SMART ANTENNA

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What is Smart Antenna?

- A smart antenna system combines multiple antenna elements with a digital signal-processing capability to optimize its radiation and/or reception pattern automatically in response to the signal environment.
In truth, antennas are not smart—antenna systems are smart. And the DSP makes them smart by digital beamforming.
Types of Smart Antenna systems

Smart antenna systems are customarily categorized, as

- **Switched beam** → a finite number of fixed, predefined patterns or combining strategies (sectors)
- **Adaptive array** → an infinite number of patterns (scenario-based) that are adjusted in real time
Switched Beam Antennas

- It form multiple fixed beams with heightened sensitivity in particular 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.
Switched Beam Antennas

- **Figure** - Switched Beam System Coverage Patterns (Sectors)
Drawbacks of switched beam antenna

- Intra cell-hand offs
- Call loss
- Interference
Adaptive Array Antennas

- Adaptive antenna technology represents the most advanced smart antenna approach by using a variety of new signal-processing algorithms.

- It provides optimal gain while simultaneously identifying, tracking, and minimizing interfering signals.
Adaptive Array Antennas

Figure - Adaptive Array Coverage
Limiting effects of the wireless channel

- Multi-path propagation gives rise to
  - fading
  - inter-symbol interference
  - time variation of signals

- Co-channel interference gives rise to
  - increased noise level and hence greater errors
Multi-path propagation

- Multipath components suffer different delays
- This gives rise to ISI
- reject or stimulate multipath components by changing their radiation patterns
Co-channel interference

- Interference from other directions than wanted user
- Suppress unwanted user by placing nulls in directions of unwanted signals
- Improved transmission quality and/or system capacity
Who can use smart antennas?

- It enables operators of PCS, cellular, and wireless local loop (WLL) networks to realize significant increases in signal quality, capacity, and coverage.

- It is basically used in case of military communication because of its wide coverage area & better signal quality, but....
Advantages of smart antenna

- Integration.
- Range or coverage and capacity.(traffic/area)
- Interference suppression.

- Frequency reusability
- Accurate user positioning.
- Reduction in transmission power

Fixed cell shape

Dynamic cell shape
Uses of smart antenna

- Phased arrays are mainly being studied for point-to-point wireless systems, e.g., for wireless local loops.
- Adaptive arrays are being considered on cellular terminals where local scattering causes wide angular spread.
- In the TDMA system ANSI-136 adaptive antenna algorithms have been widely deployed.
Conclusion

- The use of smart antennas is not purely a radio transmission issue.
- It also influences network services such as handover and connection setup.
- 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.
References

- http://broadcastengineering.com/hdtv/smart_antennas/
- Handbook on Advancements in Smart Antenna Technologies for Wireless Networks, IGI 2008
Thank You!!!