

FCC Band Plan Technical Forum

Panel #1: Filter Technology and its Impact on Band Planning

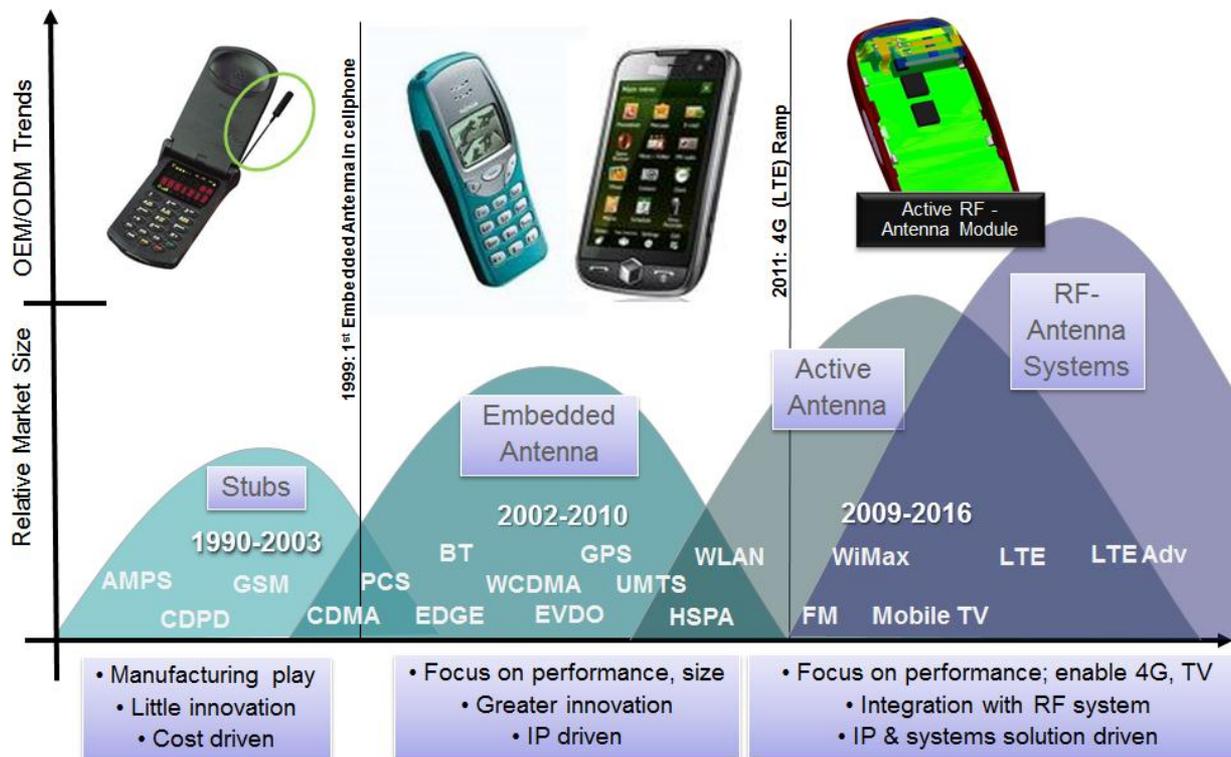
Ethertronics

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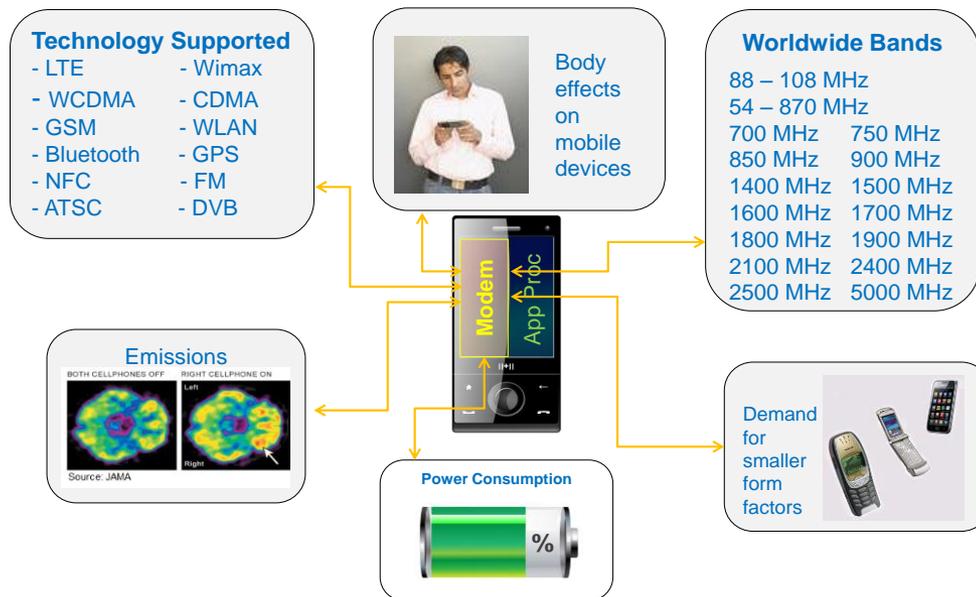
Antenna Development Progression in the Wireless Space

- In the last 20 years antennas for mobile devices have transitioned from external stubs to embedded designs
- Moving forward, active antenna techniques will provide a more capable antenna system, one that is dynamically tunable; this will provide a larger bandwidth, better efficiency, and dynamic compensation for environmental effects



Issues Considered During Antenna System Development

- Increasing number of frequency bands, along with MIMO requirements for 4G devices and downward progression in frequency (i.e. 700 MHz) in the same or smaller form factor is complicating the antenna system in mobile devices
- The antenna system competes with display and battery for internal volume to occupy
- Each antenna in a device needs to meet its efficiency and bandwidth requirements, and the antennas in the mobile device need to work well together, i.e. isolation and de-correlated patterns
- 4G requires a two antenna system on each end of the comm link, complicating the mobile device design

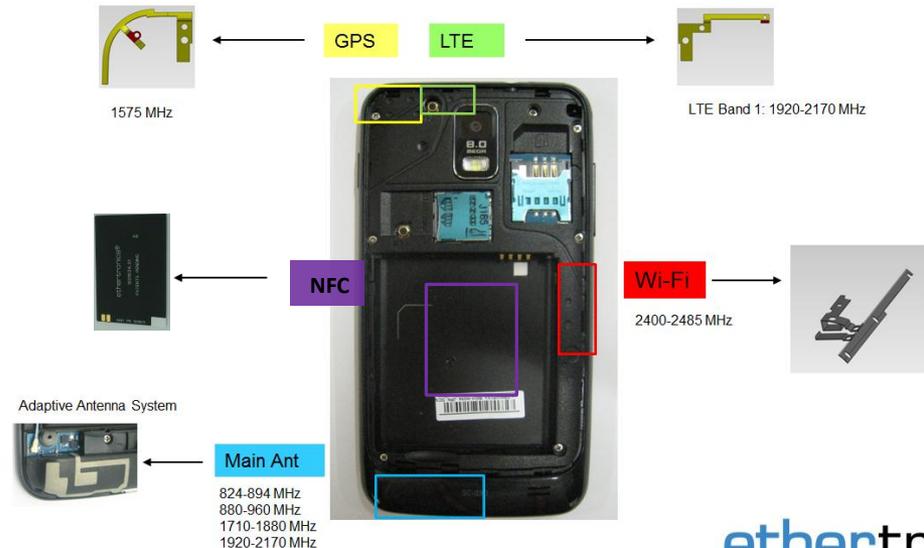


Multiple Antennas Integrated into Mobile Device

- Antenna system integration for 4G is more challenging compared to 2G/3G devices
- Five antennas being designed into the typical smartphone today
 - Main, Secondary, Wifi, GPS, NFC
- Antenna elements embedded into plastic cover or fabricated on plastic supports

Antenna layout in smartphone

Typical smartphone



Active Antennas Entering the Market to Solve Bandwidth and Capacity Issues

- Several active antenna techniques are now or will soon be available to dynamically tune the antenna, allowing for greater frequency coverage and control of the bandwidth
- 1) Open and closed loop impedance matching, 2) Band Switching techniques where the radiator is dynamically tuned, and 3) Beam Steering techniques are currently available or will soon be ready to assist the antenna system in meeting wider frequency band requirements



Active antenna providing full 3G and 4G frequency coverage; Band switching technique where the radiator is dynamically tuned



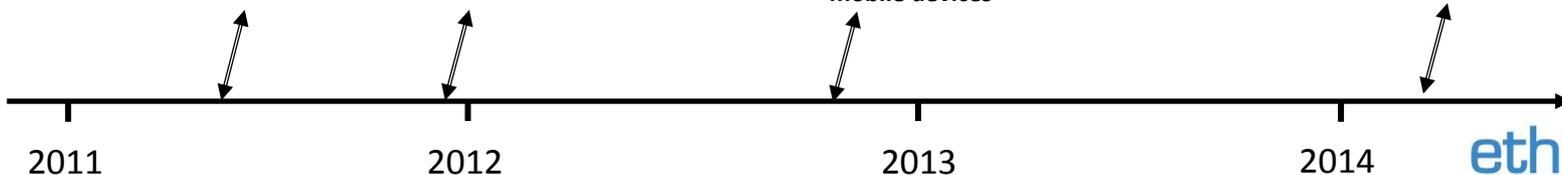
Adaptive matching of 4G antenna for smartphone application



Beam steering technique for mobile devices



Tunable front-end with adaptive antenna



Architecture of Future Mobile Devices

- The benefits of tunable components can be best realized by consolidating the front end; this will allow for non-50 Ohm optimization between antenna and PA
- With dynamic tuning being implemented or considered for several components comprising today's front-end, a more comprehensive system level approach to front-end design will provide for improved bandwidth performance

