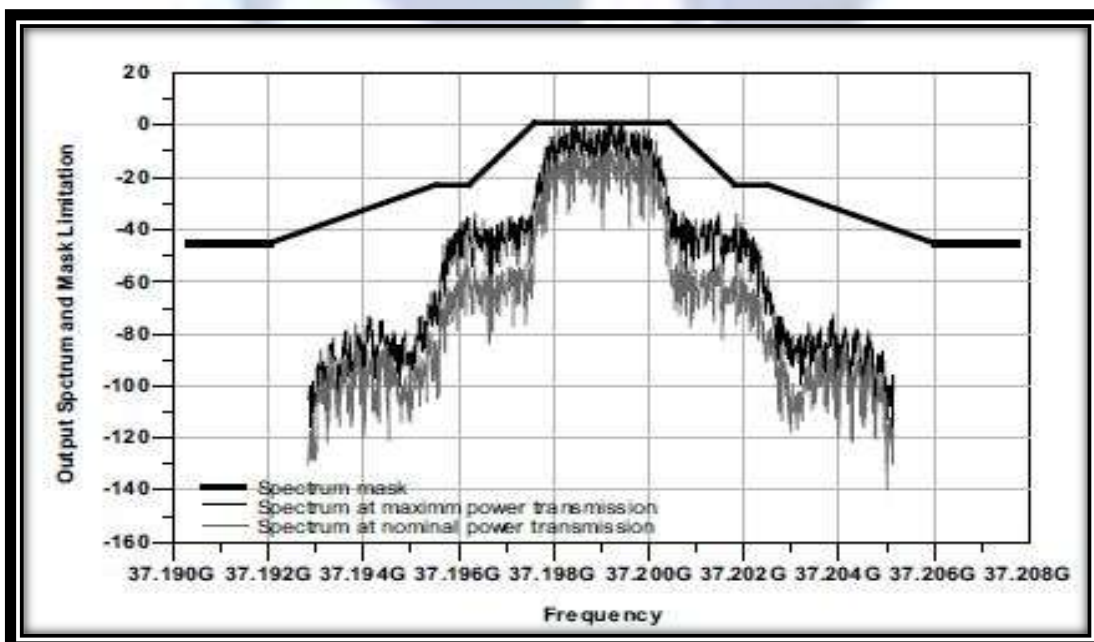
An experiment was conducted on the effect of ATPC on a point-to-point microwave system under raining condition [2]. A 38GHz microwave link was used as the test bed, which was installed between a specific Wireless Communication Centre and telecommunication tower in a specific area as a study region. The key parameters are; separation distance of approximately 300 m, antenna gain of 44.5 dBi and the radio unit outputs an automatic gain control (AGC) signal that indicates the RSL. The block diagram which simply explains the principle of ATPC system in microwave link is clarified in figure 2. The experimental results verified the feasibility of ATPC system in overcoming the rain attenuation by performing analysis in both simulation and subsystem testing. In addition, ATPC could give performance improvement to microwave system [2]. Figure 3 and figure 4 show the result of experiment.



**Fig. 2: block diagram of ATPC [3]**

**V. Spectrum Sharing by ATPC for Low Priority System**

A spectrum sharing method is proposed for systems which share the same frequency band or adjacent bands with different priorities. Spectrum sharing remains one of the most important issues for wireless communication systems. The principle is to assign exclusive frequency bands to different systems or different operators, and systems that used adjacent frequency channels are expected to use appropriate spectrum masks to avoid harmful interference with each other.



**Fig. 3: Output spectrum [2]**

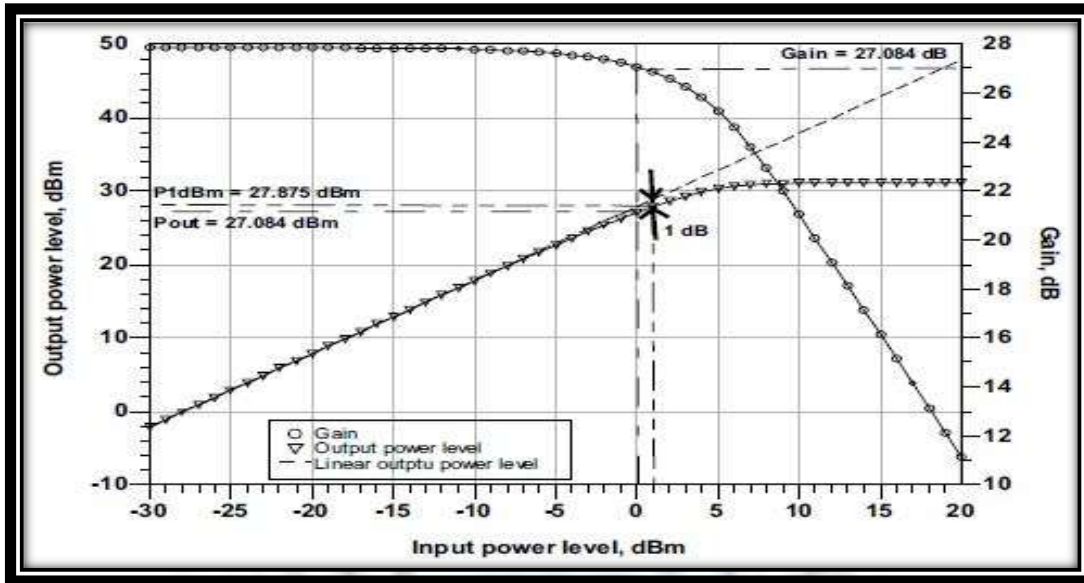


Fig. 4: output power & transmitter gain comparison

In this section a new communication system is assigned a frequency band adjacent to those currently in uses, it is usual for the existing systems to have higher priority than the new one. This method is expected to work well if the activity of the high priority system is not so high or the geographical density of the high-priority system is low. The principle of this method is to control the transmission power adaptively according to the information offered by the high-priority system receivers. So, the maximum allowable transmission power is calculated based on ambient status information including positions of interfering transmitters and victim receivers, and allowable interference level of the receivers. Figure 5 shows the implementation of the proposed spectrum sharing method. This new transmission method for low-priority systems in spectrum sharing environments controls the transmission power adaptively according to the information acquired from high-priority system receivers [3].

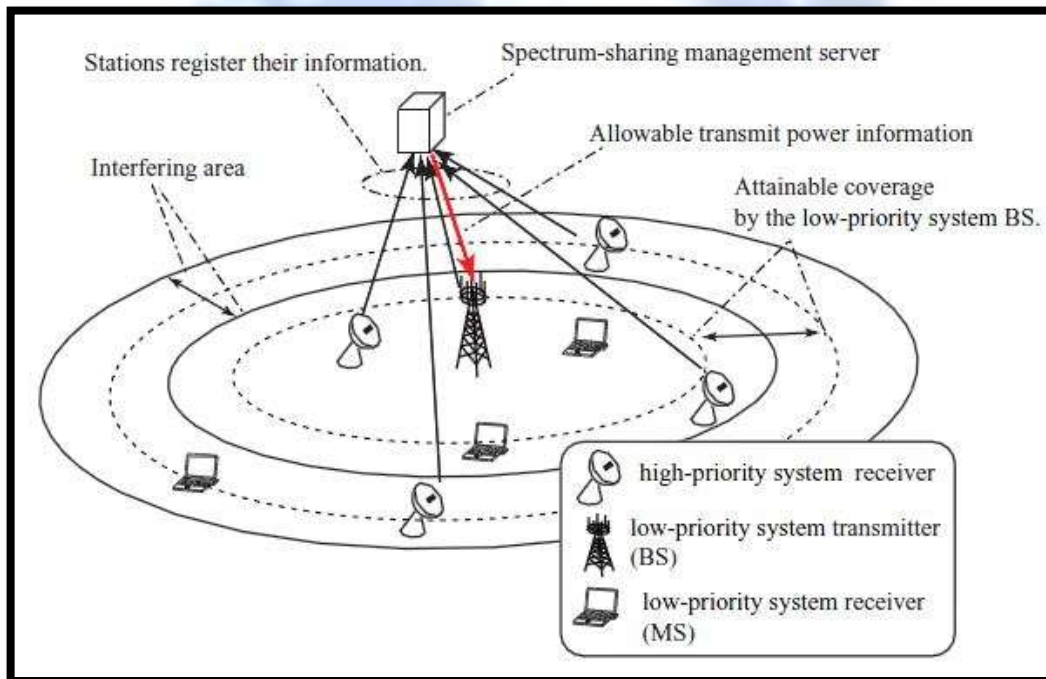


Fig. 5: System model

### **Conclusion**

ATPC works to improve the quality of system; hence it keeps the required system signal power to minimal value under all cases. Also, ATPC offers immediate and long term advantages to the link, including reduced average power consumption, extended equipment life span and lower long term RF interference levels. In addition, ATPC is essentially the scheme to avoid the unnecessary higher transmission power of the signal. Therefore, ATPC is useful from the viewpoint of the interference reduction.

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