Test Report—Water Bottles

Spearix prototype hardware operating in 2.4GHz band tested against fluids over 4.2meters separation. How supply chain applications are easily impacted by water obstructions and the gradual optimization steps possible with RADiS(TM) diversity that fixes the problem.
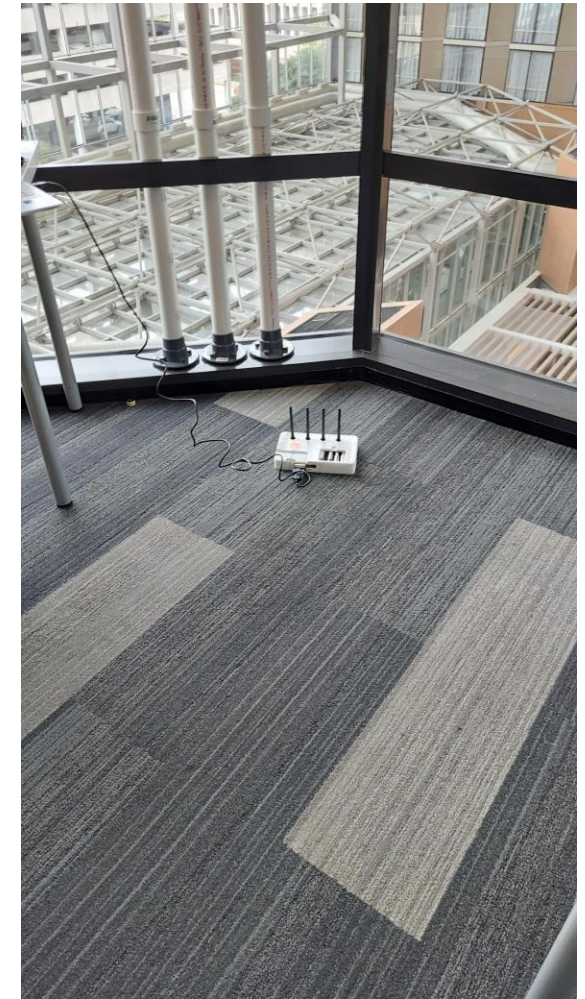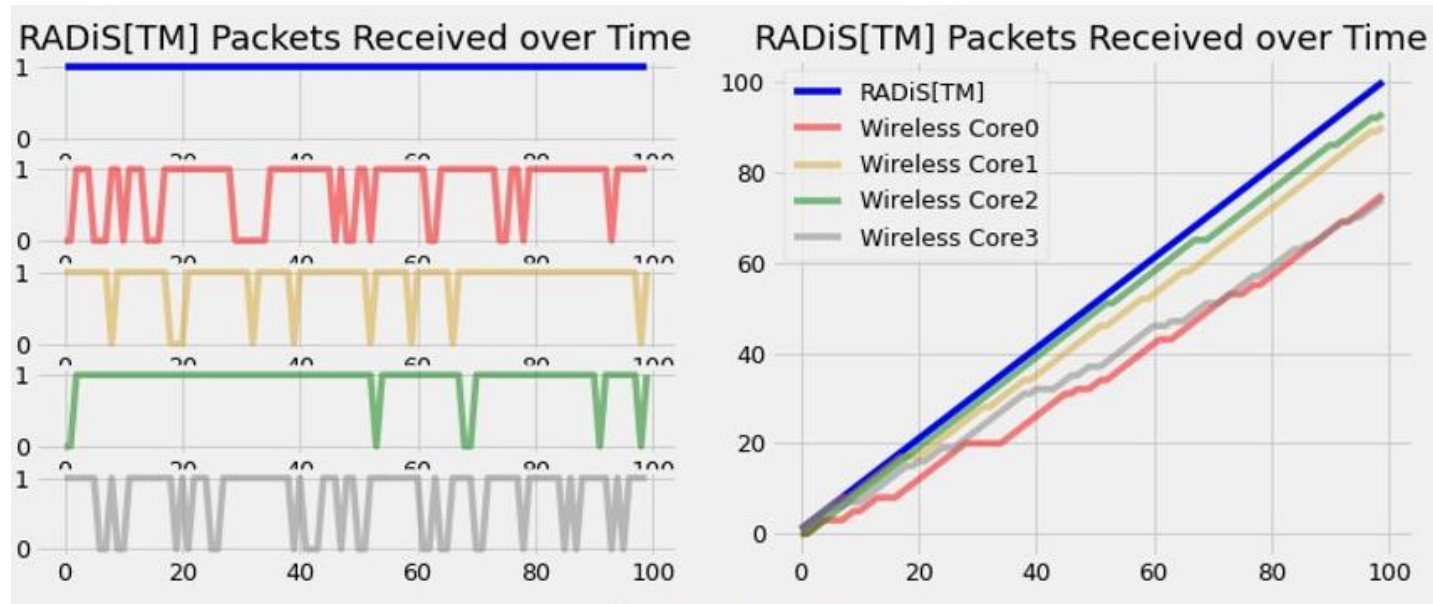
Sept 12, 2023

Packet Receiver Setup

- Packet receiver on top table top, not the floor
- Set up to receive 100 packets, 80 bytes length, every 300msec
- Packet reciever & packet transmitter separated by 4.2 meters

Packet Transmitter Setup

- Packet transmitter on the floor of 5th floor high rise (concrete floors)
- Noisy environment and low to the ground transmitting at –5dBm to 0dBm
- Results: RADiS(TM) composite received all packets, Core0 & Core3 70%

Crowd with 1 Stack
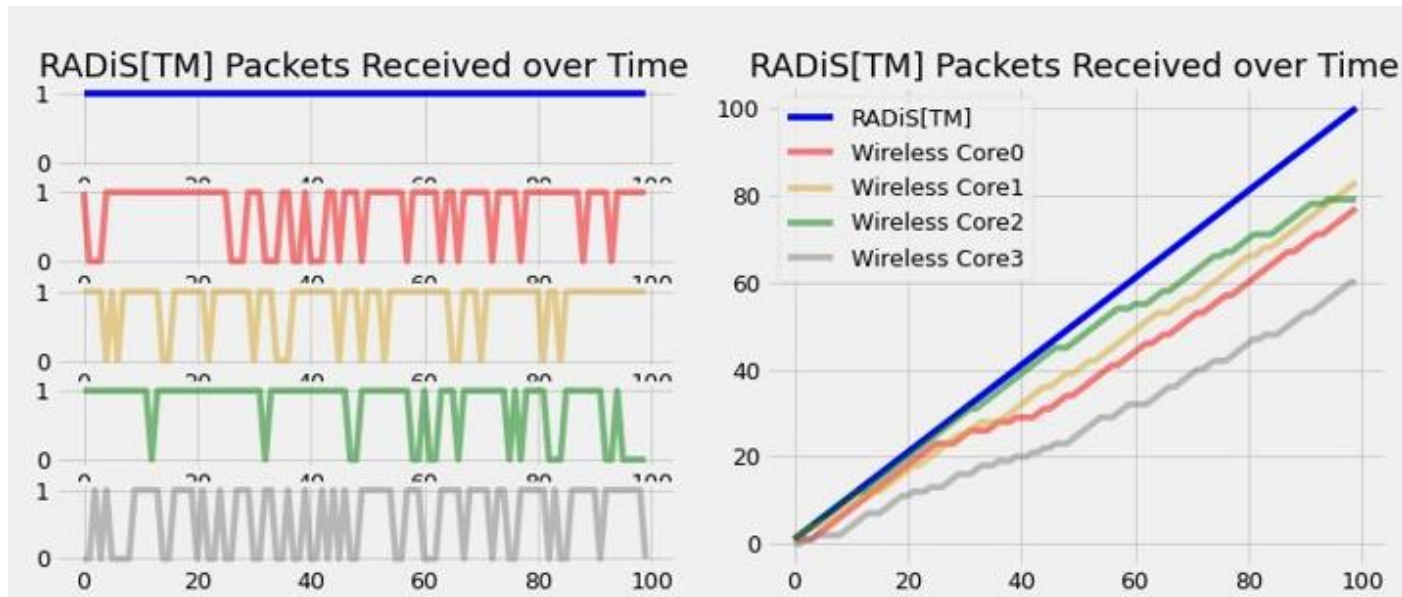
- Placed water bottles surrounding the transmit, receive remains same
- Frequency hopping in sequence & -5 to 0dBm power level
- RADiS(TM) composite unaffected, Core3 drops to 60%

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Crowd with 2 Stacks
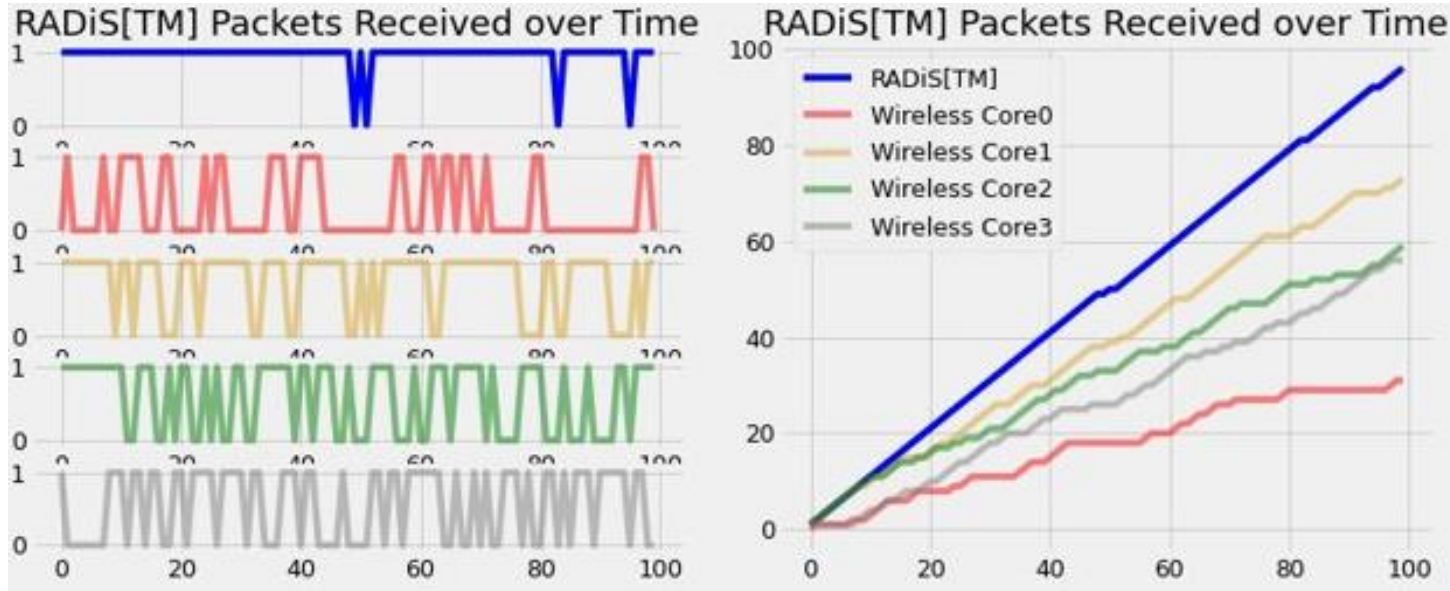

- 2 Stacks forms chimney effect with top open
- Frequency hopping in sequence & -5 to 0dBm power level
- RADiS(TM) achieved 96%, Core0 drops to 25%

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Completely Encircled
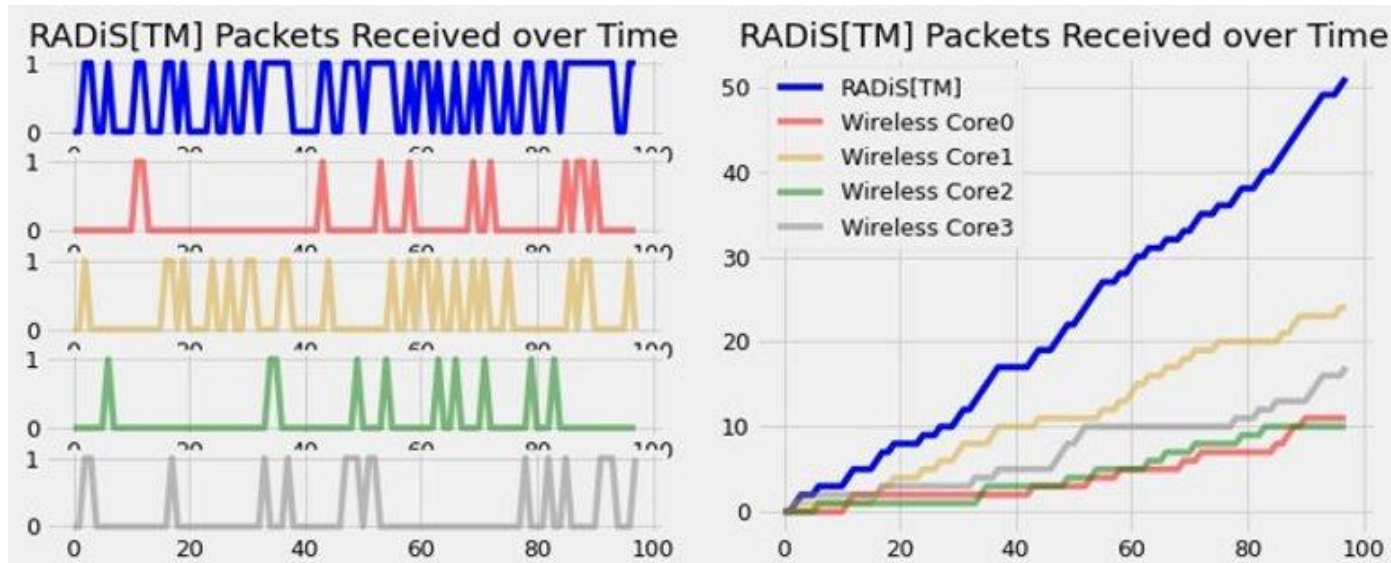
- Worst case test, completely encircled except the floor
- Frequency hopping in sequence, -5dBm to 0dBm transmit power
- RADiS(TM) drops to 51%, Core3 drops to 10%--losing reliability & needs improvement

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Improvement—No Frequency Hopping
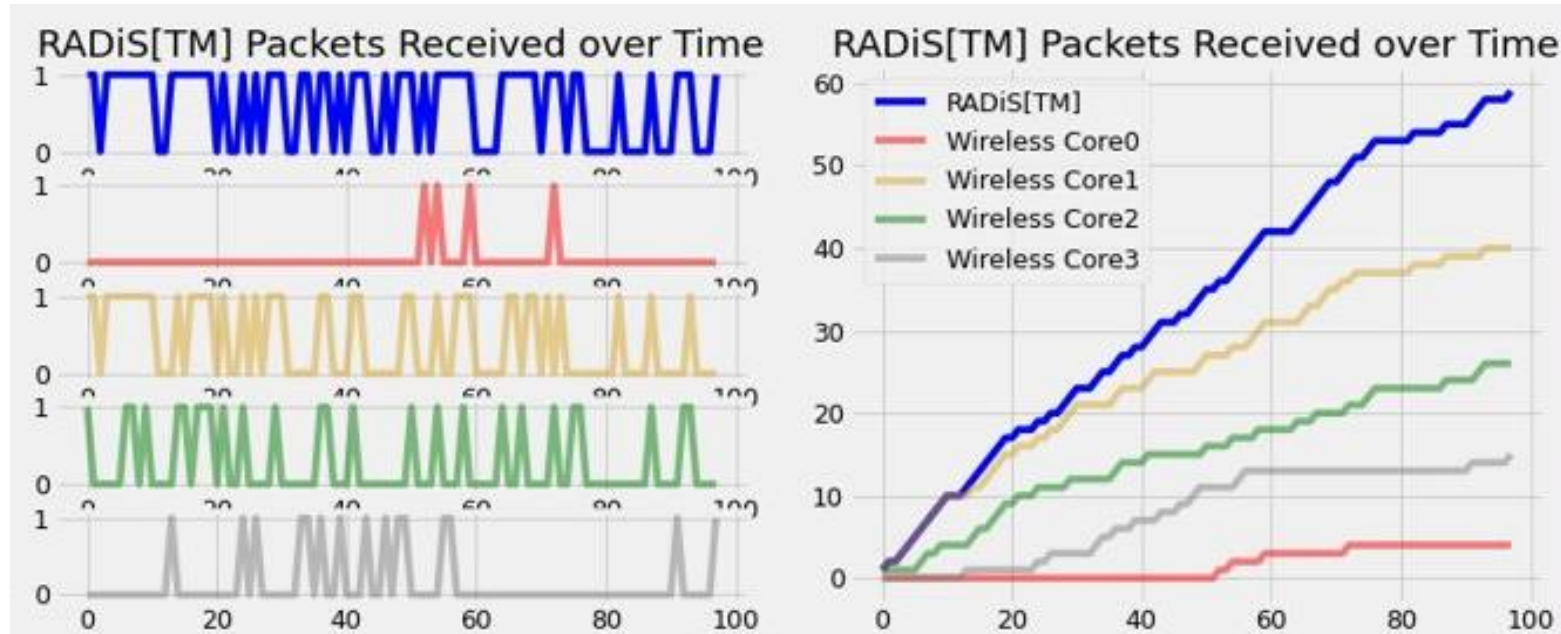
- Transmit all static frequencies, no hopping but same –5 to 0dBm power
- RADiS(TM) improves to 59%, Core0 drops to 4% due to bad frequency-space mode
- Static frequencies helps optimize frequency-space diversity modes
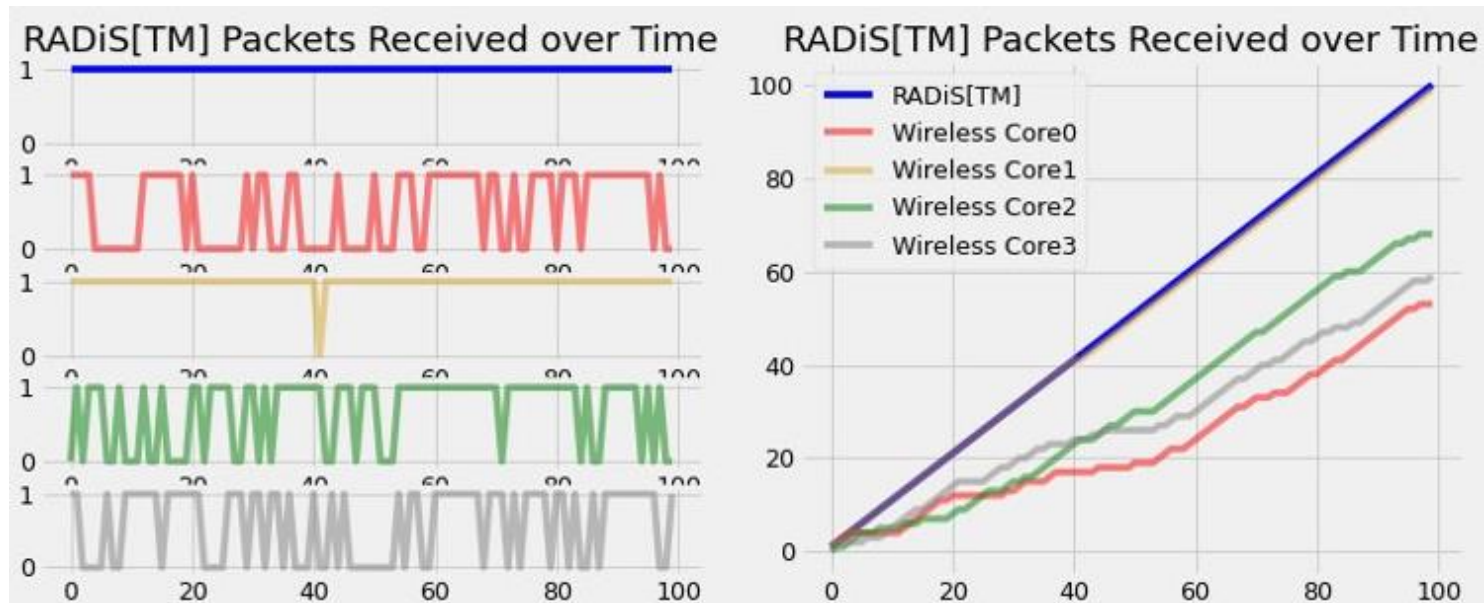
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Improve Output Power
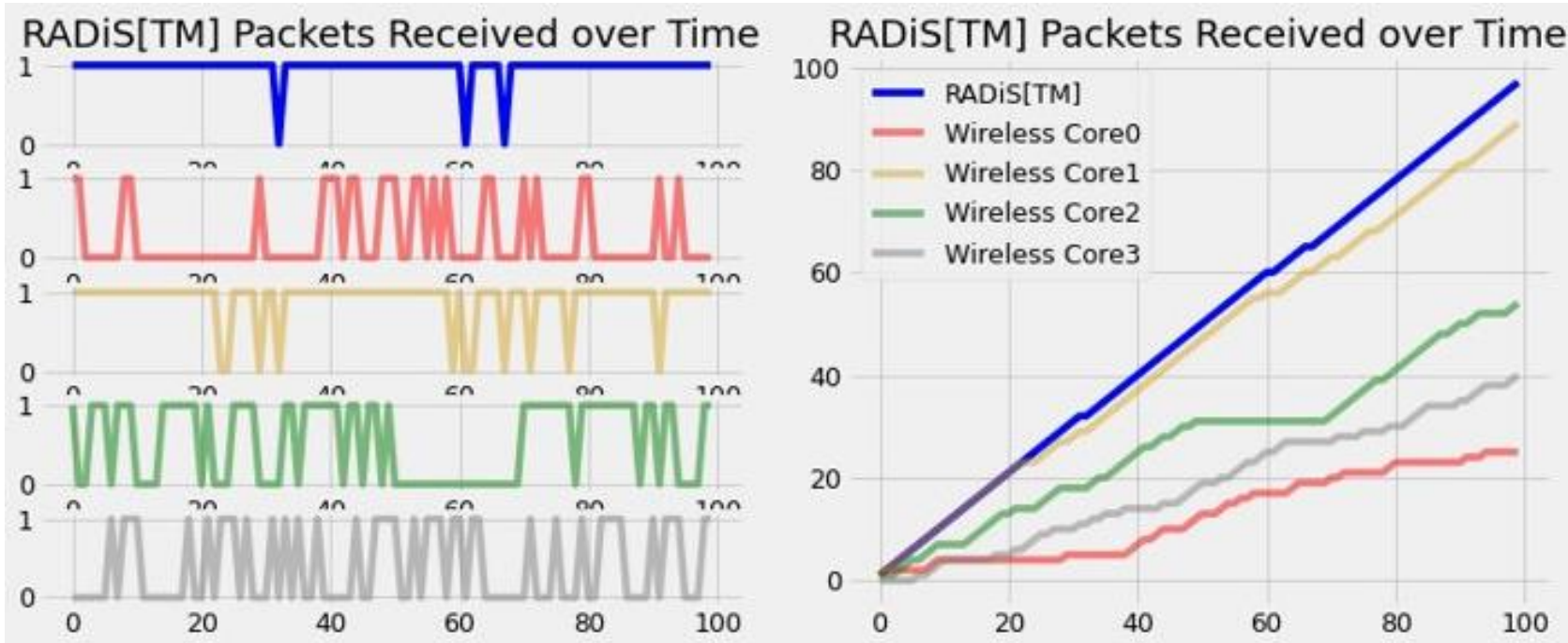
- Now output power increase becomes useful
- No hopping, transmit power increased to 0dB to +5dBm
- RADiS(TM) improves to 97%, Core0 improves to 25%--good power optimization

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Power Setting for Highest Reliability

- Increase RF power to 10dBm can squeeze more reliability, lower latency
- RADiS(TM) maxes out at 100%, Core0 improves to 53%
- Fine tuning RF power enables fine selection between battery & performance

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Conclusion—RADiS(TM) can Solve Worst Case

- RADiS diversity can solve reliability when challenged by liquids

- RADiS modes can be scaled to optimize battery life or performance

- Previously thought solutions (higher RF power, frequency hopping) run out of steam and cannot fully meet reliability demands

- As wireless operates with 10 to 20% packet success rate, connectivity (even mesh) stops working, especially in CSMA implementations

- Frequency hopping averages bad frequencies among those ok ones

- Without RADiS, the variability of supply chain environments caused impossible to determine reliability and battery loss

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