Wireless Coverage in Elevators

Car-mounted distributed antenna systems promise to end the nagging problem of dropped calls in elevators.

By John Spindler / *Zinwave*

Elevator coverage for mobile services is becoming a mandatory requirement for buildings and is rapidly becoming a requirement in lease agreements between tenants and building owners. In addition, in-elevator coverage is required for public safety wireless applications.

Unfortunately, traditional solutions for wireless coverage inside elevators leave much to be desired: Antennas mounted within elevator shafts don't provide consistent coverage throughout tall buildings, and lobby-mounted antennas cause constant handoffs for elevator passengers with mobile devices, degrading call performance and leading to call drops. However, a new solution promises to overcome the shortcomings of these legacy solutions.

DEMAND FOR WIRELESS COVERAGE IN ELEVATORS

With the evolution of mobile telecommunications, user demand for continuous, high-quality wireless voice and data performance throughout buildings has become a major issue for building owners. Increasingly, tenants demand ubiquitous coverage within buildings. They want to be able to continue calls or mobile sessions as they enter and ride inside elevator cars, and they have little tolerance for service disruptions due to elevators.

Providing seamless coverage inside elevators is one of the biggest challenges in in-building wireless. Wireless signals cannot easily pass through nonporous materials, so elevator cars, which are metal, can block wireless service from the outside, leading to poor connectivity within. In addition, as an elevator travels from the bottom of a building to the top, it can pass through different zones of wireless coverage, depending on the placement of remote antennas within the structure; this can lead to poor service or dropped calls.

The challenge of providing wireless service inside elevators is a function of building height, the strength of construction materials required for elevator cars and car mobility. Because of building height, antennas within an elevator shaft may not provide adequate signal strength (especially in taller buildings) to cover the entire shaft, and the metal construction of the cars blocks outside wireless signals. As a car moves up and down an elevator shaft, the signals from external antennas grow and fade as the car nears and then moves away from antennas on each floor.

Traditionally, there are two ways to provide wireless coverage inside elevators:

- Place distributed antennas in each elevator lobby on every floor
- Place a high-power distributed antenna at the top or bottom of each elevator shaft.

COVERAGE FROM THE ELEVATOR LOBBY

Traditionally, antennas have been located in elevator lobbies as close as possible to the elevator doors so that leakage through the

elevator doors provides coverage to the elevator cars. However, modern elevator construction and speed and the increasing numbers of elevators in each bank make this method more and more unpredictable. Because signal strength loss from a lobby antenna through a set of elevator doors can be as high as 30 dB, the signal may be adequate only when the elevator is directly adjacent to the lobby. This makes meeting building service requirements very difficult.

Some design choices create further challenges. For example, elevators that cover only part of a building and bypass certain floors make coverage between floors for the entire elevator journey almost impossible. High-rise buildings with multiple wireless sectors require handoffs between the coverage areas as the elevator passes through the different zones. As a mobile device travels from zone to zone, these multiple handoffs lead to an increased possibility of dropped calls inside the elevator.

Finally, attempting to provide wireless service from an elevator lobby can be expensive because equipment dedicated to providing elevator coverage is needed on every floor.

ANTENNAS AT THE TOP OR BOTTOM OF ELEVATOR SHAFTS

The second traditional solution is to mount antennas at the top or bottom of an elevator shaft. Typically, high-gain antennas radiate high power to flood the area with coverage. Because radio signals attenuate as the car moves farther from the antenna, this solution is most effective in mid-rise buildings, in which elevator shafts are relatively short.

A NEW COVERAGE SOLUTION

A third way to provide wireless coverage inside elevators is to mount a remote antenna on the roof of each elevator car. This solution addresses the shortfalls of the traditional elevator coverage methods already discussed. It creates a dedicated zone of wireless service that travels with the car as it moves up and down through the elevator shaft. This eliminates device hunting or handoff from one wireless zone to another as the car moves from floor to floor – the mobile device always remains within the same coverage zone. In addition, it eliminates wireless signal attenuation caused by locating antennas away from the car – either at the top or bottom of a shaft or in an elevator lobby – and thereby guarantees a strong signal. With this solution, consistent wireless performance is ensured regardless of whether an elevator is on the bottom floor, on the top floor, somewhere in between or moving between floors.

> Distributed antenna systems for elevator car–mounted units require fiber optic cabling from end to end.

An elevator car–mounted antenna solution requires appropriate cabling infrastructure, remote unit size, feeder hub flexibility and multifrequency support.

The distributed antenna system (DAS) that supplies an on-car remote unit must use a fiber optic cabling infrastructure from end to end. The 1/2-inch coaxial cabling that traditional DAS solutions use is too heavy and inflexible to be installed along with the other cables that connect an elevator to its electrical power source. In contrast, fiber is light and flexible, and it supports distances of up to 2 kilometers, so it has ample performance and reach to deliver multicarrier wireless signals to an elevator car, even in the tallest buildings.

The remote unit must be small enough and light enough to mount on the roof of an elevator car. Many DAS solutions on the market today use chassis-based remote units that are too large and heavy.

The feeder hub that drives the remote units must be as scalable and flexible as possible. Ideally, installers would mount this hub at the top of an elevator bank or in an adjacent wiring closet and use it to drive individual remotes on the tops of multiple elevators. A scalable hub should be modular and able to drive at least eight remotes.

Finally, the remote units must support multiple frequencies and services. Different mobile operators use different frequencies, such as 850/1900 MHz, 700 MHz LTE and 2100 MHz AWS, and predicting which frequencies will be needed inside elevator cars in busy buildings is impossible.

In addition, mobile operators license new frequencies every few years. If possible, a remote unit should not only support all current frequencies but also accommodate new services in the future without requiring a hardware upgrade. The system shouldn't have to be physically upgraded each time a new frequency appears (which is a common occurrence). In addition, the system should accommodate public safety services. Supporting multiple frequencies and services will significantly reduce the total cost of ownership of an elevator coverage system.

In short, the ideal solution for wireless coverage within elevators is an all-fiber DAS that uses small remote units, has flexible and scalable hubs and has a wideband architecture that supports current and future frequencies without requiring hardware upgrades.

Wireless coverage inside elevators has usually required overprovisioning of remote antennas in areas near the elevator doors, generally resulting in a costly, suboptimal solution. A car-mounted remote antenna system delivers superior coverage and performance at a reasonable cost, ensuring happy building owners, tenants and visitors. ❖

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