Biocloud 4.0 : A case study into coupled radiating coaxial cables with wireless mesh networks for clean room implementation

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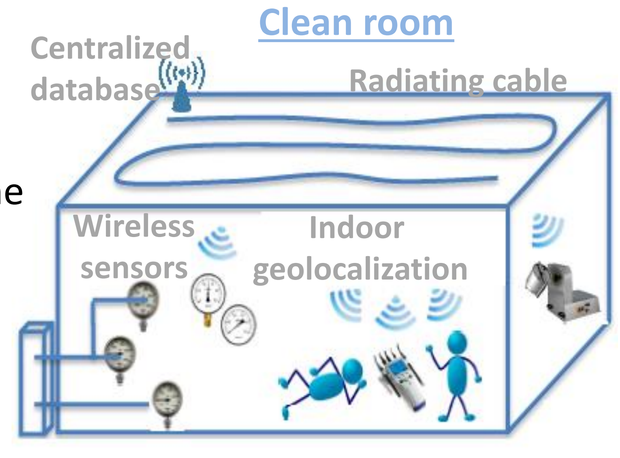
Context and objectives

The variety of innovative solutions for biotech and pharma industries are steadily increasing, one being a “patient-centric” approach to healthcare. Biocloud 4.0 will enable the user to have a complete view of the implemented network (data and status information). This work focuses on the wireless network workstream associated with the main project.

No wireless solutions are available for this approach. We chose to work with one of Linear Technology’s solution, SmartMesh IP, combined with a radiating cable. One of the goals is to study the impact of this cable on the network and combine the solution with relevant requirements of pharmaceutical companies (reliability, number of devices connected, emission rate…).



Devices

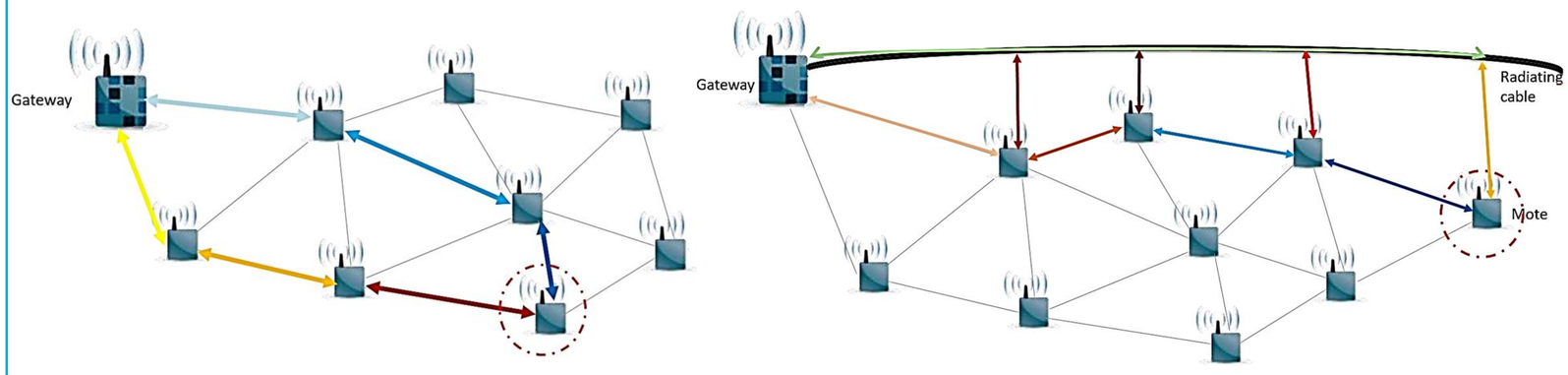
There are two types of devices in the network :

- SmartMesh IP Manager:
  - Manages sending packets and maintains communication if topology changes
- SmartMesh IP Mote:
  - Manages information (links with neighbours, synchronisation maintenance, report generation…)

Studied topology

We are working with two topologies :

- Standard mesh topology
- Radiating cable mesh topology



Preliminary study

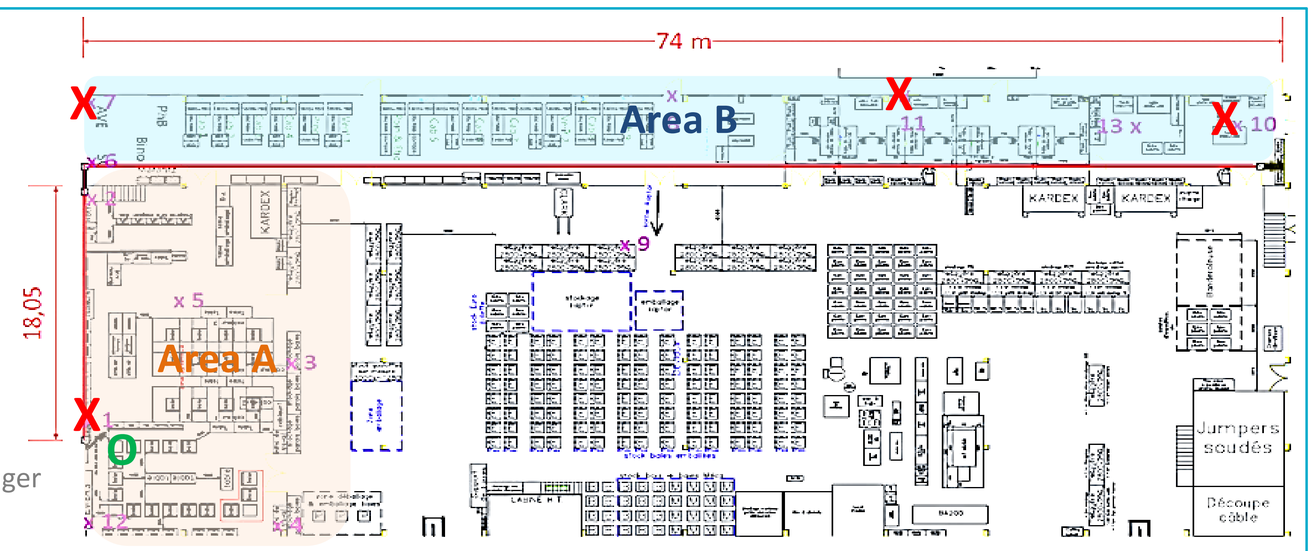
Exclusively using motes we obtain a suitable coverage and believe improvements can be achieved using radiating cables. In addition, this cable will create a more direct path to the manager. With this more direct path we anticipate smaller latency and less energy consumption as the retransmission rate will be smaller. The reliability will also be greater with the radiating cable as opposed to simply using antennas.

Test bench

We placed 4 SmartMesh IP Motes and 1 SmartMesh IP Manager over 4 separate rooms. A radiating cable was also installed.

In our tests, we varied the following parameters:

- Radiating cable (connected to the manager) use/ antenna use
- Topology (star or mesh)
- Emission power used by motes and manager
- Antenna position and orientation



	Area A		Area B	
	Radiating cable	**Antenna**	**Radiating cable**	**Antenna**
RSSI	-52 dBm	-46 dBm	-92 dBm	-98 dBm
Latency	189 ms	116 ms	862 ms	1472 ms
Hops number	1	1	1,481	2,936
Number of packets not sent (congestion / failure to allocate a packet)	3	3	25	94
Failed transmission	3%	5%	36%	44%

Results

The rooms can be considered as two zones:

- Area A, the manager is in close proximity to the motes and few motes are present, an antenna configuration is better adapted to this scenario.
- Area B, motes are further from the manager, and a radiating cable setup is recommended.

Future work

Future work will consider a network with 40 motes and 2 managers, optimising the antenna position and cable usage, transmitted power levels, congestion response, the number of parents, manager disconnection response, network behaviour using 2 managers and the impact of motes circulation.

This multi-partner project is still ongoing and is financially supported by Walloon Region BioWin Cluster, project 7574.

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