



## Mobile Operators – Indoor Coverage

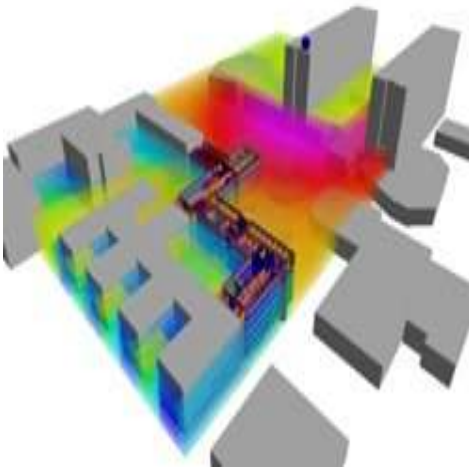


Indoor coverage is full of promises and problems. For service providers, the promise is an expanded subscriber base, and increased airtime and revenues. The biggest problem concerns how mobile operators will deliver on that promise. Limited resources can cause lacking in design methodologies, staffing models and tool sets needed to guarantee universal signal coverage for most buildings.

Indoor coverage is almost universally spotty. This can't be taken for granted. Mobile Operators are letting millions in potential airtime revenues slip through their fingers because of poor signal coverage inside office buildings, convention centres, shopping malls, airports and other commercial establishments.

How much potential revenue are you losing? You won't know until you survey your market with indoor, RF-measurement tools and sniff out dead zones that need adjustments to outdoor base stations or installation of indoor repeaters or microcells. But surveying indoor RF coverage in wireless markets is a daunting challenge for several reasons.

### Good Indoor Coverage



Mobile Operators need to rethink their network designs and frequency plans to serve indoor environments. The industry's standard RF-design methodologies have been geared to vehicular phone-usage scenarios but have not been well suited to the tricky indoor environment of cinder blocks, concrete and glass. Consider the diversity, multiplicity and density of materials through which RF signals propagate inside a building. Add the fact that only a few feet of open space often separate these materials. Consider the many sharply contrasting planes and angles off of which signals bounce. Finally, throw in the characteristics of an environment served by microcells.

When we weigh the effects of these variables, an RF signal easily can encounter 50 completely different morphological characteristics, change direction innumerable times and be handed off more than once before travelling 20 meters in a typical building. Another indoor challenge lies in the capability to provide universal coverage assurance. Mobile Operators have to survey and optimize each building's floors, corridors and rooms. Measurement and optimization works continue on an ongoing basis as wireless networks are reconfigured, indoor microcells are installed and moved, existing buildings are remodelled, new buildings are constructed, and weather conditions change. No wireless service provider has the massive technical field force necessary to undertake an ongoing, indoor RF survey of this magnitude.



## **Upgrading Existing Systems**

With the growing demand of data and broadband, mobile operators are looking towards upgrading existing indoor systems as a means to increase revenue. Indoor rollout is driven by network optimisation activities to address interference, capacity, and dead coverage spots. Improvement in high-speed data performance is also an important factor. The challenges covers the complexity of higher SNR, different link budget criteria for high speed internet, handovers, and cell breathing of 3G systems. While the easiest way is to completely dismantle and rebuild an entirely new system, there are possibilities using good RF techniques to retain the existing system and retrofit the system with additional “layers” to introduce new systems like 3G, WiFi or WiMax.

## **Outdoor Macro Street Coverage and Indoor Coverage**

In a number of dense urban areas, frequent handovers and interference is a major technical issue to provide quality signals. In order to overcome the limiting factors of wireless propagation in confined environments and to optimize the distribution of network capacity more efficiently, mobile operators can consider providing an additional street-level wireless layer to work seamlessly with indoor systems. Keeping neighbour micro and the multiple dedicated indoor systems in a confined environment allows minimum handoffs and reduces interference dramatically.

The option of Base Station Hotels (BTS Hotel) is very attractive from both an economical and a technical point of view because of their intrinsic ability to provide a shared infrastructure that can be efficiently used by multiple wireless operators and services. While the cost-sharing factor is obvious, it is also worth noting that the technical advantages of a shared solution with reliably consistent radio performance contribute to reduce interferences and maximise capacity and efficiency.

## **Solutions**

Several solutions present themselves for new systems or upgrading existing systems. For smaller solutions, picocells proved a viable answer. Then there is Distributed Antenna System (DAS), which worked by taking a donor feed from the macro cell, or from a repeater, and then distributing that through the building. A DAS can support one or several mobile operators and one or several mobile technologies (GSM, WCDMA, CDMA2000, TETRA etc).

A choice of active or passive DAS depends on several factors like capacity, building layout, building size, sectorization methods and others. Active DAS systems deliver the greatest cost benefit in very large buildings. Below 500,000 square feet, passive systems start to become more cost-effective. Especially for upgrading existing passive system, active DAS offers some very attractive economic and technical options, creating new hybrid systems.

## **Multi System Solutions**

The DAS can be used to concurrently distribute both cellular and non-cellular bands, e.g. both GSM and WLAN or WiMax in one and the same antenna system. Such systems will require good isolation between systems to prevent intermodulation and inter-system interference.



5 Bar Coverage offers a variety of indoor system services. Either on a full turnkey basis or providing a technical proposal, 5 Bar Coverage offers the following services:

1. New System
  - a. Single Operator Based
  - b. Multi Operator Based
  - c. Multi Operator & Multi System Based
2. Upgrade Existing System
  - a. Extension of existing coverage
  - b. 2G to 3G
  - c. New systems like WiFi, WiMax and Tetra
3. Troubleshooting Existing System
  - a. Uplink Interference
  - b. Quality & Performance Optimization
  - c. Walk Test