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## Smart Antennas with Ad-Hoc Network

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**ABSTRACT:** The use of smart antennas in wireless ad-hoc networks with unique capabilities. Smart antenna had been studied extensively for use in cellular radio base station applications. Here we compare the advantages of ad-hoc network over a cellular network. When two stations communicate using their antenna arrays, in many cases the transmit power can be significantly reduced while still maintaining a sufficient margin. Here we show that this reduction in power is a key factor in modifying the capacity of ad-hoc network.

**KEYWORD:** SMART ANTENNAS ,AD-HOC , MRF WAVES , BEAMFORMING, FIR, MMSE, piconet.

### I. INTRODUCTION

Smart antenna is a multi-element antennas where the signal received at each antenna element intelligently combined to improve the performance of the wireless system and has features of diversity effect involves the transmission and reception of multiple radio frequency waves to increase the data speed and reduce the error rate. Ad-hoc network are the network of hosts that may be mobile with no pre-existing infrastructure and it built spontaneously as device connect instead of relying on a base station to coordinate The flow of message to each node in the network.

### II. SMART ANTENNAS

A smart antenna consists of several antenna elements, whose signal is processed adaptively in order to exploit the spatial domain of the mobile radio channel. The smart antenna technology can significantly improve wireless system performance and economics for a range of potential users. It enables operators of PC's cellular and wireless local loop networks to realize significant increase in signal quality, network capacity and coverage.

In actual, antennas are not Smart Antenna, systems are smart. Generally co-located with a base station, a smart antenna system combines an antenna array with a digital signal-processing capability to transmit and receive in an adaptive, spatially sensitive manner. 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.

This is a new and promising technology in the field of wireless and mobile communications in which capacity and performance are usually limited by two major impairments multipath and co-channel interference. Multipath is a condition that arises when a transmitted signal undergoes reflection from various obstacles in the environment. This gives rise to multiple signals arriving from different directions at the receiver. It arrays with smart signal processing algorithms to identify spatial signal signature such as the Direction of arrival (DOA)of the signal and use it to calculate beam forming vectors, to track and locate the antenna beam on the mobile targets. The antenna could optionally be any sensor. Smart antenna techniques are used notably in acoustic signal processing, track and scan Radar, Radio astronomy and Radio Telescopes and mostly in Cellular Systems like W-CDMA and UMTS.

A smart antenna is a digital wireless communications antenna system that takes advantage of diversity effect at the source (transmitter), the destination (receiver) or both. Diversity effect involves the transmission and/or reception of

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multiple radio frequency (RF) waves to increase data speed and reduce the error rate. The result is bad signal quality at the receiver due to phase mismatch. Co-channel interference is interference between two signals that operate at the same frequency. A smart antenna enables a higher capacity in wireless networks by effectively reducing multipath and co-channel interference. This is achieved by focusing the radiation only in the desired direction and adjusting itself to changing traffic conditions or signal environments. Smart antennas employ a set of radiating elements arranged in the form of an array.

They have two main functions:

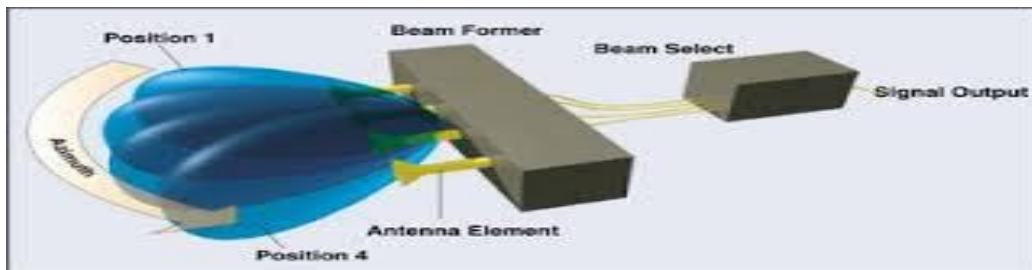
- \*DOA(direction of arrival estimation)
- \*Beamforming

\*DOA:

The smart antenna system estimate the direction of arrival of signal,using techniques such as music(multiple signal classifications),ESPRIT(estimation of signal parameters via rotational invariance techniques algorithms, matrix pencil method. They involve finding a spatial spectrum of the antenna/sensor array and calculating the DOA from the peaks of this spectrum.

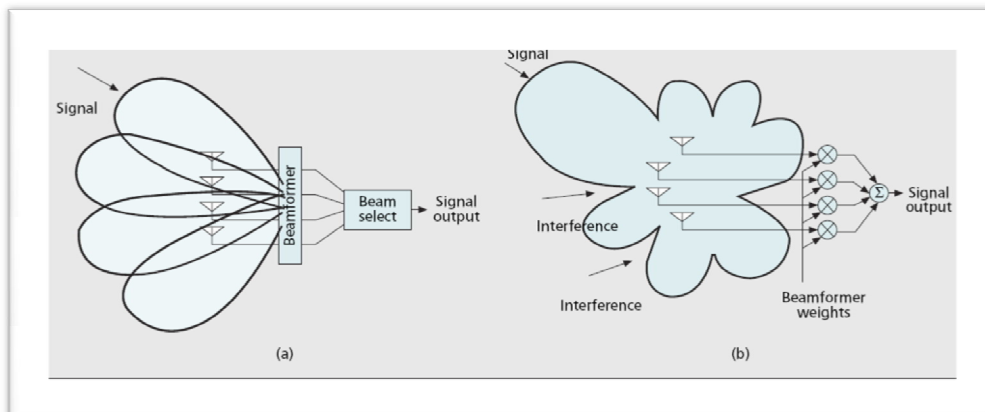
\*BEAMFORMING:

Beamforming is the method used to create the radiation pattern of the antenna array by adding constructively the phases of the signals in the direction of the targets/mobiles desired and nulling the pattern of the targets. This can be done with a simple FIR tapped delay line filter. The weights of the FIR filter may also be changed adaptively, and used to provide optimal beamforming, in the sense that it reduces the MMSE between the desired and actual beam pattern formed



Based on the type used there are two types of smart antenna

- \*Switched multibeam antenna (figure a)
- \*Adaptive array (figure b)



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## III AD-HOC NETWORKS

Ad-hoc network are the network of hosts that may be mobile with no pre-existing infrastructure and it built spontaneously as device connect instead of relying on a base station to coordinate The flow of message to each node in the network.

\*The principle behind ad hoc networking is multi-hop relaying in which messages are sent from the source to the destination by relaying through the intermediate hops (nodes).

\*In multi-hop wireless networks, communication between two end nodes is carried out through a number of intermediate nodes whose function is to relay information from one point to another. A static string topology is an example of such network.

\*In the last few years, efforts have been focused on multi-hop "ad hoc" networks, in which relaying nodes are in general mobile, and communication needs are primarily between nodes within the same network.

\*An examples of such developments is the Bluetooth standard that is one of the first commercial realizations of ad hoc wireless networking developed by Bluetooth Special Interest Group (SIG):

\*A piconet formed by a group of nodes establishes a single-hop (master node) point-to-point wireless link.

\*A scatternet formed by multiple piconets (master nodes) can establish a multi-hop wireless network.



### \*ADVANTAGES OF AD-HOC NETWORKS:

\*Military applications

\*Ad hoc wireless networks is useful in establishing communication in a battle field.

\*Collaborative and Distributed Computing

\*A group of people in a conference can share data in ad hoc networks.

\*Streaming of multimedia objects among the participating nodes.

\*Emergency Operations

\*Ad hoc wireless networks are useful in emergency operations such as search and rescue, and crowd control.

### \*DIRECTIONAL ANTENNAS IN AD-HOC NETWORK:

\*Directional antennas provide a higher gain and permit greater frequency reuse and topological control as well as increased connectivity

\*Ex:

If the transmitter(node A) knows the location of the intended receiver (node B), then the RTS can be sent with a directional beam, although it would be received with an omnidirectional beam at node B, since node B would not know that the RTS was sent. Node B would then send the CTS with a directional beam .This increases range and reduces the required transmit power ,as well as increases frequency reuse and network connectivity.

\*Furthermore, if a client associates with an access point with a directional beam, it may continue to associate with that access point (since the signal may remain strong) even after it moves beyond other access points. Thus, with movement , after a period of time many of the clients could be associated with the wrong access points , leading to a large reduction in overall network capacity.

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\*The main issue with directional antennas is that they do not work well in multipath environments, which are typical of most wireless systems

\*ADAPTIVE ARRAY IN AD-HOC:

\*Adaptive arrays do work well in multipath environments, can listen omni-directionally ,but beamform when the packet is received, thus obtaining the adaptive array gains even when a packet arrives from an unknown location. This increases the range for the RTS packet even when the location of the transmitting node is unknown a priori, unlike directional beam systems

\*Adaptive arrays, can be readily implemented even in very small form factors and adjust to the interactions in the environment

## IV CELLULAR VS AD-HOC NETWORK

Cellular Networks	Ad Hoc Wireless Networks
Fixed infrastructure-based	Infrastructureless
Guaranteed bandwidth (designed for voice traffic)	Shared radio channel (more suitable for best-effort data traffic)
Centralized routing	Distributed routing
Circuit-switched (evolving toward packet switching)	Packet-switched (evolving toward emulation of circuit switching)
Seamless connectivity (low call drops during handoffs)	Frequent path breaks due to mobility
High cost and time of deployment	Quick and cost-effective deployment
Reuse of frequency spectrum through geographical channel reuse	Dynamic frequency reuse based on carrier sense mechanism
Easier to employ bandwidth reservation	Bandwidth reservation requires complex medium access control protocols

## V CONCLUSION

\*Thus we had implemented both smart antennas and ad hoc networks can provide increased performance to wireless networks .Combination of these two can provide gains that are greater than the sum of gains ,but only if used properly

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