

Development of Smart Antenna Technology

Antenna options

2004 Spectrum Efficiency Scheme
Ofcom contract no. 410000267

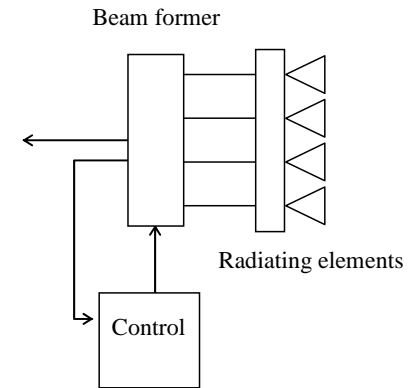
Demonstrator Day
7th December 2005

Consider antenna options

Lead in to the technology development and demonstration

System components

- Radiating elements
 - Provided required coverage over the user base
- Beamformer and control
 - Process and combine the signals from the radiating elements to enhance system performance in the presence of noise, interference and multipath



Control options

- Switched beam
 - Select discrete beam positions by switching input ports
 - Gives advantage if interferer is not in active beam
 - Degrades as wanted signal moves away from beam peak
- Steered beam
 - Select near continuous beam positions by controlling phase
 - Can steer nulls or beam
 - Gives advantage if interferer is not near wanted signal
- Fully Adaptive
 - Can steer nulls and beam independently using phase and amplitude control
 - Most flexible, but most complex approach

Adaptive antenna

- Can work in “beam space” or “signal space”
 - Beam space
 - Need to know the required signal direction
 - Most useful in high interference, low multipath environments
 - Signal space
 - Need to know signal characteristics (modulation scheme)
 - Useful in high interference, low, moderate and high multipath environments

Demonstrator antenna

- Signal space approach was selected for the WLAN demonstrator
 - signal preamble characteristic is known, client and interferer positions are not
- Need to choose
 - Where to convert from rf to digital
 - The form and number of the radiating elements

RF-digital conversion

- RF beamforming
 - need to control phase and gain/attenuation
 - need high quality rf components
- Digital beamforming
 - need to sample phase and amplitude
 - need fast A/D
- Convert to digital as close to the radiating elements as possible

Antenna elements

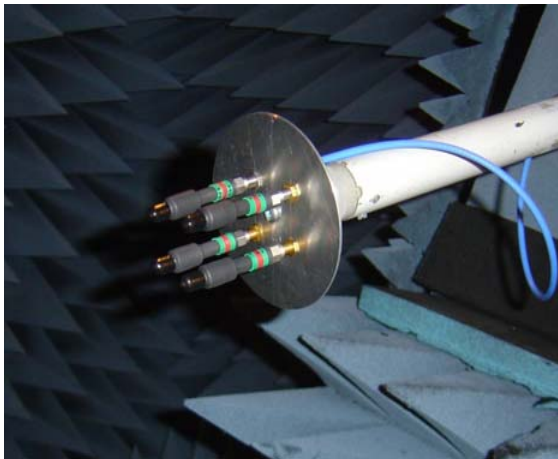
- Demonstrator scenario - office based IEEE802.11a
 - Moderate multipath
 - Small number of interferers
 - Client devices at similar elevations
 - Both omni and sector coverage options

Antenna elements

- Selected elements
 - Omni – array of dipoles
 - Sector – array of patches
- Number of elements
 - Compromise
 - Beamwidth/gain and the number of independent nulls
vs
 - Element cost, installation constraints and processing load
 - Four elements considered appropriate for this application

Antenna elements

- Both dipole and patch array manufactured, tested and integrated with the demonstrator



- Simple, standard design antennas were selected for the demonstrator
- Benefits could be gained from the use of more novel designs and structures, for example metamaterials
 - can allow additional freedom over the shape of the antenna for a given coverage
 - suppress surface waves to increase efficiency
 - lower mutual coupling to improve interference rejection

