A Review Paper on Smart Antenna for Mobile Communication

Sandeep Dhaka
Department of Electronics & Communication
Vivekananda Institute of Technology, Jaipur
Jaipur, India

Abstract: **This paper presents brief account on smart antenna system for mobile wireless communications, the adaptive antenna techniques in future wireless systems is anticipated to have a significant clash on the more efficiently use of the spectrum, the minimum cost of establishing new wireless networks, the optimization of service quality and realization of transparent operation across multi technology wireless networks. This paper presents brief account on smart antenna system. Smart antenna can place nulls in the direction of interferers via adaptive updating of weights linked to each antenna element. Smart antenna system thus cancel out most of the co-channel interference resulting in better quality of reception and lower dropped calls. The paper explains about the radiation pattern of the antenna and why it is used in its relative field. The strength of smart antenna are easily employable to Cognitive Radio and OFDMA system.**

Keywords: ***Adaptive Antenna, Wireless, Beam forming, DSP, Diversity.***

INTRODUCTION

In view of fulmination accretion in the number of digital cellular subscribers, service providers are becoming increasingly concerned with the limited capacities of their existing networks.

This concern has led to the dispersion of smart antenna systems throughout major metropolitan area cellular markets a smart antenna is an array of elements connected to a digital signal processor. Such a configuration dramatically increases the capacity of a wireless link through a combination of diversity gain, array gain, and interference suppression.

Increased strength of translates to higher data rates for a given number of users or more users for a given data rate per user. Multiple path of propagation are generated by reflection and scattering.

Also, interference signals such as that produced by the microwave oven in the picture, are superimposed on the desired signals. Measurement suggest that each path is really a bundle or set of paths, resulting from surface roughness or clutter. The random gain of the bundle is called Multipath fading.

This paper mainly concentrate on use of smart antennas in mobile communications that increases the strength of the mobile and cellular system such as faster bit rate, multi-use interference, space division multiplexing (SDMA), adaptive SDMA, increase in range, multipath mitigation, reduction of errors due to multipath fading, best suitability of multi-carrier modulations such as OFDMA.

The advantage of smart antenna, application in cellular systems are decreased inter symbol interference, decreased co-channel interference & adjacent channel interference, improved bit error rate due to decreased amount of multipath, increase in receiver sensitivity, reduction in power consumption & RF pollution. Smart antennas are extreme appropriate for use of perception radio software radio technology provides flexibility and the greatest advantage of smart antenna is a very high security.

Smart Antenna:

- Smart: The concept of using multiple antenna and innovative signal processing to serve cells more intelligent has present for many years. In fact, varying degrees of relatively costly smart antenna systems have already been used in defence systems. Until recent years, cost barriers have prevented their use in commercial systems.
- The advent of powerful low-cost digital signal processors DSP, general-purpose processors and ASICS, as well as innovative software-based signal-processing technique have made intelligent antennas practical for cellular communications systems. This system is supplying greater extension area for each cell site, higher rejection of interference and substantial capacity improvements.

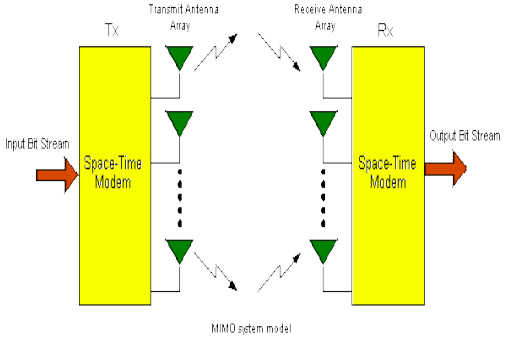

Fig.No.1 smart antenna system

- Principal of Smart Antenna System: Each antenna element "sees" each propagation path differently, enabling the collection of elements to distinguish individual paths to within a certain resolution. As a consequence, smart antenna transmitters can encode independent streams of data onto different paths or linear combinations of paths, thereby increasing the data rate, or they can encode data always onto paths that clear independently to assure the receiver from calamitous signal clear, thereby providing diversity gain.

- A smart antenna receiver can decode the data from a smart antenna transmitter this is the highest-performing configuration or it can simply provide array gain or diversity gain to the desired signals transmitted from correct transmitters and abolish the interference. No manual placement of antennas is required.
- The smart antenna electronically adapts to the environment. In truth, antennas are not smart antenna systems are smart. Basically co-located with a base station, a smart antenna combines an antenna array with a digital signal-processing strength to transmit and receive in an antenna, spatially sensitive manner. Such a configuration dramatically increased the capacity of a wireless link through a combination of diversity gain, array gain and interference suppression. Increased strength translates to higher data rates for a provide number of users or more users for a provide data rate per user. In other words, such a system can automatically change the directionality of its radiation patterns in response to its signal environment.
- This can dramatically increase the performance characteristics of a wireless system. Multipath of propagation are created by reflections and scattering. Also, interference signals such as that produced by the microwave oven in the picture fig. are superimposed on the desired signals. Measurement comment that each path is really an array or body of paths, resulting from surface gruffness or irregularities. The random gain of an array is called multipath fading.
- Types of Smart Antenna Systems:
  The following are distinctions between the two major categories of smart antennas regarding the choices in transmit strategy:
  • Switched Beam—a finite number of fixed, predefined patterns or combining strategies
  • Adaptive Array—an infinite number of patterns that are adjusted in real time

1. Switched Beam Antenna

Switched beam antenna systems form multiple fixed beams with highest sensitivity in desired directions. These antenna systems detect signal strength, choose from one of several predetermined, fixed beams, and switch from one beam to another as the mobile moves throughout the sector.

Instead of shaping the directional antenna pattern with the metallic properties and physical design of a single element, switched beam systems combine the output of multiple antennas in such a way as to form finely directional beams with more spatial selectivity than can be achieved with conventional, single-element approaches fig

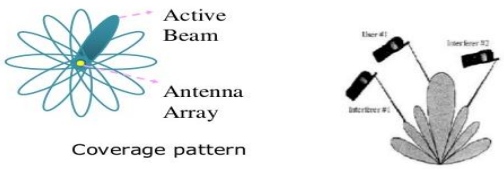

Fig.No.2–Switched Beam Antenna

1. Adaptive Array Antenna:

Adaptive array antenna technology is the most advanced smart antenna approach to date. Using a variety of new signal-processing algorithms, the adaptive system takes advantage of its ability to effectively locate and track various types of signals to dynamically minimize interference and maximize intended signal reception.

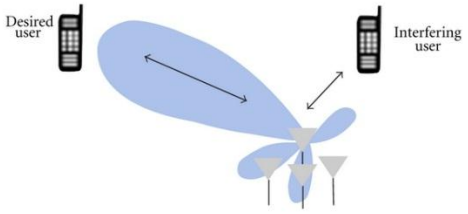

Fig. No. 3 Adaptive Array Antenna

These systems go to increase gain according to the location of the user; however, only the adaptive system provides optimal gain while simultaneously identifying, tracking, and minimizing interfering signals. Adaptive Array Coverage: A representative depiction of a main lobe extending toward with a null directed toward a co-channel interferer as shown in fig.

Application In Mobile Communications

- Higher Gain for desired signal in the direction of interest.
- Phased array smart antenna reduces probability of interference with narrower beam and adaptive array adjust the beam pattern to suppress the interference. It also helps in multipath mitigation which supports three types of antenna diversity spatial, polarization and angle diversity.

CONCLUSION

In conclusion to this paper “Smart Antenna” systems are the antennas with intelligence and the radiation pattern can be varied he beam forming can be obtained. As the system uses a DSP processor the signals can be processed digitally and the performance with a high data rate transmission and good reduction of mutual signal interference.

The narrow beams causes interference, allowing many users to be connected with in the same cell at the same time using the same frequencies and can adapt the frequency allocation to where the most users are located. With adaptive beam forming, spectral efficiency of the cell could be multiplied at times. Smart antenna effectively minimized the power consumption which in turn avoids RF pollution, minimize health hazard and save scarce resource.

Indeed it has been argued that performance requirement of a future cellular communication system cannot be made without the use of smart antennas.

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