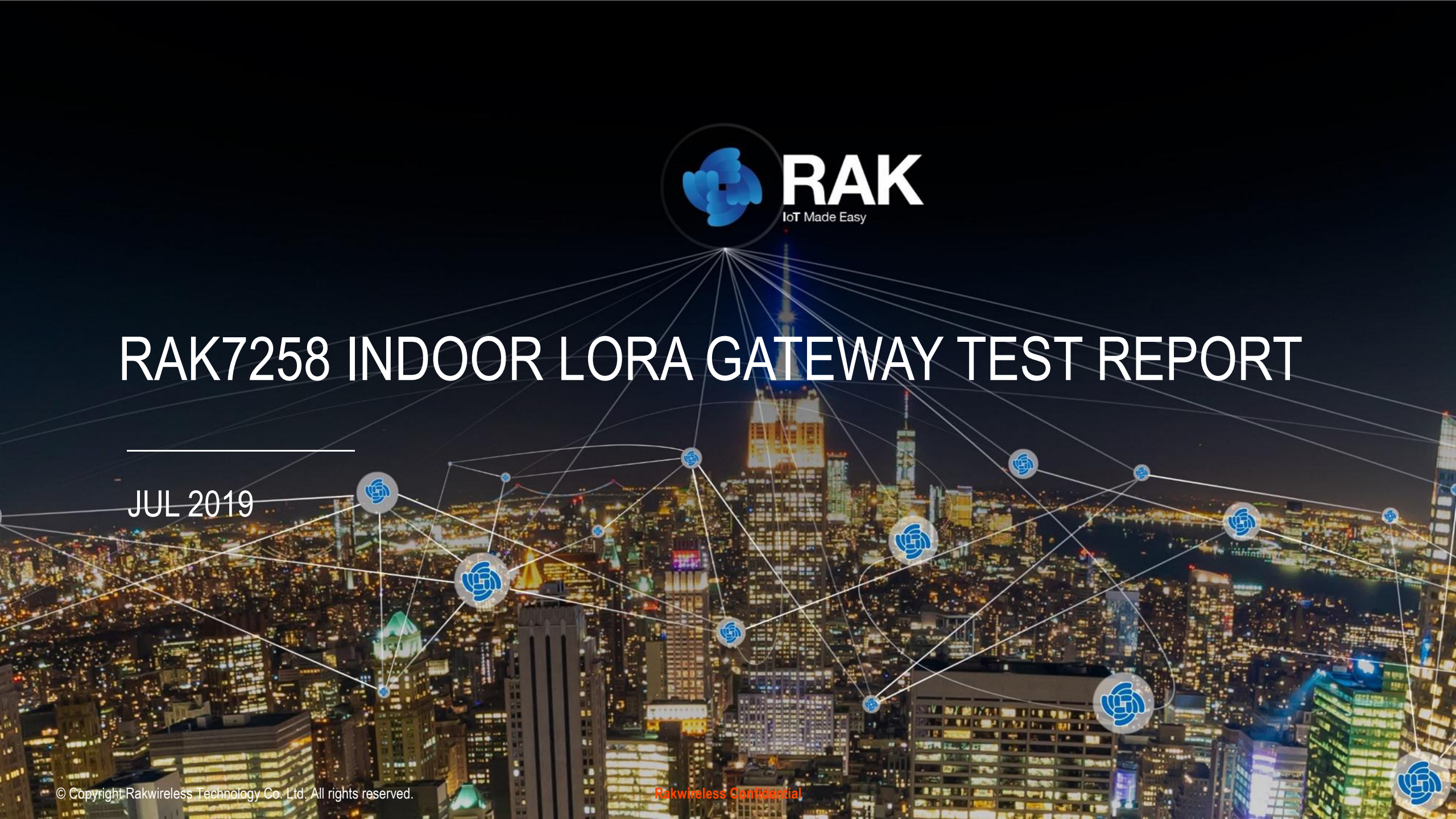


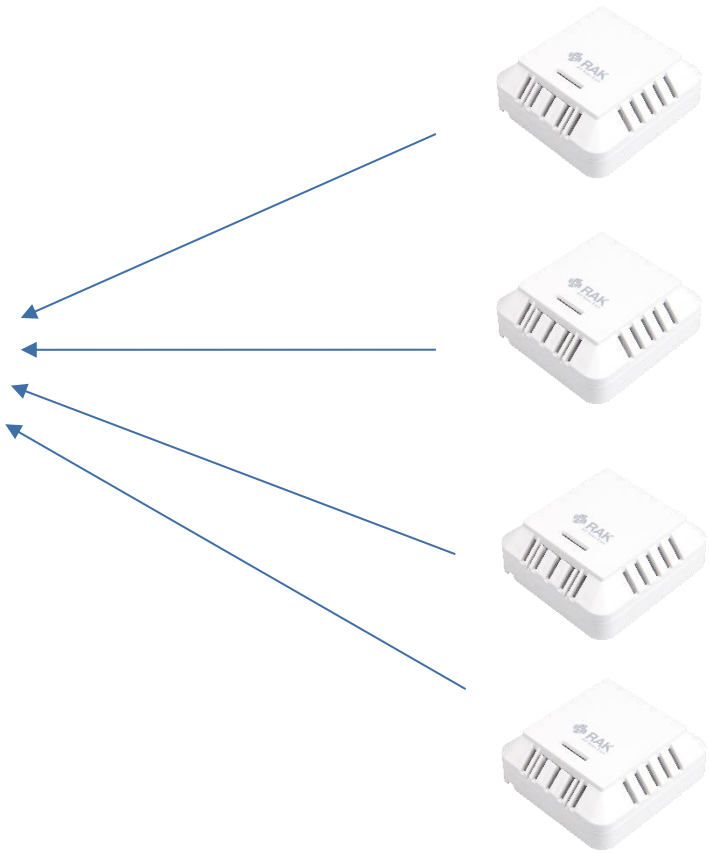
RAK7258 INDOOR LORA GATEWAY TEST REPORT

JUL 2019

Gateway and Node Devices

RAK7204 Environmental Sensors
(temperature, humidity, air pressure and IAQ)

Equipment Setup and Configuration



RAK7258 configuration:
Built-in NS enabled
OTAA
CN470 frequency
ADR disabled

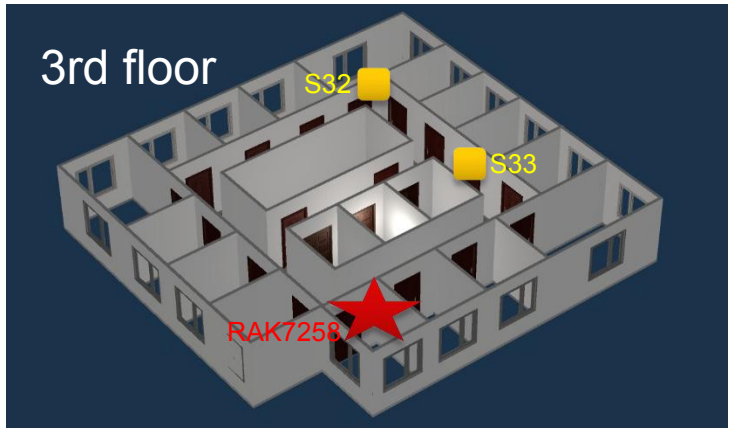
RAK7204 configuration:
Class A
OTAA
CN470 frequency
Data packet interval 10s
TX Power 17dBm
Built-in antenna

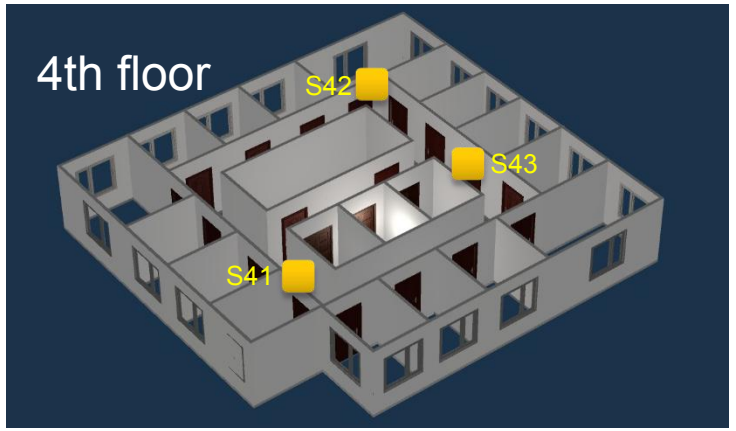
Each RAK7204 sensor sends a set of temperature and humidity measurements to the RAK7258 gateway every 10 seconds. The lost packets and RSSI values are examined and reported.

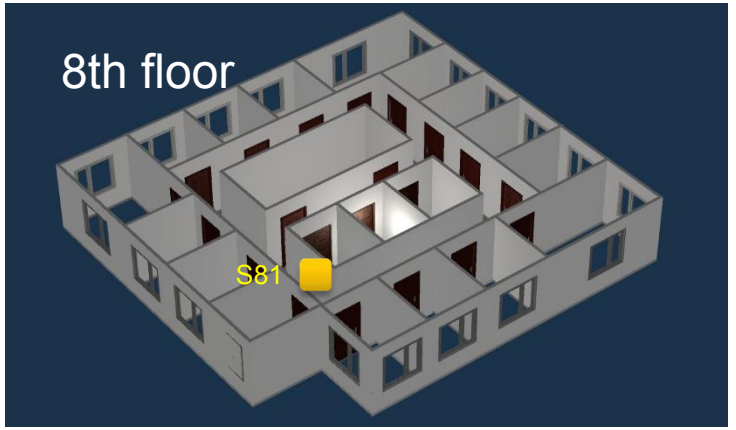
Testing Environment

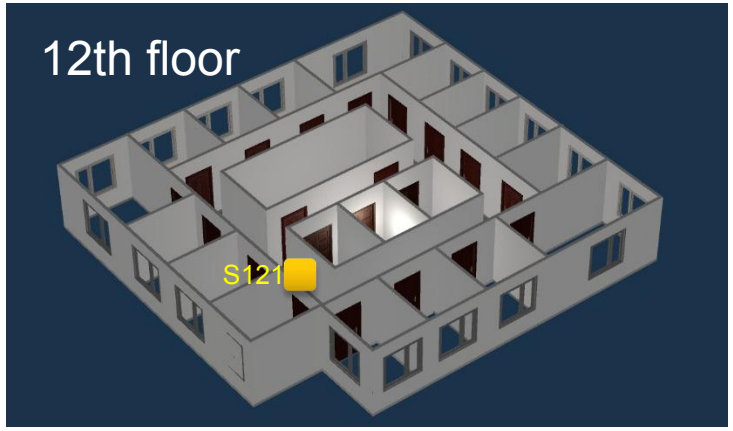
The location is the RAK Beijing office building.
The building is 17 stories high and has a single floor area of about 1000 square meters.
The RAK7258 LoRaWAN Gateway is placed on the 3rd floor, the RAK7204 environmental sensors are installed on the ceiling of floors 3, 4, 8, 12, and 17, respectively.

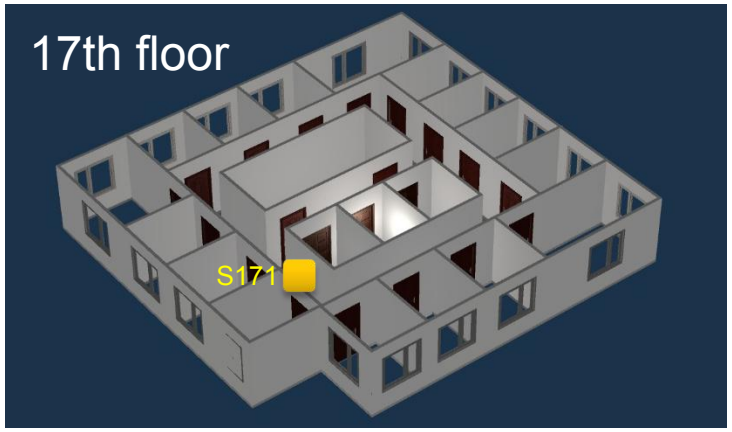
Device Installation Locations







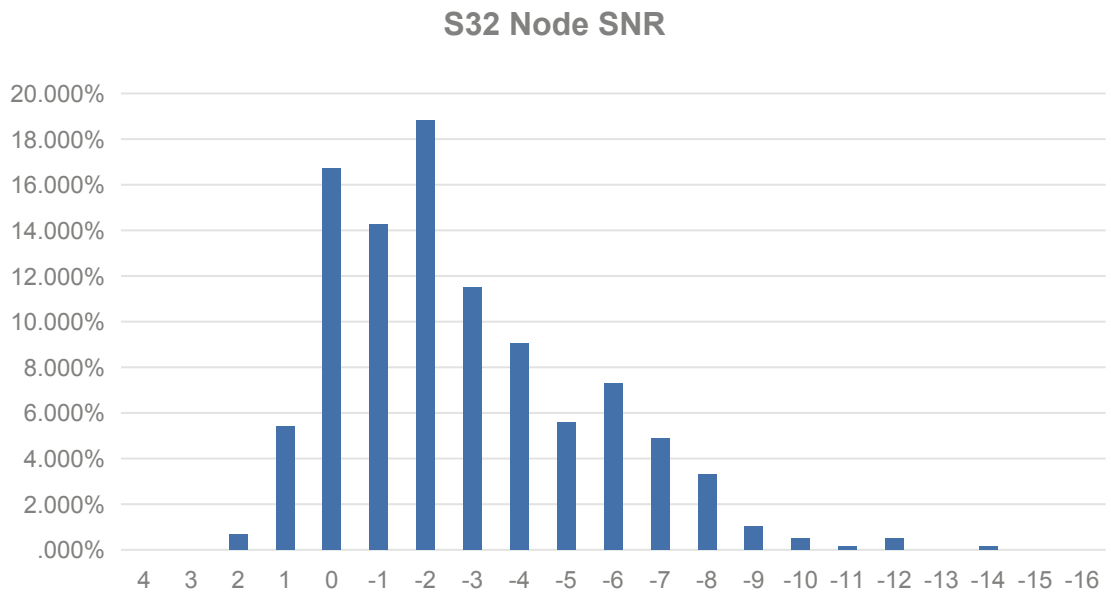


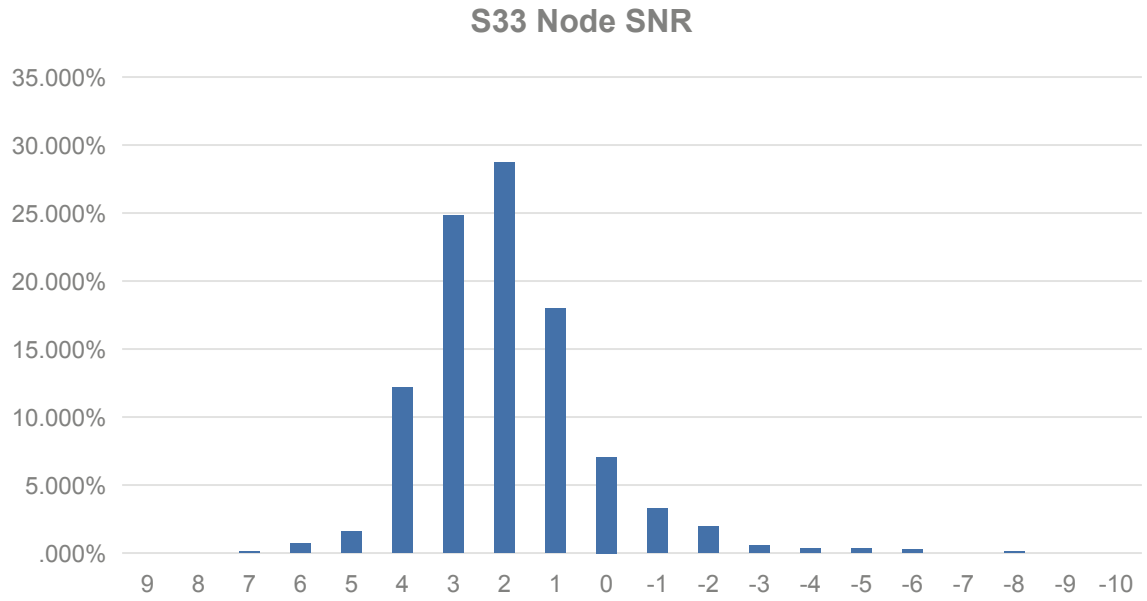


Floor	Device ID	Location
3	RAK7258	Room 306
	S32	At the door of room 315
	S33	At the door of room 317
4	S41	At the door of room 406
	S42	At the door of room 415
	S43	At the door of room 417
8	S81	At the door of room 806
12	S121	At the door of room 1206
17	S171	At the door of room 1706

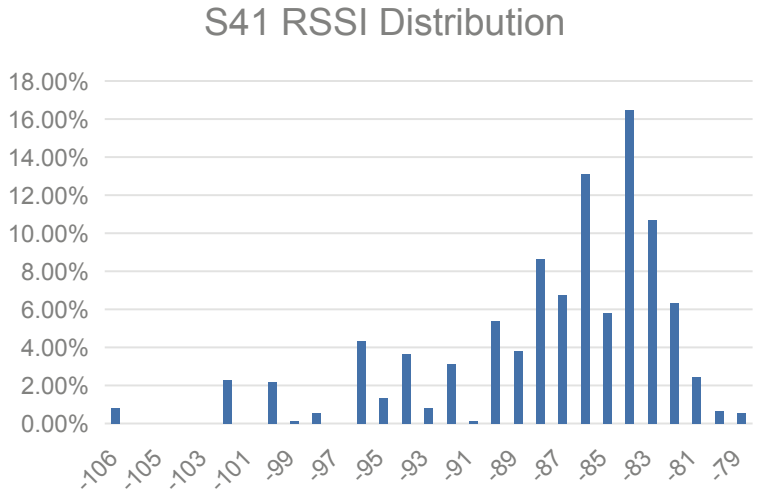
3rd Floor Test Data

Node Device Location	S32	S33
Total count of packets sent	654	931
Count of packets received	574	878
Packet Loss Rate	12%	6%
Average RSSI	-95.3	-92.6
Average SNR	-2.3	2.4

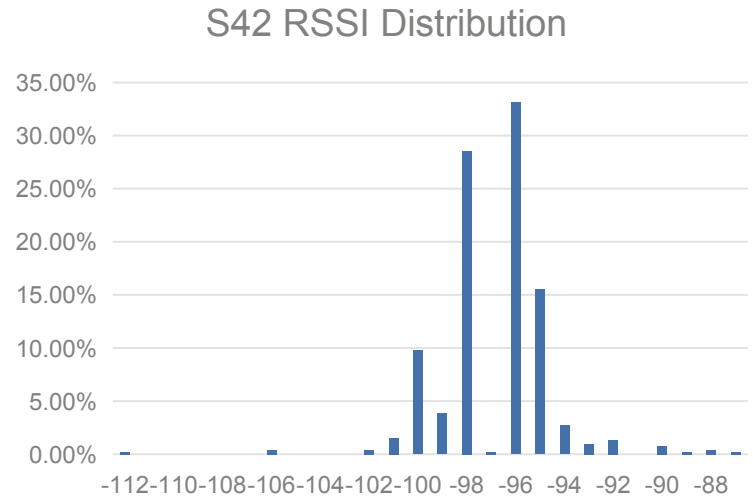


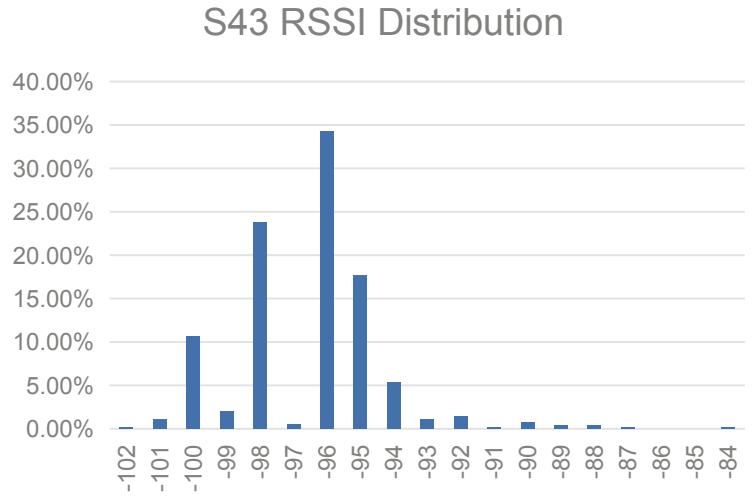


4 Floor Test Data



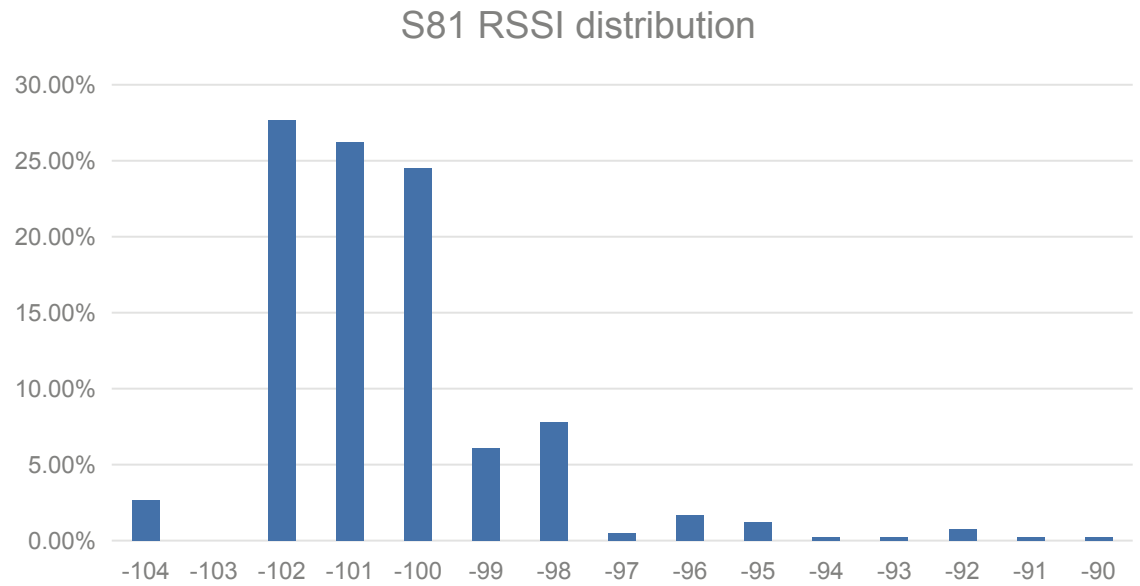
Node Device Location	S41	S42	S43
Total count of packets sent	762	654	656
Count of packets received	740	521	555
Packet Loss Rate	2.8%	20%	15%
Average RSSI	-87.4	-96.8	-96.5
Average SNR	7.0	-9.1	-7.5





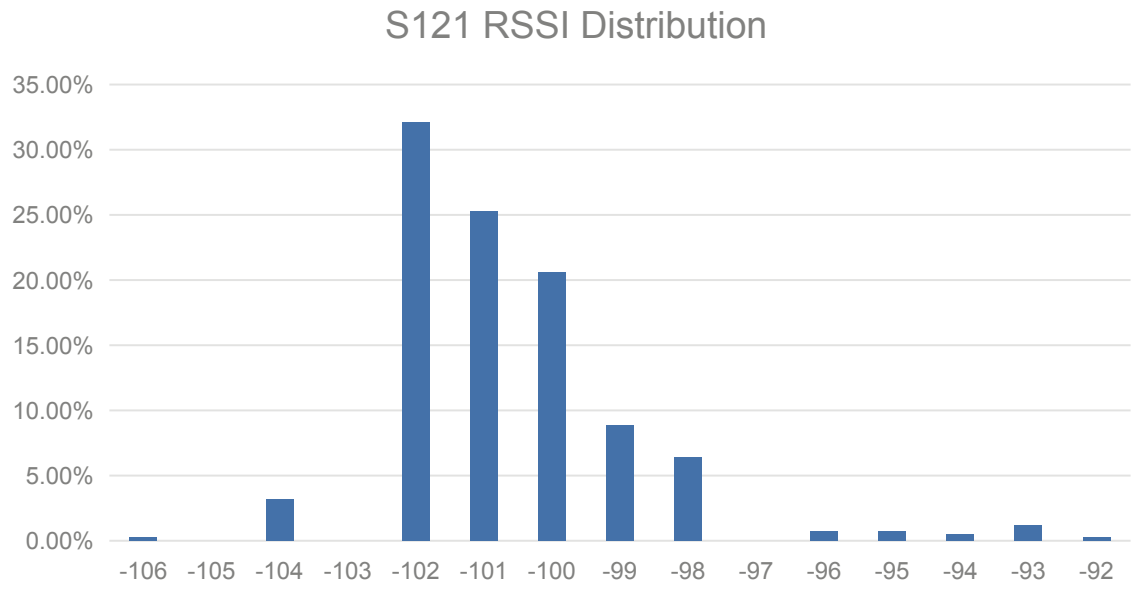
8 Floor Test Data

Node Device Location	S81
Total count of packets sent	528
Count of packets received	412
Packet Loss Rate	22%
Average RSSI	-100
Average SNR	-13.2



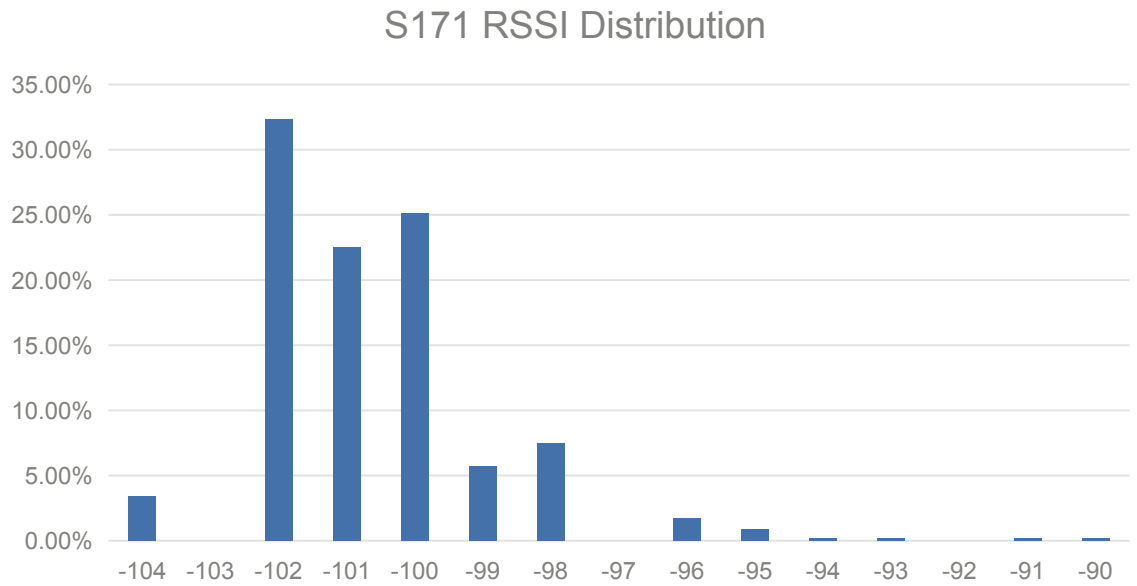
12 Floor Test Data

Node Device Location	S121
Total count of packets sent	525
Count of packets received	408
Packet Loss Rate	22%
Average RSSI	-100.6
Average SNR	-15.3



17 Floor Test Data

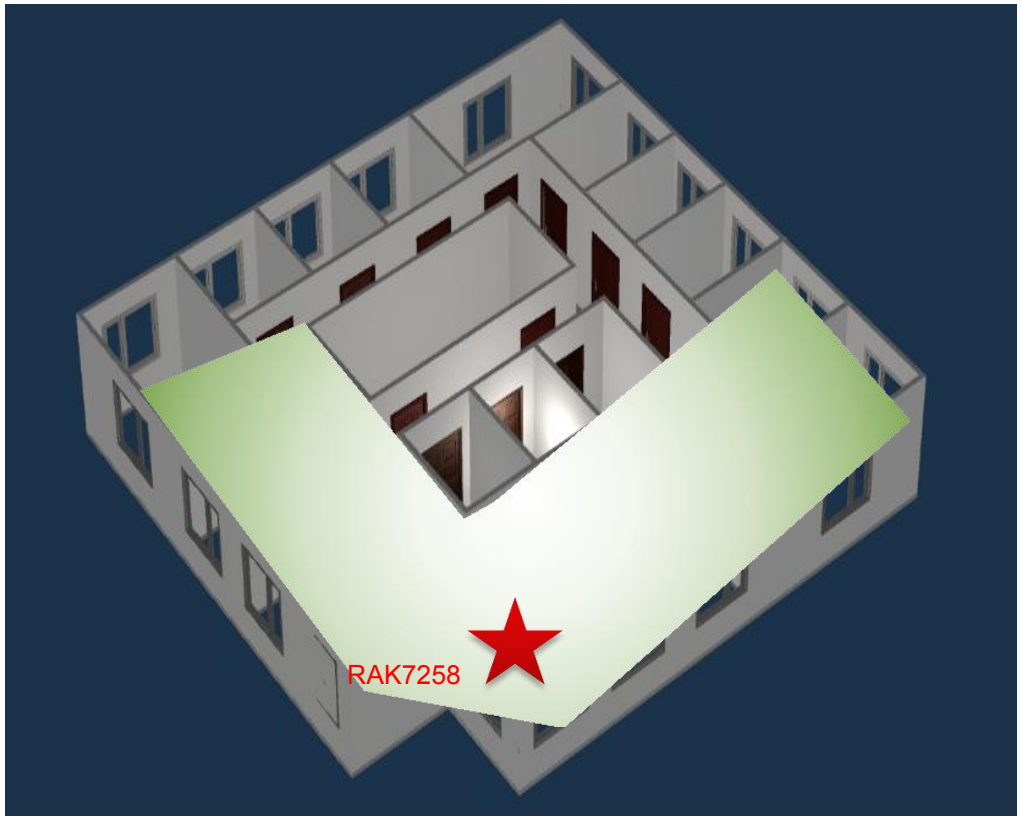
Node Device Location	S171
Total count of packets sent	529
Count of packets received	470
Packet Loss Rate	11%
Average RSSI	-100.6
Average SNR	-12.9



Conclusions

1. Horizontal Coverage:
   The RAK7258 Gateway can completely cover the floor, where it is located, together with the adjacent floors. If the Gateway is on the third floor, it can cover floors 2, 3, and 4 completely. This is within the expected performance of a LoRaWAN Gateway.

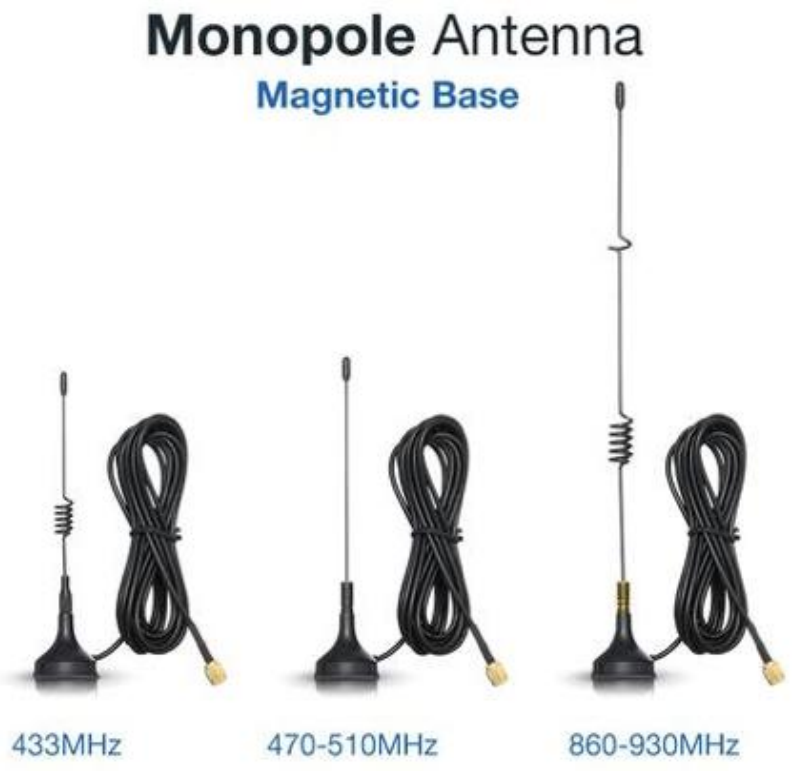
1. Vertical Coverage:
   The RAK7258 Gateway can cover about half of the 17 stories of the building. Thus you will need to position it somewhere in the middle. Ideally you would have multiple units spread over the 17 floors. This effect is mainly due to the presence of a lot of metal especially in the walls and the elevator shaft, leading to reflections and attenuation. Check the image for a rough representation of the coverage area.



Notes on Antenna placement

1. We can make the following claims based on the results in addition to the conclusions from Slide 11:

   - RAK7258 has sufficient coverage for the whole building provided it is somewhere in the middle of the structure
   - The are dead spots due to the presence of metallic objects and parts of the construction that impact propagation negatively
   - Placement of the Gateway is important, assuming the antenna is rigidly mounted
   - Antenna orientation is important



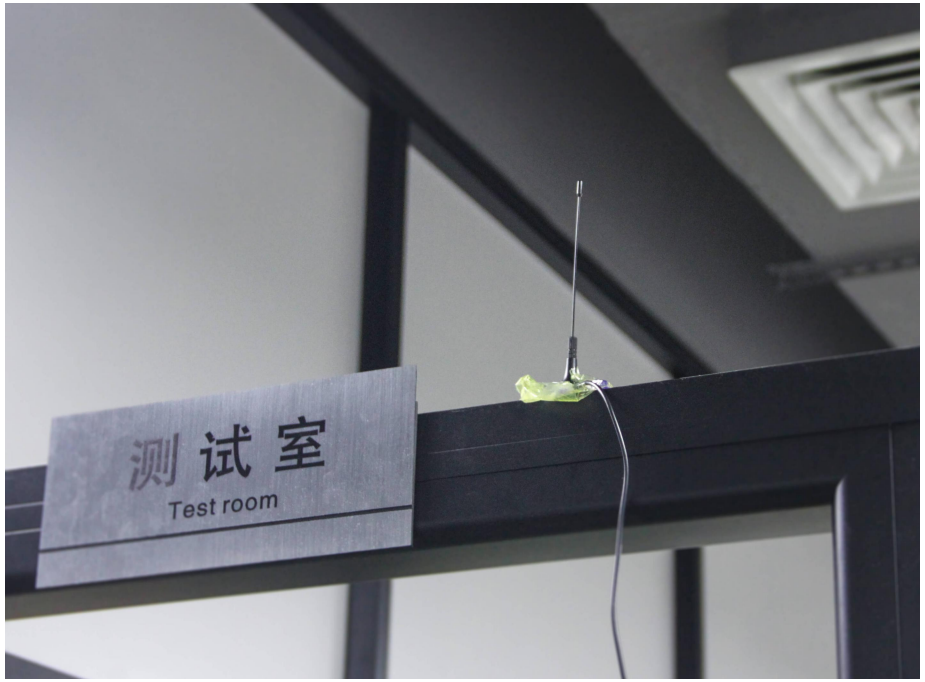
Magnetic Base Monopole Antenna

The new antenna RAKwireless is offering has been used for testing the improvements it brings together with how orientation affects the RSSI

Notes on Antenna placement

1. Monopole antenna pointing upwards towards the ceiling:

   - We use as the base performance. This is also the orientation of the antenna for the tests presented in slides 6 to 10



Node	Rate	Tx	Rx	Loss	RSSI Min	RSSI Max	RSSI Avg	SNR Max	SNR Min	SNR Avg
5th	**SF7**	**100**	**99**	**1%**	**-106**	**-90**	**-100.2**	**-6.3**	**8.0**	**0.98**
4th	**SF7**	**104**	**102**	**2%**	**-114**	**-96**	**-101.1**	**-6.5**	**4.8**	**0.45**
3rd	**SF12**	**100**	**99**	**1%**	**-122**	**-98**	**-103.5**	**-9.8**	**4.3**	**-1.40**
2nd	**SF12**	**100**	**79**	**21%**	**-107**	**-101**	**-105.2**	**-20.0**	**-12.0**	**-14.70**
1st	**SF12**	**100**	**64**	**36%**	**-120**	**-102**	**-105.5**	**-19.3**	**-4.8**	**-12.60**

Notes on Antenna placement

1. Monopole antenna pointing downwards toward the floor:

   - It is obvious that there is decreased packet loss. This is especially prominent when the node is on the 1st and 2nd floor.

Node	Rate	Tx	Rx	Loss	RSSI Min	RSSI Max	RSSI Avg	SNR Max	SNR Min	SNR Avg
5th	**SF7**	**101**	**101**	**0%**	**-111**	**-97**	**-103.5**	**-8.3**	**8.3**	**2.60**
4th	**SF7**	**103**	**103**	**0%**	**-108**	**-97**	**-104.0**	**-8.5**	**6.5**	**0.66**
3rd	**SF12**	**103**	**103**	**0%**	**-110**	**-101**	**-106.5**	**-10.5**	**4.5**	**0.35**
2nd	**SF12**	**100**	**97**	**3%**	**-108**	**-104**	**-106.6**	**-20.8**	**-1.3**	**-8.90**
1st	**SF12**	**103**	**102**	**1%**	**-110**	**-104**	**-106.5**	**-21.0**	**-5.8**	**-10.80**

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