

White paper: Don't be afraid of Bluetooth –

Take all aspects into account when you consider Wi-Fi Real Time Location Systems. (RTLS)

Updated 29. March 2019.

The purpose of this white paper is to help people in charge of the RTLS purchasing process when they evaluate different solutions. We have written the document in the form of a checklist to ease the task of the reader. The main focus of the document is based on Wi-Fi RTLS solutions but some aspects could cover RFID as well. The majority of Wi-Fi RTLS provider's do not offer the whole package. They sell tags and software – the end user is responsible of purchasing and maintaining the infrastructure. The message of the white paper is: Beware of hidden costs.

1. Patient safety

Bluetooth Smart technology based tags have only a fraction of output radio power compared to WiFi tags. This means that Bluetooth tags won't affect even the most delicate medical devices. The output power 9Solutions uses is 2,5 mW. Older WiFi standards allow 100 mW and the newest standard up to 1000 mW maximum output power.

Output power	Technology
1000 mW	IEEE 802.11a 5 GHz WiFi
500 mW	3G -phone (power class 2)
100 mW	IEEE 802.11b/g 2.4 GHz WiFi
2.5 mW (4 dBm)	Bluetooth (9Solutions)

2. Bluetooth coexistence with WiFi

9Solutions system will not degrade the performance of your Wi-Fi network. 9Solutions system is a Bluetooth based solution. Bluetooth is a frequency hopping technology, which means that 9Solutions system is using 1600 different channels each second! And it does it a smart way. Bluetooth adaptive frequency hopping (AFH) algorithm ensures that 9Solutions system does not block your Wi-Fi network. It simply does not use channels that Wi-Fi is using. Also, maximum bluetooth transmission power is 2.5mW. WiFi transmission power is 100 mW for 2.4 GHz systems.



Many major WiFi access point vendors offer an access point which has WiFi and Bluetooth features in same device!

3. References

9Solutions bluetooth based system has been deployed in almost 1100 healthcare facilities in Finland; Customers using 9Solutions system are tracking tens of thousands of people and asset. There are hundreds of customers using 9Solutions technology along with WiFi networks without any reported issues.

Most significant references who have chosen 9Solutions technology:

- Oulu university hospital
- Helsinki university hospital
- Kuopio university hospital
- Essote
- Kainua
- JUST
- KSSHP

- Sosteri
- Attendo care homes
- Esperi care homes
- Mehiläinen care homes

4. Are you really using an existing infrastructure?

Although many Wi-Fi RTLS vendors tout the “plug and play” attributes of using their existing infrastructure, the leading manufacturer of WLANs has a deployment guideline document for Wi- Fi RTLS that is over 200 pages in length, and it turns out, the system calibration manual of the leading Wi-Fi RTLS vendor is over 80 pages in length. So in essence, the actual value of using the “existing” infrastructure means you have to add a lot more infrastructure. Meaning, at the same time, you lock-down the existing infrastructure: All infrastructure changes lead to re-calibration of the RTLS. In addition, typical WiFi network won't be enough to provide accurate locating infrastructure. Many vendors require additional WiFi access points or complementary techniques such as RFID, infrared etc. to improve locating accuracy.

5. What are real life Wi-Fi RTLS performance expectations?

- Locating accuracy of 10m @ 90% confidence without adding secondary technology like IR in each room.
- Battery lifetime of days to weeks in personnel tracking applications. If some WiFi RTLS vendors promise personnel tag battery lifetime of years, it could mean location transmission interval of hours which in person tracking is somewhat useless. Over the air programming support reduce battery life even further.
- Battery life time a couple of year in asset tracking applications – assuming that assets are motionless most of the time, no over the air programming support and long tracking interval.

6. Evaluate the capital expenditures needed to deploy an enterprise based RTLS solution, that can provide you with adequate room level accuracy.

How long will this RTLS solution take to be installed and how soon can you start to achieve benefits?

- How non-disruptive will this installation be to the healthcare environment?
- How many more AP(s) do I need to install and how many more runs of Ethernet need to be put in?
- What additional overlay technologies are recommended/needed?
- Calculate operational expenditures (man hours) that will need to be allocated to a site survey and implementation of the RTLS solution. Be sure to determine the man hours and opportunity cost for shut downs required to install new access points, initial calibration requirements and ongoing maintenance costs.
- Does opening the existing infrastructure add IT security risks?
- What is user exposure to high frequency radiation, SAR?

7. Understand the facts behind Wi-Fi RTLS

Snapshot from “Cisco Wireless Location Appliance Deployment Guide”

(<http://www.cisco.com/en/US/docs/wireless/technology/location/deployment/guide/depd.html#wp37641>)

“To determine the optimum location of all devices in the wireless LAN coverage areas, you need to consider the access point, density and location.

- Ensure that no fewer than 3 access points, and preferably 4 or 5, provide coverage to every area where device location is required. The more access points that detect a device, the better. This high level guideline translates into the following best practices, ordered by priority:
- Most importantly, access points should surround the desired location.
- Roughly one access point should be placed every 50-70 linear feet (~17-20 meters). This translates into one access point every 2,500 to 5000 square feet (~230-450 square meters).

Following these guidelines makes it more likely that access points will detect tracked devices. Rarely do two physical environments have the same RF characteristics. Users may need to adjust those parameters to their specific environment and requirements.”

8. So, what’s the solution?

9Solutions system is a wireless Bluetooth Low Energy based RTLS. It has all the same functions as a Wi-Fi based solutions plus much more – without all the hassle.

The table below compares implementation of Wi-Fi RTLS and 9Solutions system.

Wi-Fi	9Solutions
Wi-Fi based RTLS locks-down existing infrastructure. Every single change in Wi-Fi network leads to re-calibration of RTLS system.	9Solutions system does not use existing IT infrastructure. 9Solutions system Nodes form a wireless self-organizing network for RTLS use. Enjoy wireless Internet access utilizing your Wi-Fi – It’s great technology for that purpose, Wi-Fi was not designed for RTLS
Frequent RTLS systems calibrations are part of daily life with Wi-Fi based RTLS. The fact is that all environment changes lead to re-calibration of the RTLS system in all triangulation / RF-Finger printing based solutions. The biggest problem is people. 60-70% of human body is water – 2.4GHz signal does not penetrate water, which means that people wandering around the building significantly affect radio network parameters.	9Solutions system does not need calibration. Power on the last Node and start using your RTLS solution. 9Solutions system is cell-based solution; each 9Solutions system Node forms a cell. Changing environment is not a problem as communication distances are short.
Do you want to start using the RTLS systems within days or within months from decision to buy? Typical Wi-Fi based	9Solutions system installation is very fast. Installation time per room is normally a couple of minutes. On average you

<p>installations takes months. Site surveys, installation and network optimization and system calibration takes time.</p>	<p>can expect deployment speed of 50-100 rooms a day for one person.</p>
<p>Typical locating accuracy of Wi-Fi based solutions is 10m@90% confidence. This means that it's very hard to meet room level accuracy without adding secondary technology like IR-beacons. This in turn increases implementation and maintenance cost.</p>	<p>9Solutions system offers room level locating accuracy without using secondary technologies.</p>
<p>Battery lifetime of Wi-Fi RTLS tags is in range of days to weeks in personnel tracking applications (with 10 s tracking interval) . Large tags.</p> <p>Battery life time a couple of year in asset tracking applications – assuming that assets are motionless most of the time, no over the air programming support and long tracking interval</p>	<p>Typical battery lifetime of an 9Solutions system Tag is 1-3 years in personnel tracking applications (10 s tracking interval). The size of a 9Solutions system Tags are a fraction of Wi-Fi tags. 9Solutions personnel and patient tags are so small (with 42 mm diameter and 9,5 mm thickness) that you can wear them in wrist.</p> <p>Battery lifetime of 9Solutions system Asset Tag is 10 years, assuming that assets are <u>mobile</u> most of the time.</p>
<p>In many countries schools have made decisions to remove Wi-Fi networks, as people are worried about the effect of high frequency radiation (SAR) to human brains.</p>	<p>9Solutions system SAR values are less than 1% of typical mobile phone or Wi-Fi device.</p>
<p>Are you willing to open you IT infrastructure for 3rd party applications? Does it improve safety of IT? Does it improve performance of you wireless network?</p>	<p>9Solutions system is not using existing IT infra for RTLS. It forms it's own wireless Bluetooth network.</p>
<p>Do you like software updates? Maintaining servers? Uploading security batches?</p>	<p>9Solutions system is SaaS based solution.* This means that no local software installation is required. 9Solutions makes sure that you always have the latest software available – and we monitor the performance of your 9Solutions system system 24/7. If there is a problem with the system, we know it within 20 seconds – and we'll make sure it's fixed in no time. Fancy iPad or other mobile devices? No problem – 9Solutions system has been designed taking touchscreen devices into account.</p> <p>*A stand alone server is an option</p>
<p>Wi-Fi is using a limited number of fixed channels to transfer data. Wi-Fi RTLS deployment leads to time-consuming channel optimization process.</p>	<p>9Solutions system will not degrade the performance of your Wi-Fi network. 9Solutions system is a Bluetooth based solution. Bluetooth is a frequency hopping technology, which means that 9Solutions system is using 1600 different channels each second! And it does it a smart way. Bluetooth adaptive frequency hopping (AFH) algorithm ensures that 9Solutions system does not block your Wi-Fi network. It simply does not use channels that Wi-Fi is using. Oulu university of applied sciences has studied Wi-Fi and 9Solutions system co-existence. They ended up concluding that 9Solutions system does not affect performance of Wi-Fi.</p>

