



WIR-101: Extending IoT Communication Beyond Four Walls



Ben Garcia
Home Sensors
Manager



David Zima
RF/Microwave
Engineer



I love my home automation....



I have a home

I love my home automation....



I have a home



My home automation works well **except** the bathroom, the bedroom and outside.

I love my home automation....



I have a home

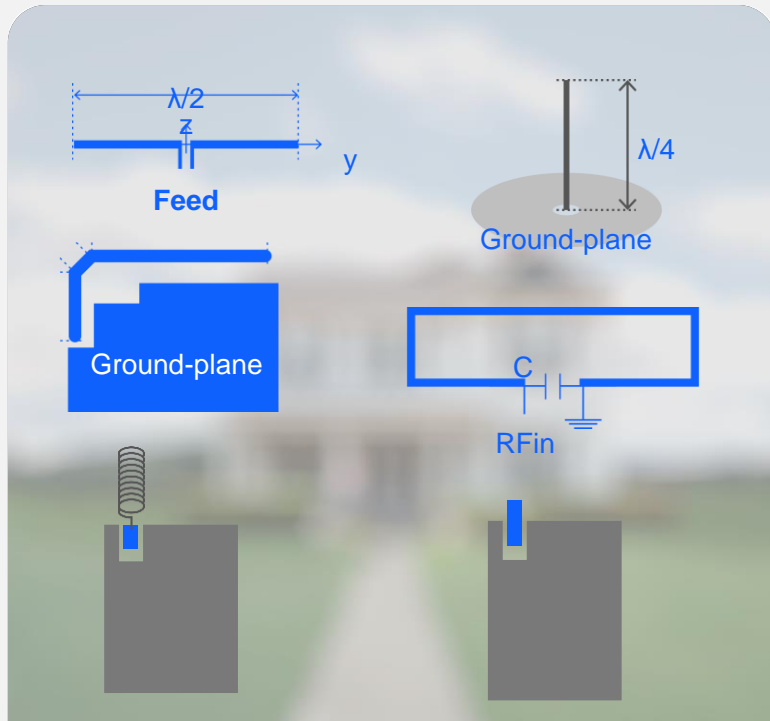


My home automation works well **except the bathroom, the bedroom and outside.**



I would really like to know when the mail is delivered!

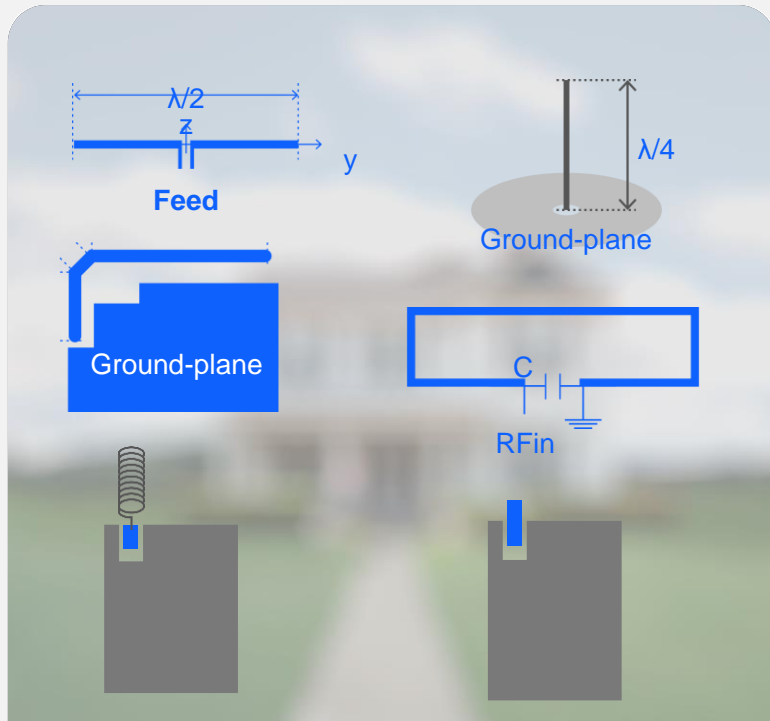
Existing tech can get to the bedroom and bathroom with a few tweaks



ANTENNAS

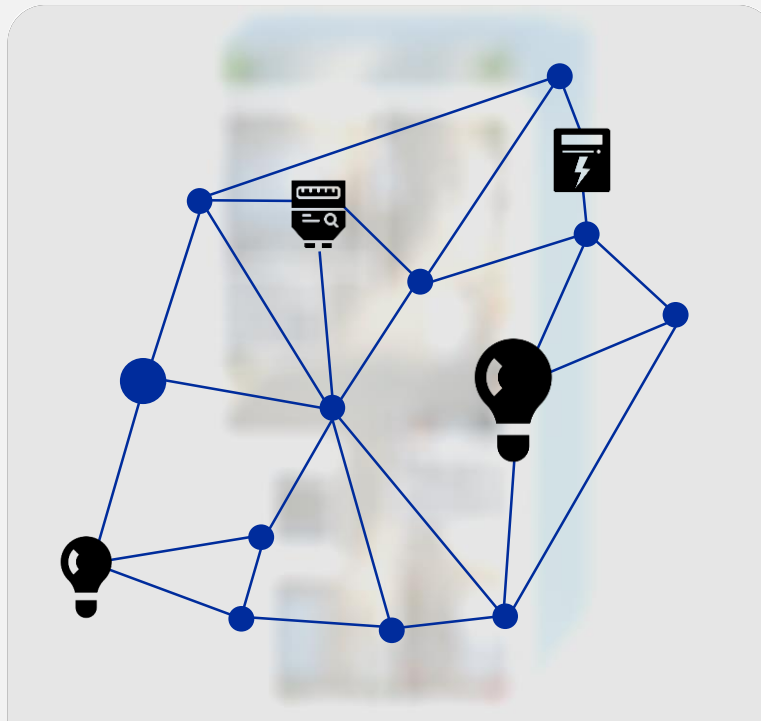
Picking the optimal antenna gives better range and reception patterns

Existing tech can get to the bedroom and bathroom with a few tweaks



ANTENNAS

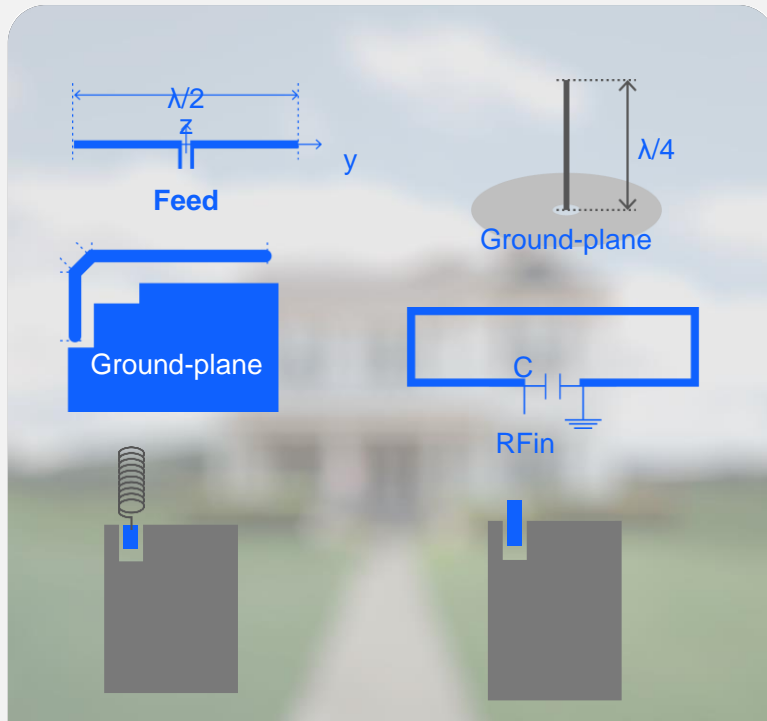
Picking the optimal antenna gives better range and reception patterns



MESH

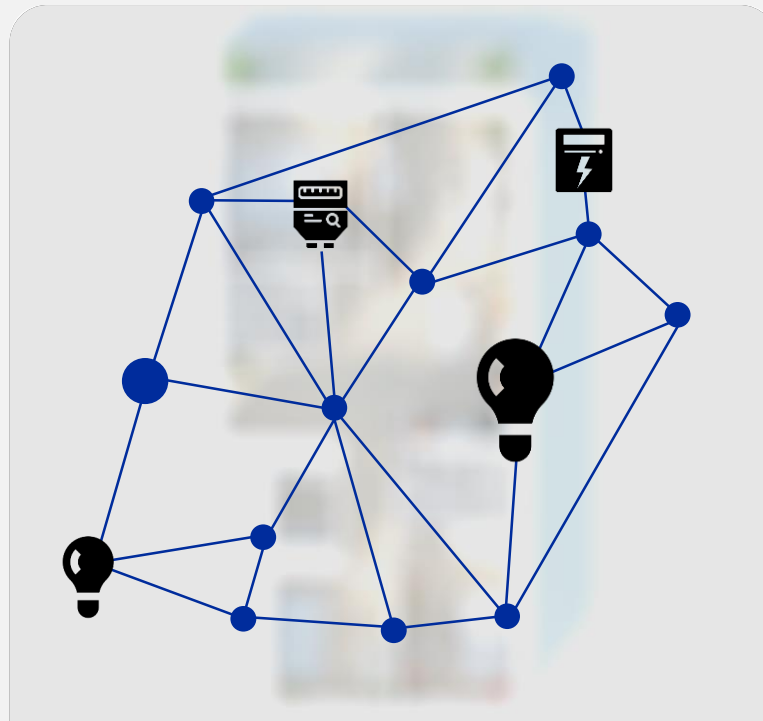
Using a mesh network topology gives multiple routes to reach a destination

Existing tech can get to the bedroom and bathroom with a few tweaks



ANTENNAS

Picking the optimal antenna gives better range and reception patterns



MESH

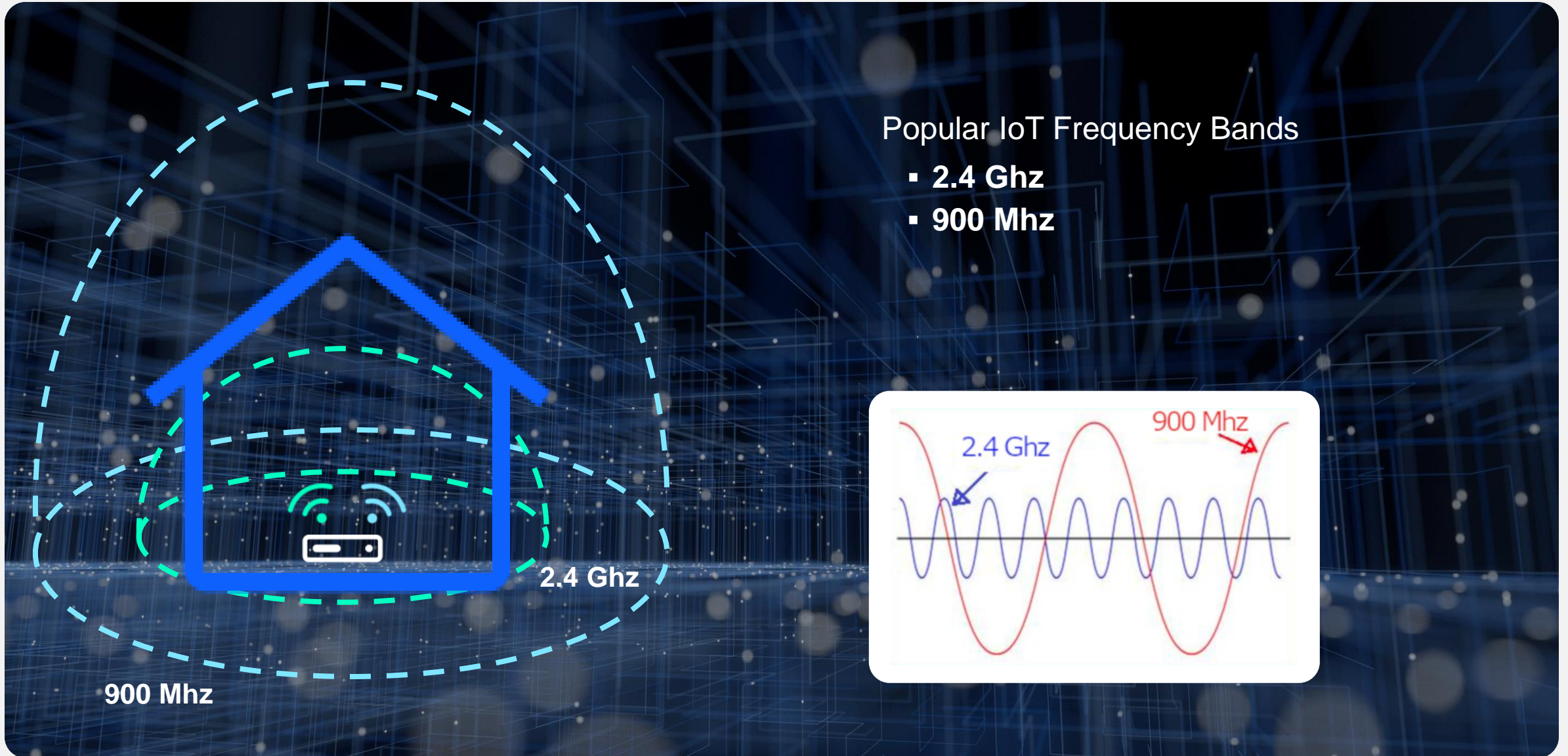
Using a mesh network topology gives multiple routes to reach a destination



REPEATERS

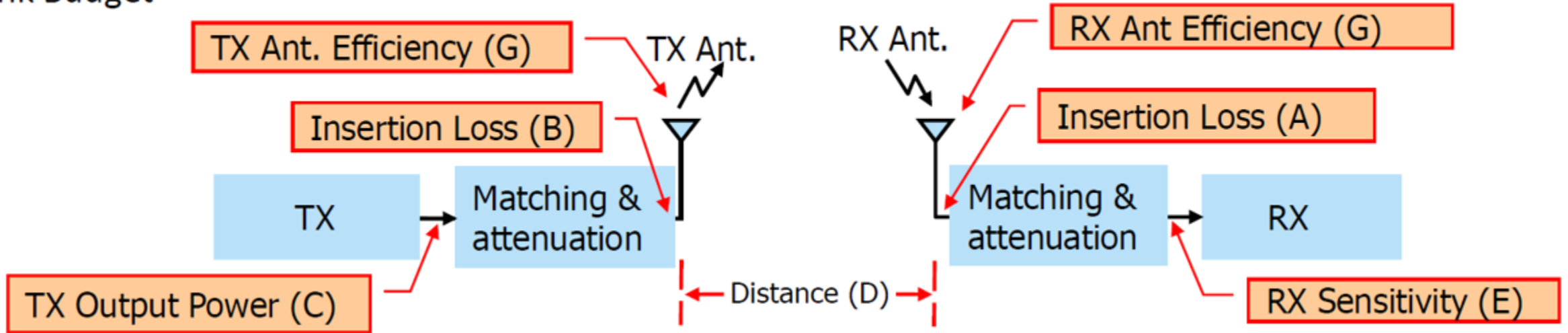
When an edge devices is beyond the range of its nearest neighbor, adding another neighbor / repeater will extend the range

Frequency Band : Why Lower is better for Pushing the Distance



Link Budget Calculation

Link Budget



The broadcast range (D) is influenced by the system “Link Budget”

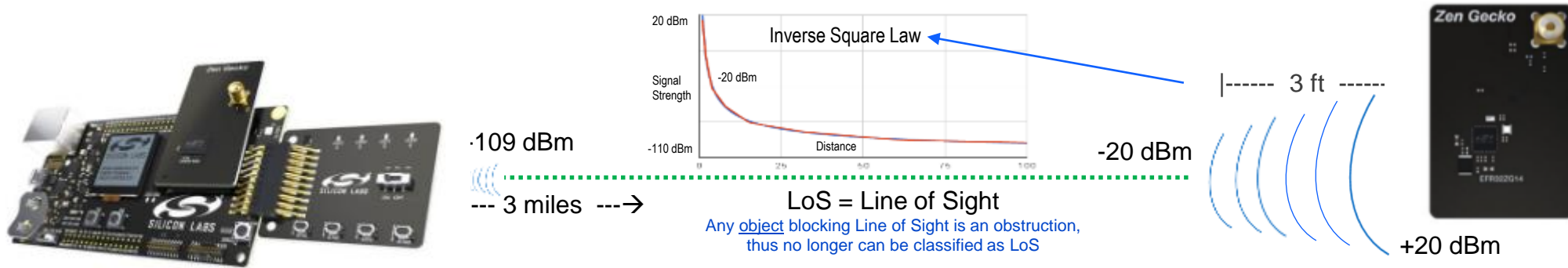
The Link Budget is the total loss in dB between TX (C) and RX (E):

Factors influencing link budget include matching network insertion loss (A, B) and antenna efficiency (G)

$$\text{Link Budget} = |P_{TX}| + |RX_{SENS}| (dB)$$

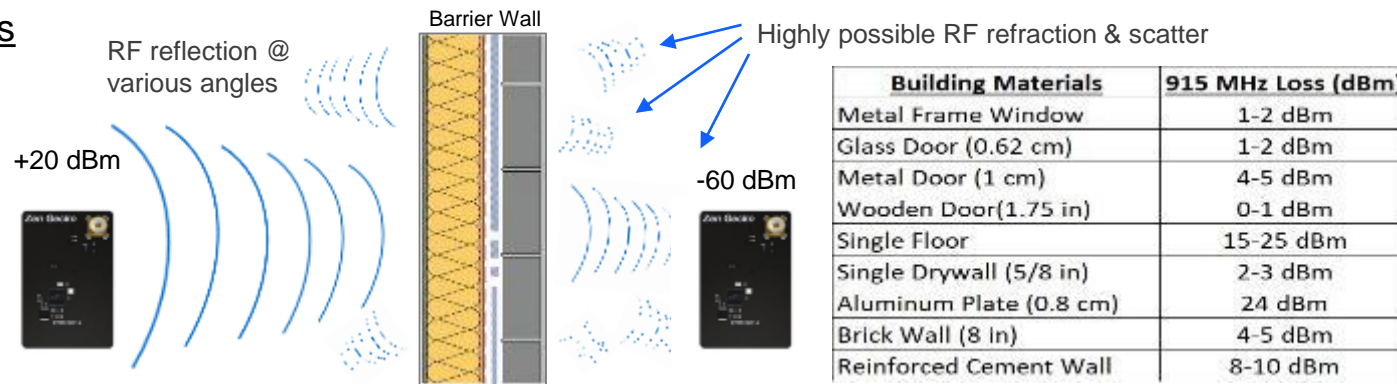
RF Path – Free Space & Object Absorption Loss

Free Space (LoS) Loss = $FSPL(dB) = 20 \log(d) + 20 \log(f) + 32.44$

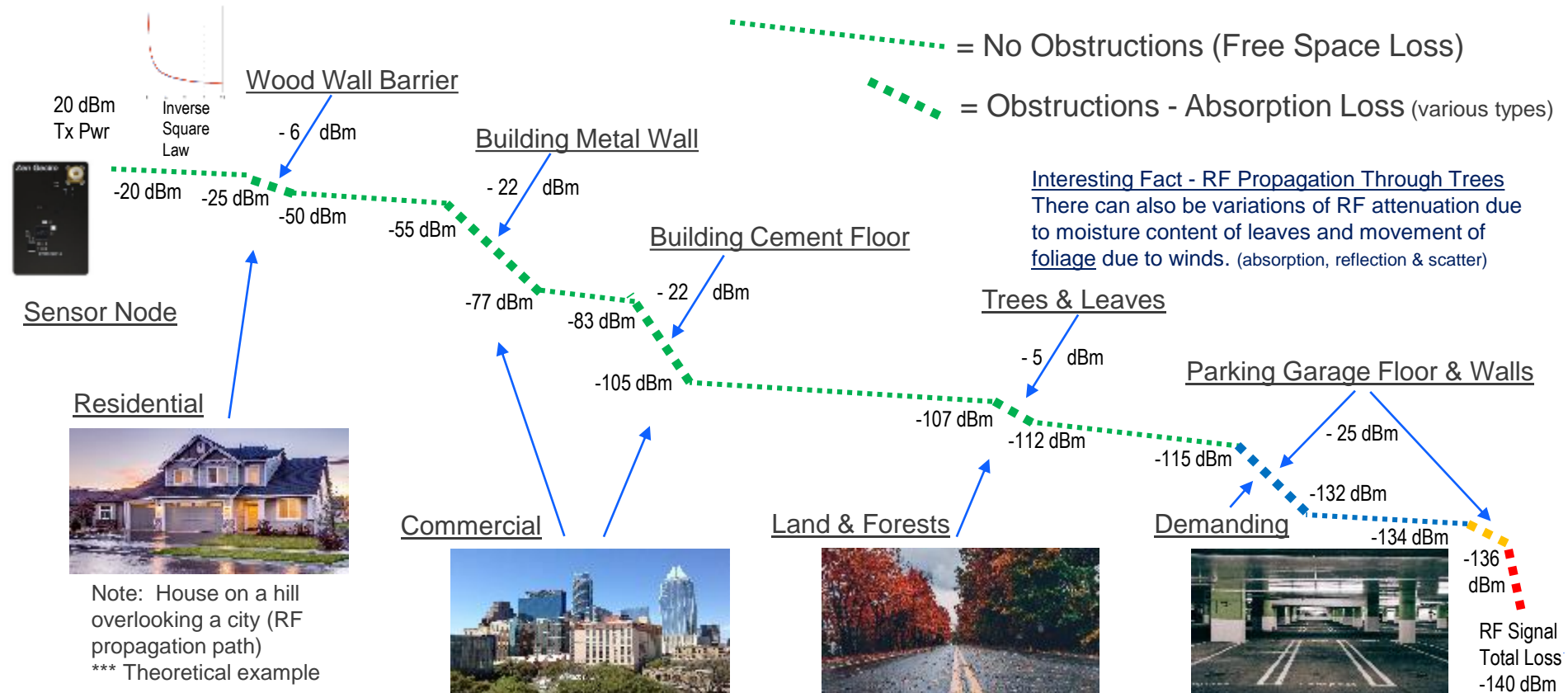


Object Absorption Loss

That part of the transmission loss caused by the dissipation of electromagnetic energy into other forms of energy as a result of its interaction with a material medium.



RF Path – Free Space & Absorption Loss (915 MHz)



Signal Loss From Barriers and Frequency

Frequency $r = 10$ Meters $r = 100$ Meters $r = 1000$ Meters

900 MHz 51.527 dB 71.527 dB 91.527 dB

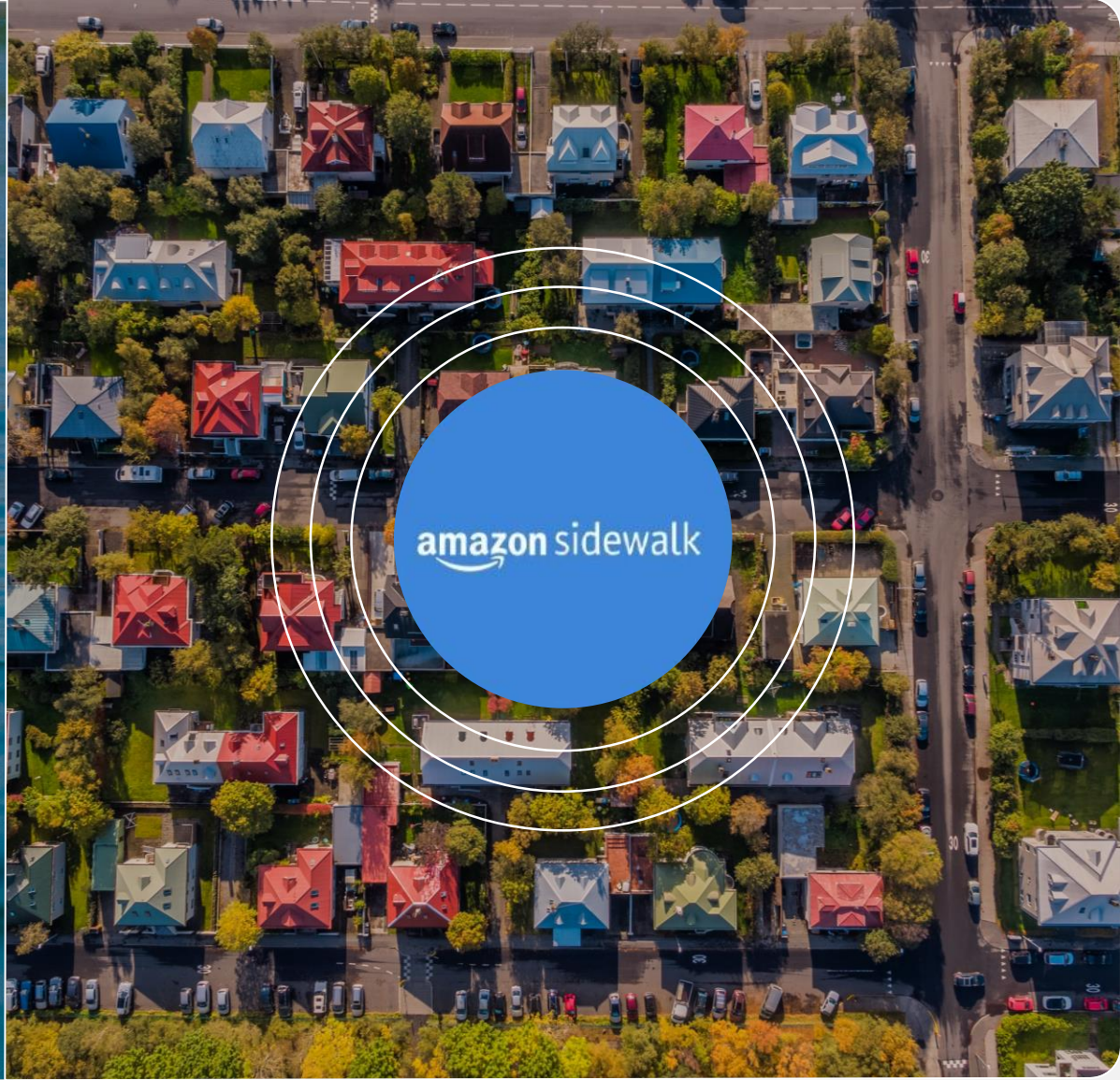
2.4 GHz 60.046 dB 80.046 dB 100.046 dB

Therefore, the path loss is 8.519dB less over the same range at 2.4 GHz compared to 900 MHz. As range doubles with every 6 dB, the range at 900 MHz is 2.7 times greater compared with 2.4 GHz. [$2^{(8.519/6)} = 2.7$].

Z-Wave Advantage

- **Full Home or Industrial Space Coverage**
 - 1. Z-Wave Characteristics = Longer Range
 - 2. Z-Wave Suffer Less External Radio Interference
 - 3. Systems Using Z-Wave ISM Bands Commonly Employ Lower-Bandwidth Transmissions
 - 4. Technologies Using Z-Wave ISM Bands Have Lower Power Budgets
 - 5. Systems Using Z-Wave ISM Bands Often Require Lower Infrastructure Cost

How do I reach that mailbox out by the street?.....



Amazon Sidewalk - Go beyond four walls



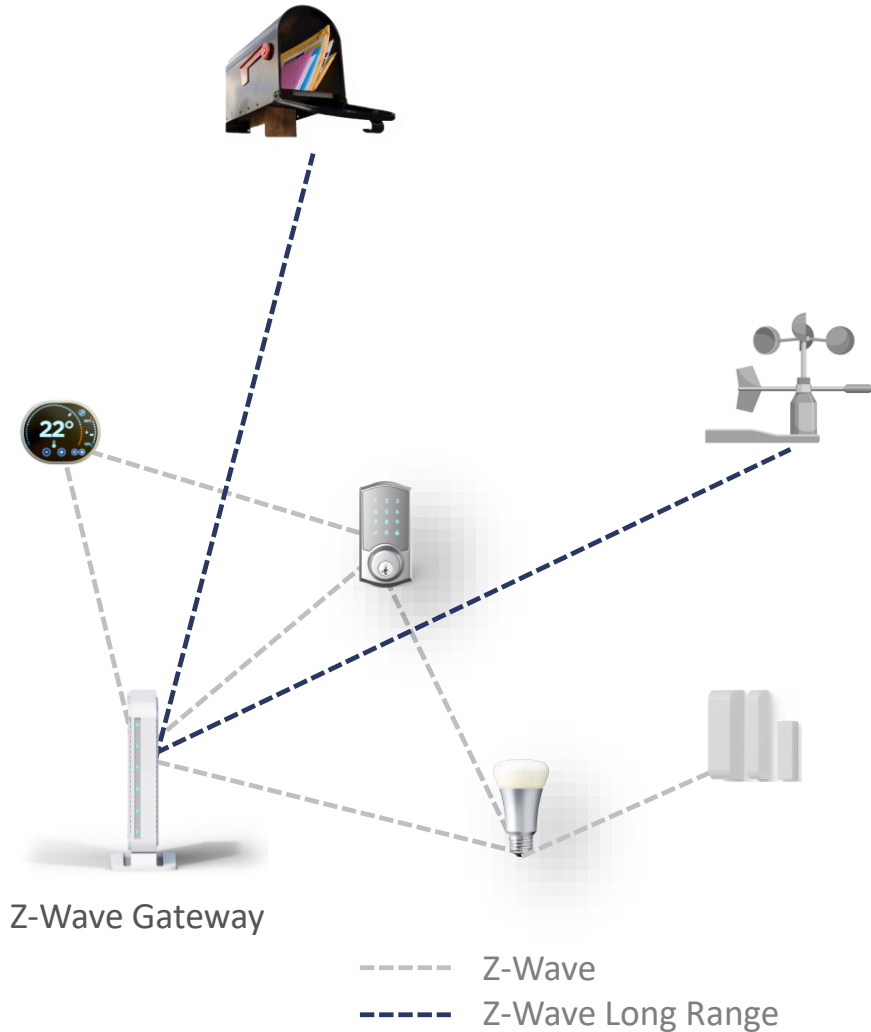
- What is Amazon Sidewalk
- How does it work

Z-Wave Long Range - Go beyond four walls



- What is Z-Wave Long Range
- How does it work

Z-Wave Mesh and Z-Wave Long Range



Z-Wave Mesh Network Topology

100 kbps data rate
-1 dBm TX power

400m Range (4 hops)
Coverage for the smart home

Scalable to 200+ nodes
8-bit address space



Z-Wave Long Range Star Network Topology

100 kbps data rate
Up to +30 dBm TX power

Up to 1-Mile Range
Coverage for the whole home, yard
and beyond without a repeater

Highly scalable up to 4000 nodes
12-bit address space

The Mailbox alert now works!

The game is on for more IoT connected devices outside the home



Irrigation
Landscape lighting
Pool monitoring & control



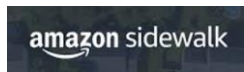
Weather stations
Rain and flood detection
Hot tubs



Solar Array
Gate/door/shutter control
BBQ Grill monitoring

Vendors and Manufacturers now have an opportunity to sell more.

Ready to Connect to Amazon and Z-Wave Ecosystems? We are!



SELECT RIGHT PROTOCOL

Bluetooth	BG21, BG24
Z-Wave	ZG13, 14, ZG23
Sidewalk	BG21, BG24, FG23

OBTAIN DEVELOPMENT KIT

Bluetooth	silabs.com/wireless/bluetooth
Z-Wave	silabs.com/wireless/z-wave
Sidewalk	www.silabs.com/partner-network/ecosystems



LEVERAGE TOOLS

- Get information on datasheets, app notes and much more: silabs.com/community
- Find out more Simplicity Studio Software: www.silabs.com/developers/simplicity-studio

Thank you!

