Cellular Antenna Network Optimization based on 'Timing Advance Profile' of 'dedicated mode Mobile Stations'

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Optimization of Cellular Radio antenna network is a key factor in increasing the performance of any Cellular network, especially in GSM, GPRS, and EDGE Network architecture. Cellular Antennae networks are generally optimized considering the maximum coverage footprint for both indoor and outdoor to a pre-set Radio Signal Strength level. But the most important factor is making the network, carrying the maximum possible 'Offered Traffic', maintaining a tradeoff between 'Coverage and Carried traffic'. Basic components of Cellular antenna network optimization are Antenna Location, Altitude, Azimuth, and Elevation. Though Azimuth is a freely modifiable factor, must be considered collectively together with neighboring cellular antennae as it has a great impact on Coverage footprint. Antenna Tilt is a factor which can be modified even remotely from the Network Operation and Maintenance centre (OMCR). 'Timing Advance' data for a given cell or a Sector, can be used to analyse the offered and carried traffic information and their locational distribution in deciding the optimum Cellular-Antenna elevation (or Antenna Tilt). In TDMA systems, especially in *GSM networks*, *Timing Advance* has a range (in GSM, 0 to 63), where each step indicates a separation distance (in GSM, 550m) from the Transceiver station. This study was focused to identify the *Traffic Pockets b*y analyzing the *Timing advance profile* data in any given cell, and optimizing the antenna-tilt so that the offered traffic pockets are covered by the main radio beam.

A very straight forward equation was formed trigonometrically to calculate the down tilt value for a cellular antenna based on the distance of the mobile station form the transceiver station, in this case assuming all the mobile stations are at ground level. Calculation was based on the real traffic taken from a GSM cellular network, on a selected cell during a busy hour, where the inter-transceiver station distance, in this region is 15 -20 km. The Cellular antennae of this particular transceiver station are at 73 m as this is an *umbrella site*. Hence Down tilt value could be calculated as 0.740^0**(**$\tan^{-1}$ (Antenna height H, / Distance, D). This technique is further developed so that by performing similar calculations for inner and outer cellular radio, based on the TA profile, we could calculate the vertical beam-width of the cellular antenna demanded by the offered-traffic as 7.25^0.

This methodology is to be further developed, so that this calculation is repeated for all the cells on a given repetition pattern to optimize all the cellular antennae, using a tilt-changing system.

Keywords: Tilt Azimuth, Antenna Beamwidth, Cellular Coverage Footprint, Electrical Tilt, Timing Advance

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