RTLS System Overview
Real Time Location System

This document describes general overview of Sewio RTLS System.

1 RTLS Introduction ............................................................................................................................................................. 2
2 RTLS Architecture Overview ............................................................................................................................................. 3
3 Deployment Guide ............................................................................................................................................................... 4
4 Related Reading ............................................................................................................................................................... 6
1 RTLS Introduction

The Sewio RTLS Kit is based on Time of Flight radio distance measurement by technique known as two way ranging. Whenever mobile device Tag tries to estimate its position it must determine at least three distances to static nodes so-called Anchors. The distances are processed in RTLS server where final position estimation is done. The raw positioning data are further available through Sensmap Server and can be visualized via Sensmap Visualization.

RTLS kit is distributed with software preinstalled in VMware Ubuntu image. Newly, software for tiny ARM embedded system is also available. The entire software might be moved to native host if required, see migration guide.

RTLS components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag</td>
<td>Mobile device to be localized</td>
</tr>
<tr>
<td>Anchor</td>
<td>Static infrastructure device with known position.</td>
</tr>
<tr>
<td>RTLS Server</td>
<td>Software for calculation final positions of Tags.</td>
</tr>
<tr>
<td>Sensmap Server</td>
<td>Software which provides data access and storage place.</td>
</tr>
<tr>
<td>Sensmap API</td>
<td>Application protocol interface for RTLS via Web Sockets or REST HTTP interface</td>
</tr>
<tr>
<td>Sensmap Visualization</td>
<td>Web based application for real-time RTLS visualization</td>
</tr>
</tbody>
</table>

RTLS Hardware RTLS Software Client Software

RTLS Kit features

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of Tags</td>
<td>100*</td>
</tr>
<tr>
<td>Maximum number of Anchors</td>
<td>10*</td>
</tr>
<tr>
<td>Update interval</td>
<td>50 ms - 8 s **</td>
</tr>
</tbody>
</table>

*for larger installation please send query to info@sewio.net
** configurable
2 RTLS Architecture Overview

RTLS system has following communication flow:

1. Tag assign to its dedicated timeslot and in regular interval polls defined number of anchors in its physical range.
2. Each anchor calculates a distance to particular Tag and sent it wirelessly to Master Anchor.
3. Master Anchor sent distances to RTLS Server.
4. RTLS Server calculates a final distance (it may apply some degree of filtration) and send final position via REST API to Sensmap Server.
5. Sensmap Server provides API to gather all position data within the RTLS System.
6. User can use Sensmap Visualization to show its Tags in real-time.
3 Deployment Guide

Position of Master Anchor is crucial because of fact that Tags channel access is driven via synchronization through Master Anchor. In optimal scenario the best position for Master Anchor is center of area to be covered by RTLS system. All other anchors should be in the same physical range in order to get best performance. In the worst case master anchor must be in range of at least two other anchors. All anchors should have line of sight to master anchor.

Wireless communication range between devices is from 25 meters to 45 meters in line of sight condition and standard transmit power (up to 150m for maximum transmit power and LOS). RTLS kit may cover with 1 Master Anchor and 5 Anchors from 320 square meters up to 2500 square meters.

Here are general rules for deployment of Anchors:

- Wireless connection from Master Anchor to other anchors is crucial. Anchors should be deployed as much as possible in line of sight with Master Anchor. While other anchors does not need to have line of sight connection among each other.

- Anchors deployment should ideally make a virtual square which lay out location area for Tags.

- Anchors and Tags have the same radio range. For the best position accuracy Tag should be in radio range of as many anchors as possible. Limit condition is that for 2D positioning Tag must see at least three anchors, for 3D at least four anchors.

- Accuracy and stability of position estimation is better for 2D calculation comparing to 3D. Therefore, use 2D calculation if possible.

- Area between anchors and tags should contain as little metal parts as possible.

- Range and accuracy might be affected by humans, metal parts or other obstacles.

2D location

- Anchors should be deployed in the same height, otherwise accuracy can be decreased. Anchors should be placed above people in order to reduce signal attenuation. There should not be any object in radius 20cm in front of anchor.

- Deploying anchors in corners of rectangular space is acceptable. However, ratio between length and width of room should not be bigger than 4:1, otherwise use square placement instead. The bigger ratio between lengths the bigger estimation error for the longer one.

- Anchors and Tags should not have very different height levels (more than 3m), otherwise accuracy and stability of position estimation might be decreased. If anchors height level needs to be quite distant from Tags height level you need to use 3D location.
2D Anchors deployment examples:

- Anchors must be deployed in different heights the more difference the better. For example top-bottom placement in diagonal. Do not place anchors below 30 cm over the floor. Placing anchors very close to ground may attenuate signal.

- For 3D location, cubic anchors deployment should be chosen.
# Related Reading

<table>
<thead>
<tr>
<th>Document</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>StartingGuide_SewioRTLSKit.pdf</td>
<td>Initial installation of RTLS</td>
</tr>
<tr>
<td>Sensmap_Server_API_datasheet.pdf</td>
<td>API interface description</td>
</tr>
<tr>
<td>RTLS_Server_datasheet.pdf</td>
<td>RTLS server settings</td>
</tr>
<tr>
<td>Tag_datasheet.pdf</td>
<td>Hardware, firmware settings description</td>
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<tr>
<td>Anchor_datasheet.pdf</td>
<td>Hardware, firmware settings description</td>
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</table>

Sewio does not guarantee, or assume any responsibility or liability for, the accuracy of RTLS products since the accuracy and precision is parameter affected by the customer's environment and optimization of installation. Furthermore, injuries and interferences caused by radio signal emission are in full responsibility of the customer, who agrees to operate with the RTLS product in such manner not to cause any above mentioned issues. Customer use of any information presented by Sewio as voluntary information and his reliance on this information is at customer’s own risk.