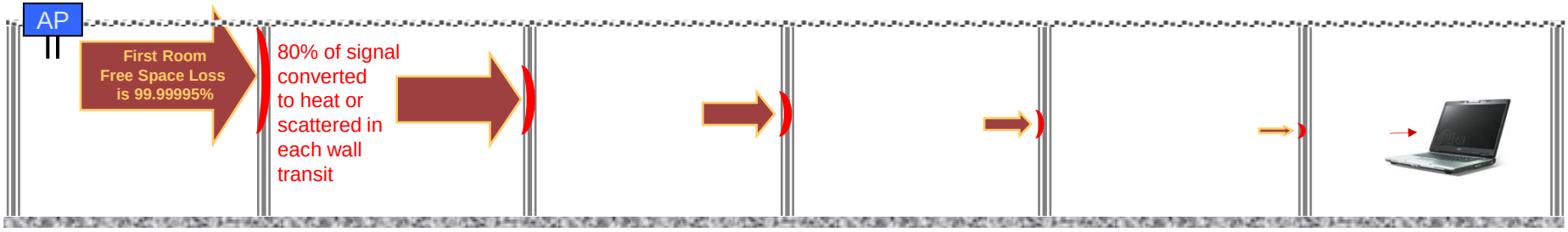
Indoor Wireless Networks Need New Antenna Technology

Here's a look at the future

Present methods of covering indoor facilities with wireless signals are inefficient, unpredictable, slow in areas beyond a few rooms, and excessively costly. They haven't changed much in 15 years. And the problem has become worse with the introduction of new, high-speed data transmission formats, e.g. 802.11n and ac.

Access Point Radio

--- The present deployment method in buildings ---



The signal level at the client notebook is only 0.0000000005% of the original transmitted signal after going through a long span of free space and seven walls. Random and unreliable "hot spots" from reflections may allow temporary speed increases, but a slow and unreliable 1 Mbps data rate at the notebook's receiver is the most that can be expected.

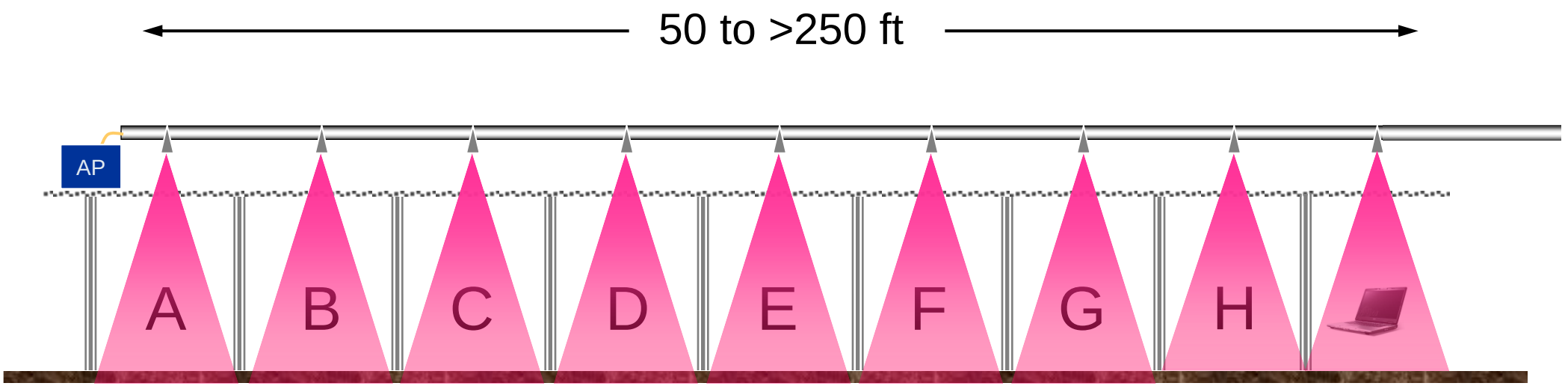
Low signals = low speed

Why suffer all this loss and poor performance?

Technical Assumptions and Results

- AP: 5GHz, +17dBm xmit, antenna = +4dB gain
- Rooms: 20ft wide, walls = -7dB ea, client ant = 0dB
- Free space loss = -78dB, walls = -35dB. Total = -113dB
- Resultant receive level at notebook is ~ -92dBm

Our Waveguide approach provides equal and full illumination of all areas



RF loss in the overhead distributing waveguide is extremely low with most AP signal power delivered to user areas, not wasted.

Attenuation and reflections in walls and objects are bypassed and free space attenuation is only a small factor.

Signals in **ALL** rooms **A-H+** are **"HOT" (> -60dBm)** and **are HIGH quality**.

The waveguide backbone can be continued to cover many **additional areas WITH** EQUAL HIGH LEVELS AND EXCELLENT SIGNAL QUALITY EVERYWHERE.

How our System Works

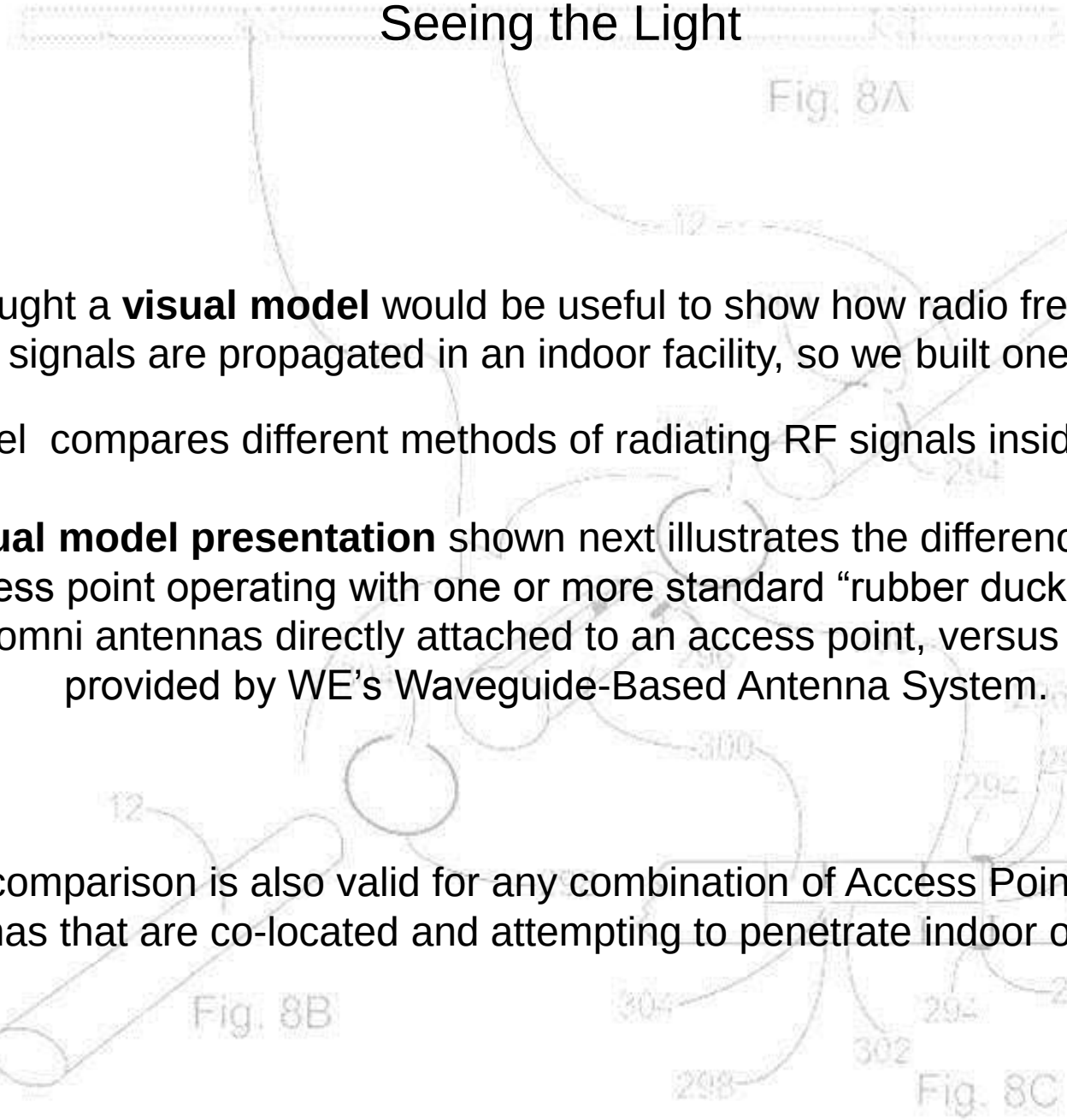
We use an easy to configure distributed antenna technology based on inexpensive, very low loss WE-developed **microwave waveguide**.

The waveguide is used as a backbone to efficiently deliver one or more wireless signals, such as 802.11a,b,g,n,ac, to all user locations for transmission by antennas that are local to clients. Other signals, e.g. ZigBee, Bluetooth, can also be transported.

This new method of signal distribution allows predictable, high-quality, high speed, highly efficient wireless coverage in all areas of warehouses, cluttered offices, malls, hotels, schools, manufacturing facilities, or hospitals.

A WE waveguide system is designed from floor plans using a WE software tool.
It's an indoor wireless system configured by design, not guesswork.

Seeing the Light

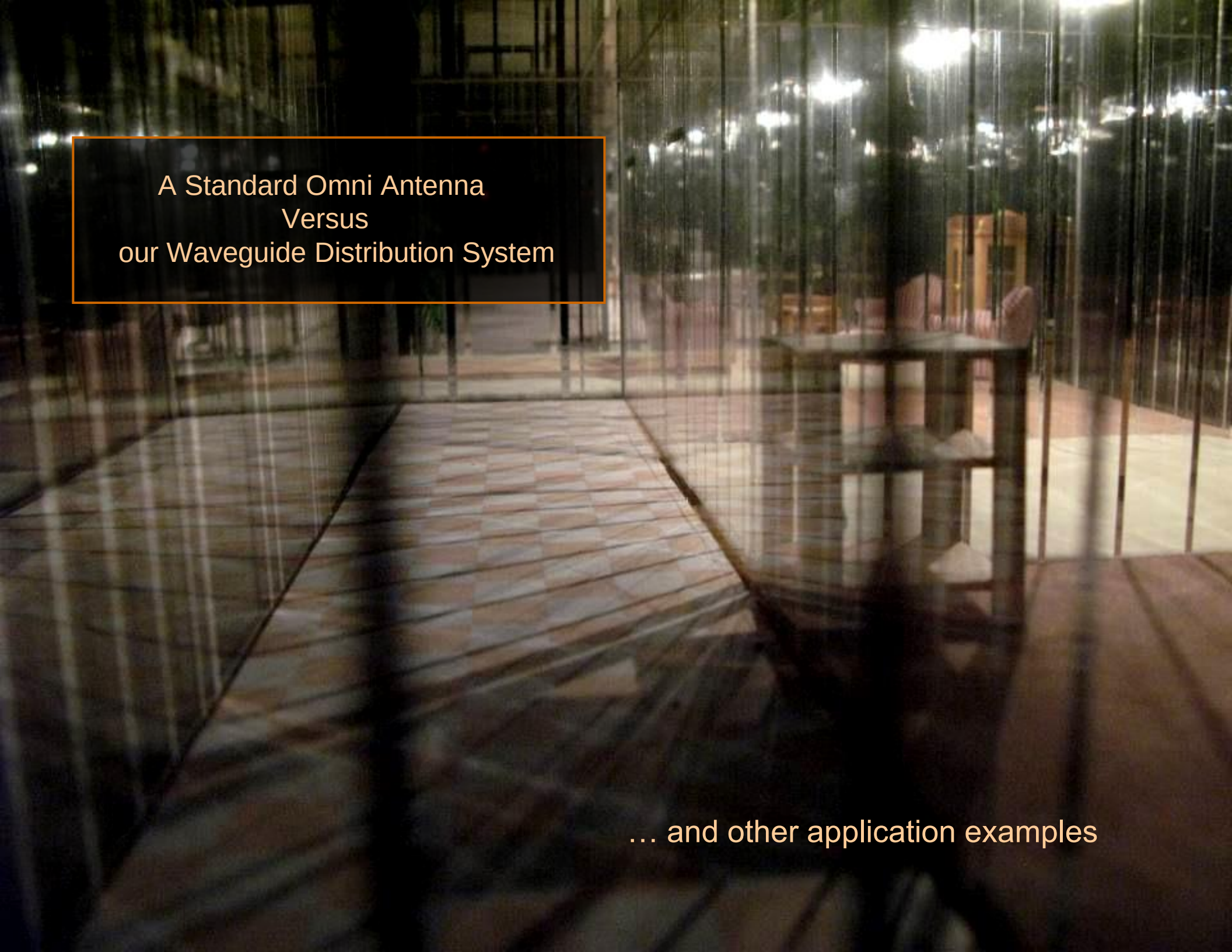


We thought a **visual model** would be useful to show how radio frequency signals are propagated in an indoor facility, so we built one.

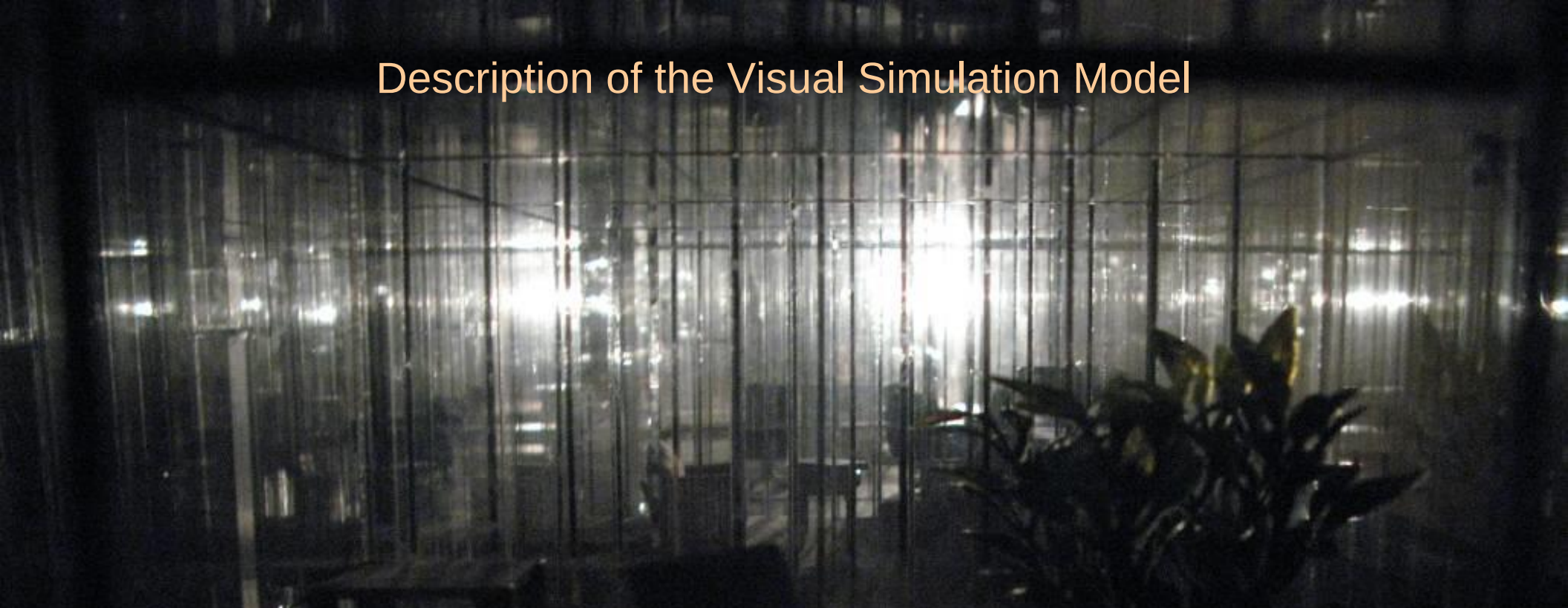
The model compares different methods of radiating RF signals inside buildings.

The **visual model presentation** shown next illustrates the difference between an access point operating with one or more standard “rubber ducky” vertical dipole omni antennas directly attached to an access point, versus coverage provided by WE’s Waveguide-Based Antenna System.

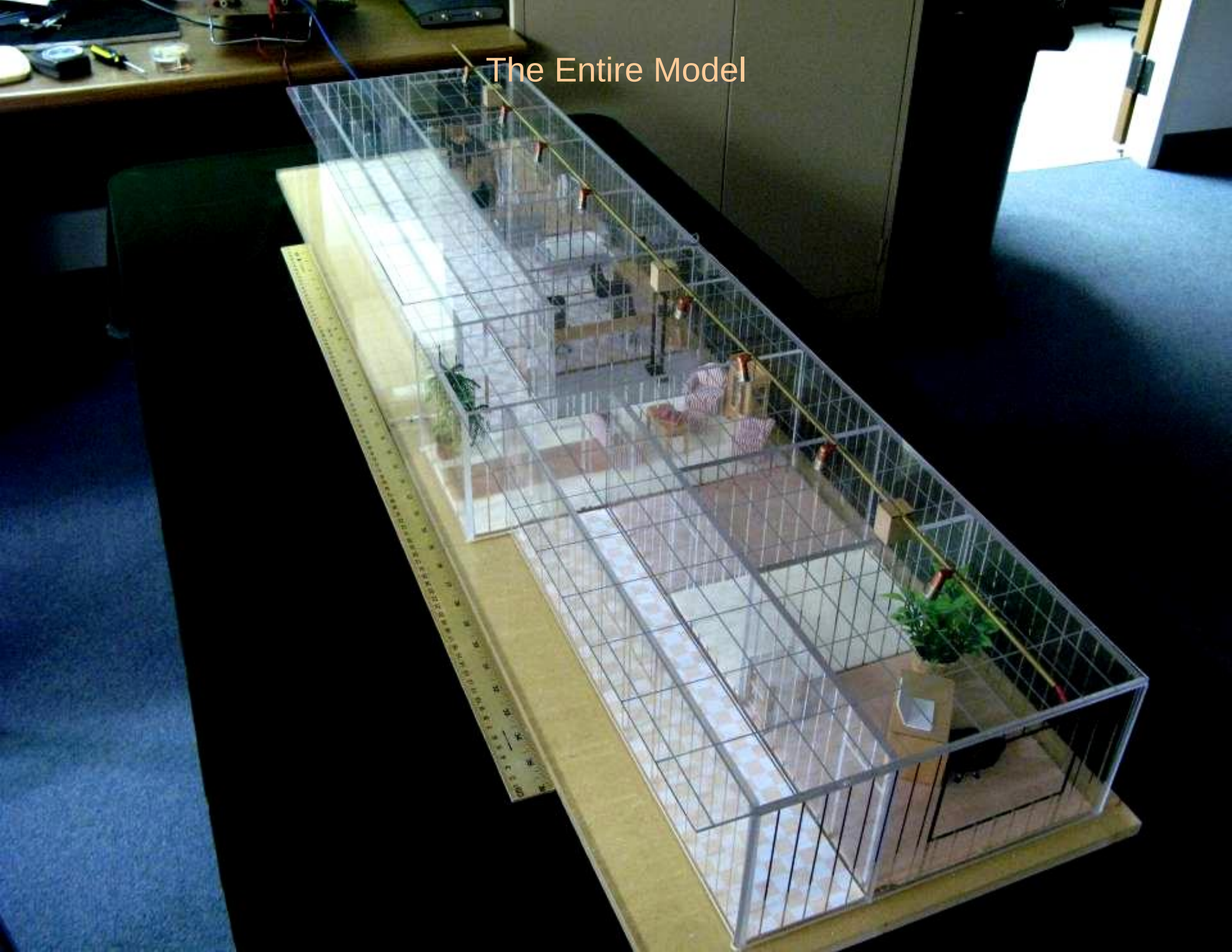
The comparison is also valid for any combination of Access Point(s) and antennas that are co-located and attempting to penetrate indoor obstacles.


A Standard Omni Antenna
Versus
our Waveguide Distribution System
… and other application examples

Description of the Visual Simulation Model



- Visualization is provided by a desktop-sized model that uses light to visualize radio frequency propagation in an office complex
- The physical model is 52 inches in length and simulates a facility that is 100ft X 25ft
- Walls in the model are made with clear acrylic plastic that visually simulates radio frequency (RF) absorption and scattering in typical office walls
- Close-to-scale strips of aluminum tape are used to simulate RF-reflecting surfaces of metal wall studs, door frames, and ceiling grids
- A minimal amount of close-to-scale miniature furniture and accessories is used for perspective in several rooms
- Signals radiating from an omni antenna (a legacy installation) on a single Access Point (AP) radio are simulated at one end of the model showing that its coverage limits are reached long before the far end of the model is illuminated
- The WE Waveguide System traverses and illuminates all rooms and can be extended to many more rooms in a real-world waveguide system

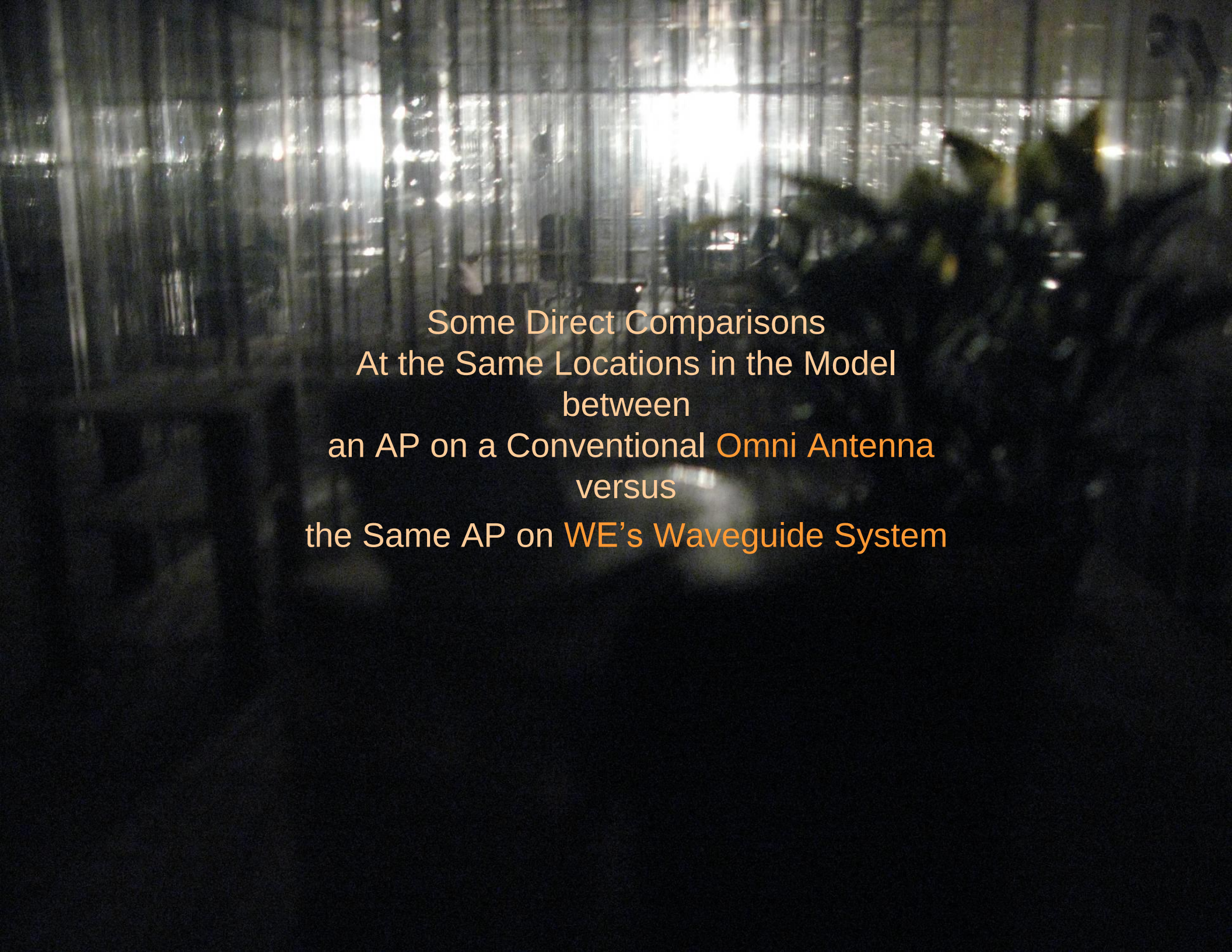

The Entire Model

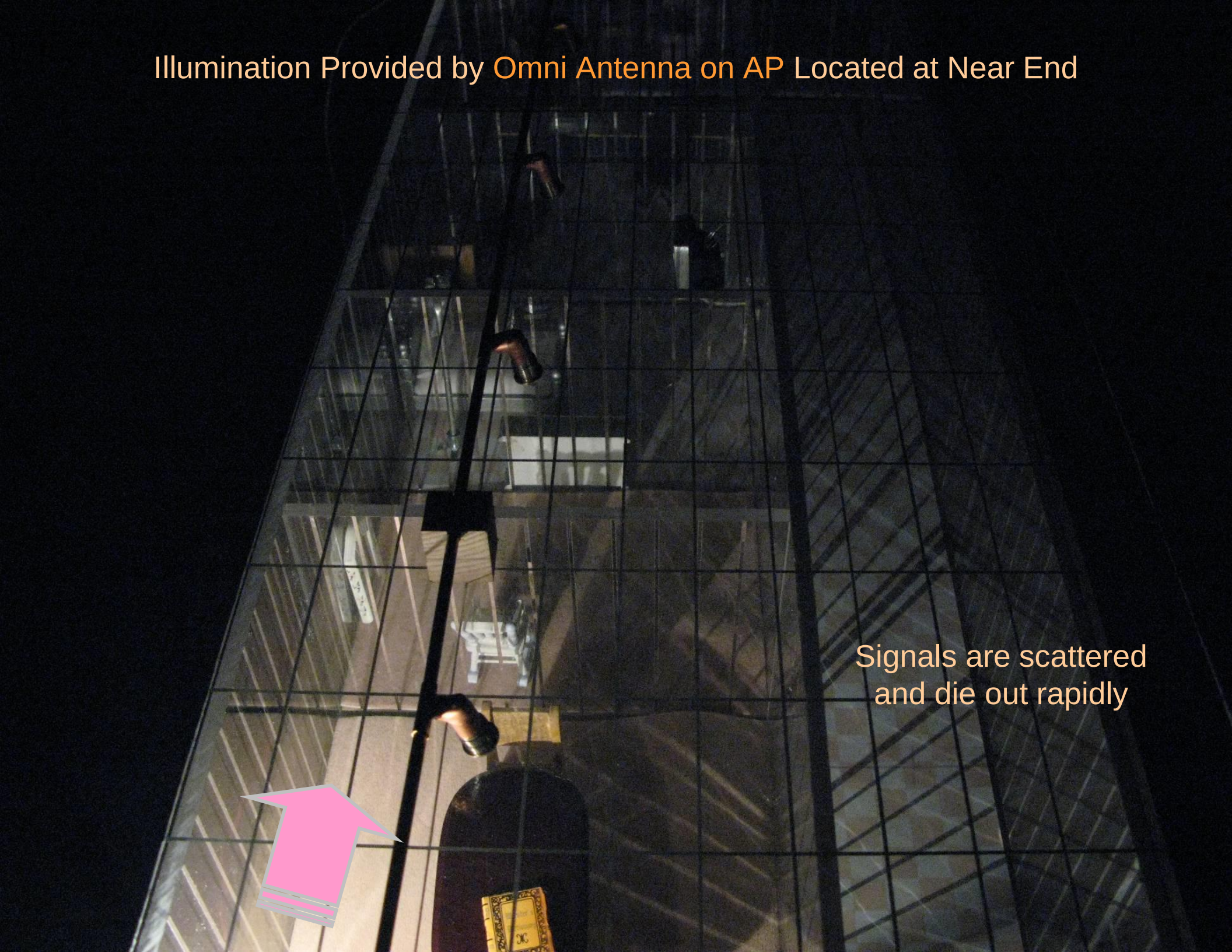
Top View of Model

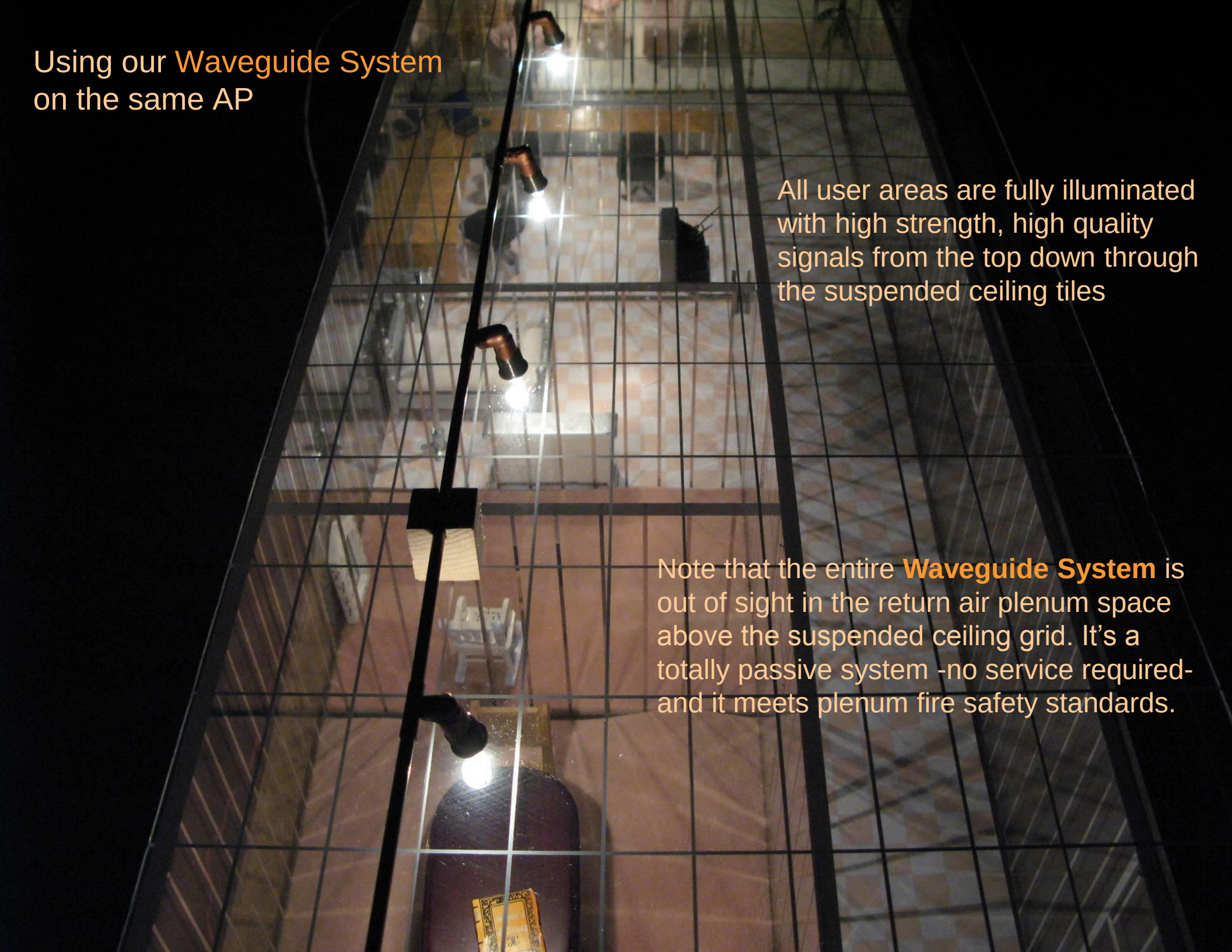

Waiting Area


Hospital Room

Office with Notebook at Far End of Model


Some Direct Comparisons
At the Same Locations in the Model
between
an AP on a Conventional Omni Antenna
versus
the Same AP on WE's Waveguide System


Illumination Provided by Omni Antenna on AP Located at Near End
Signals are scattered
and die out rapidly



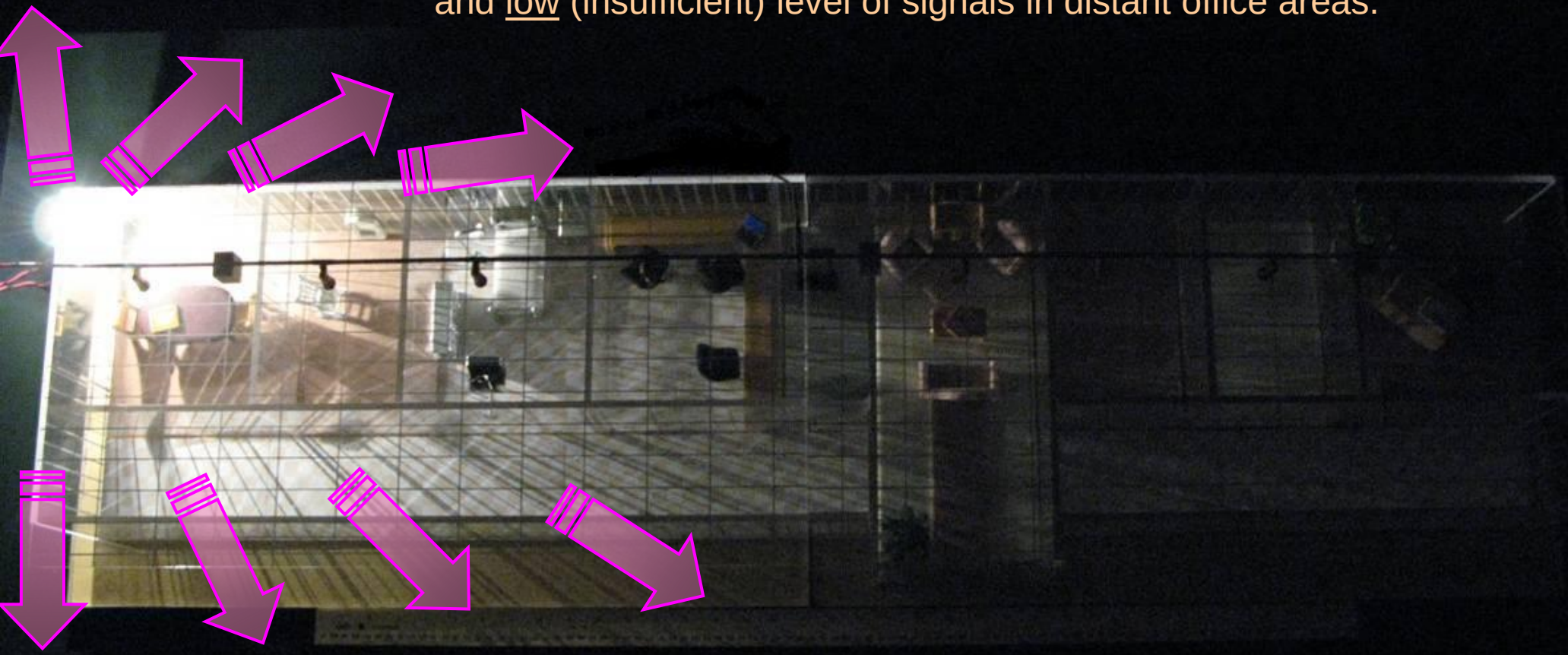
Using our Waveguide System
on the same AP

All user areas are fully illuminated with high strength, high quality signals from the top down through the suspended ceiling tiles

Note that the entire **Waveguide System** is out of sight in the return air plenum space above the suspended ceiling grid. It's a totally passive system -no service required- and it meets plenum fire safety standards.

Top View of Omni Illumination from Near End

Note the excessive (wasted) signal power near the omni antenna and low (insufficient) level of signals in distant office areas.



And a large portion of the radiated signals in the vicinity of the AP pass horizontally through outside walls, causing a potential security problem.

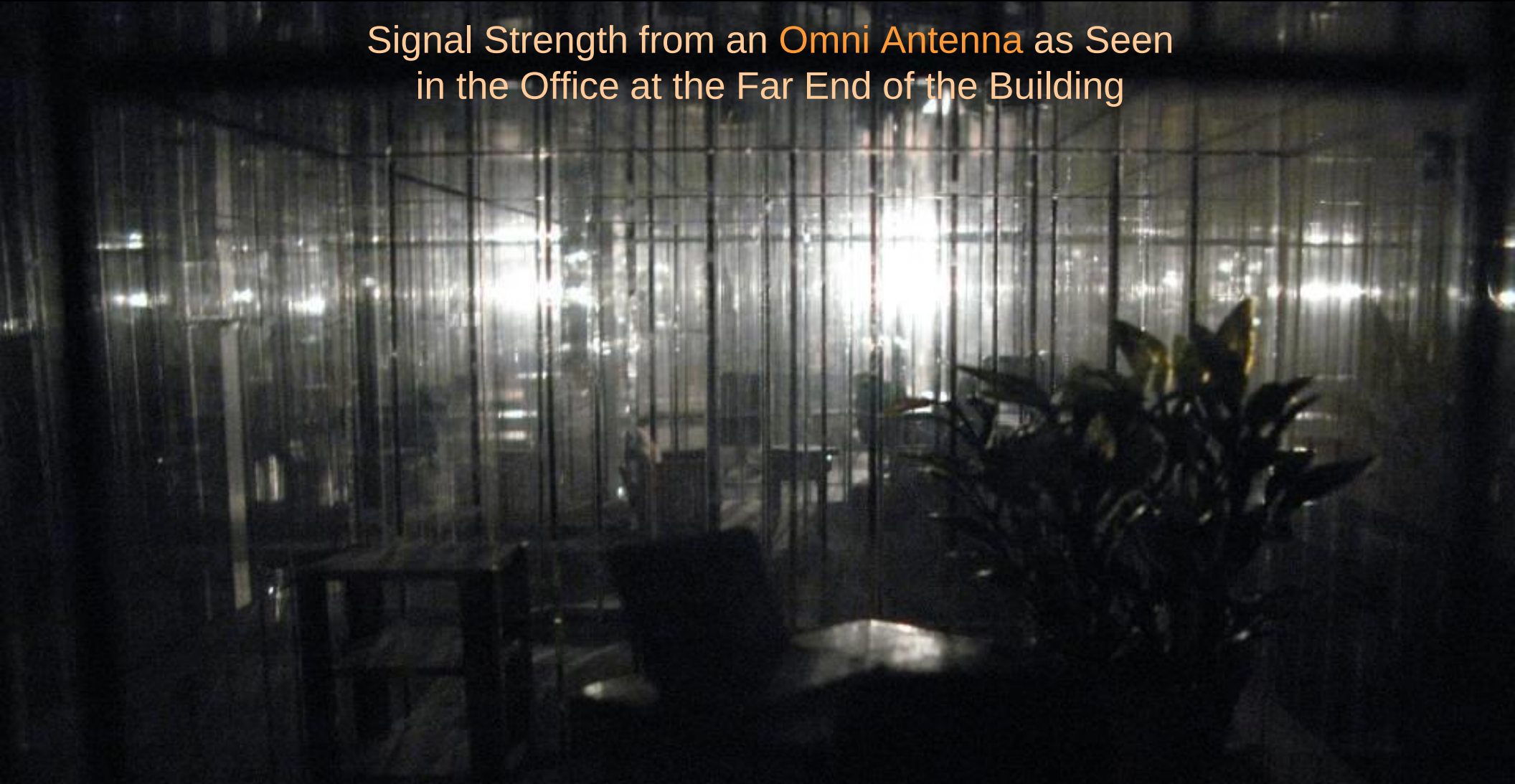
Illumination of the Office Using Our Waveguide System

Signals > -60dBm* fill each room with high quality, high speed data in each user area with an added feature of **low signal leakage** off premises for greater security.

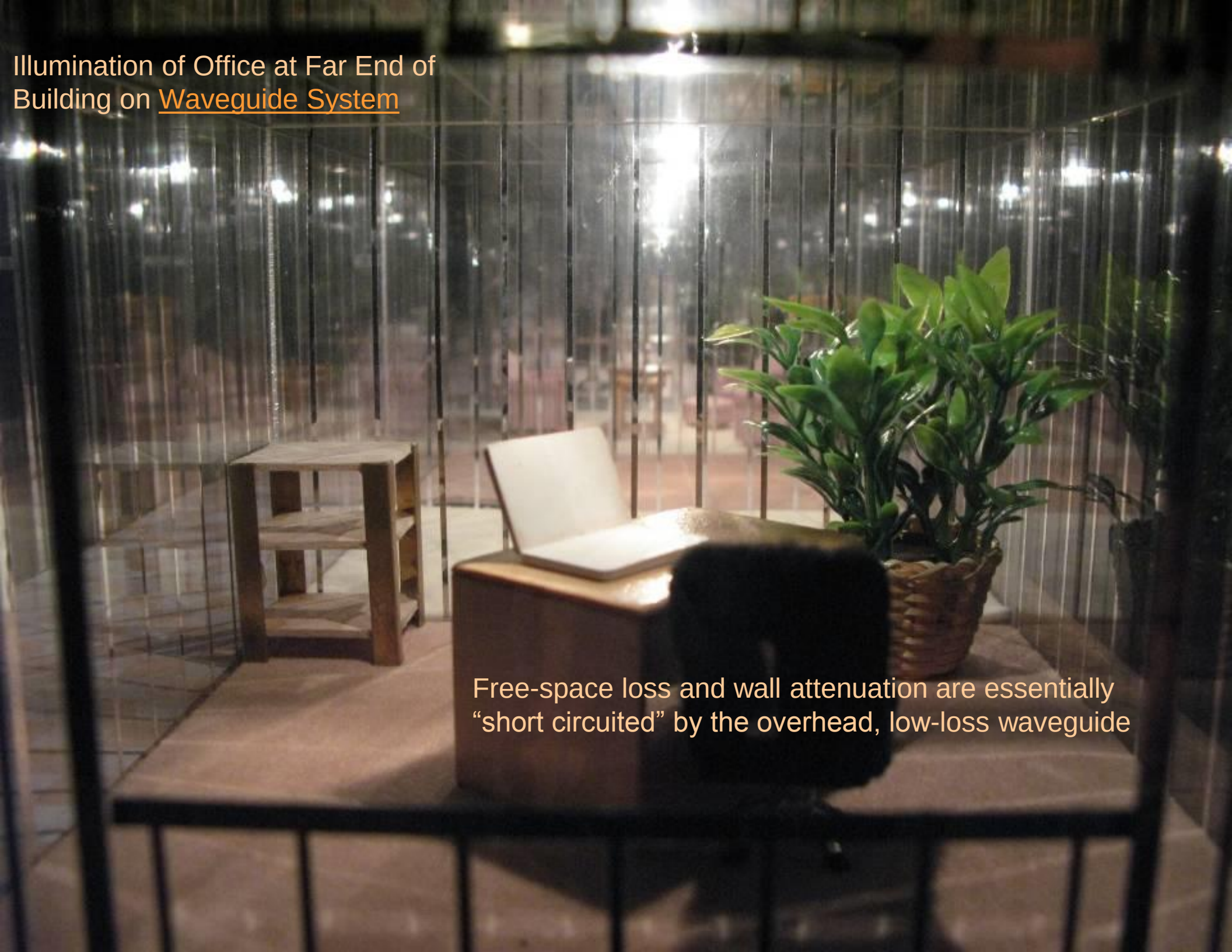
*A receive level of -60dBm is 10X the power needed to run the fastest 802.11 rates.

Many more office areas can be supported by the system at the same high speed.

Signal Strength from an Omni Antenna as Seen in the Office at the Far End of the Building



Signals are “dim” at this end of the building due to a large amount of signal loss from the omni antenna caused by high free-space attenuation and signals reflected and absorbed in 8 intervening walls between the AP and client radio.


Illumination of Office at Far End of Building on Waveguide System
Free-space loss and wall attenuation are essentially "short circuited" by the overhead, low-loss waveguide

Some Indoor “Clear Space” Applications

Example: all rooms on a hotel floor fed from a WE waveguide in wall trim


Example: a train station


Waveguide hidden in architecture along total length of wing
An Example in an Airport Terminal Wing
All areas in wing covered with high quality, high-strength WiFi signals

Summary

Our Waveguide-based Antenna Systems Deliver Superior Performance

Direct illumination of each user area by WE's Waveguide-based Antenna Systems provide high sustained data rates with consistent, predictable, high-strength signals to all client receivers over a much larger area.

Both 2.4GHz and 5GHz WE Waveguide Systems can be installed in HVAC plenum spaces to satisfy aesthetic and/or security requirements.

Signal coverage in indoor facilities can be planned with high probability that the prescribed signal levels will remain static and reliable over time.

Simple upgrade to multiple channels per system that share the same waveguide are possible at initial system design, or added later to support additional types of services, e.g. a fallback channel during an AP failure, a separate channel for different speeds, or an isolated VOIP channel.

Far fewer access points, wireless controller ports, switch ports, etc. are needed, even though greater areas are covered by WE systems.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