Guide to Exafore Horizon Deployment

Overview

Exafore Horizon is a Real-Time Locating System (RTLS) consisting of stationary devices (base stations) and mobile devices (tags), which use Ultra-Wideband (UWB) radio technology for transporting data and making distance measurements between each other. It can be deployed flexibly since, after an initial deployment, more devices can be added or removed later – one or more at a time.

Deploying an Exafore Horizon system consists of the following key steps:

- Planning the deployment
- Installing base stations in the planned locations
- Installing EXL server software
- Configuring UWB Express
- Configuring the system through an EXL server
- Verifying system operation by testing

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A key tool for commissioning the system is a multi-purpose Android GUI application called UWB Express. It can be used for all phases of system commissioning: configuration, control, visualization, and testing. It should be installed on at least one Android tablet. It is delivered as a single APK file which, once downloaded onto the tablet file system, can be installed in the usual way.

Planning

A key task in planning is to determine how many base stations will be needed and where they will be installed. Base station locations ultimately define the positioning coverage area and affect positioning accuracy and robustness, so they should be selected accordingly.

The base stations have a master/slave architecture. Typically, there are multiple slave base stations per master. Each slave delivers data to its master over UWB, and each master delivers the data through its Ethernet connector to the server over local area network (LAN). Consequently, only master base stations need to be connected to LAN, minimizing cabling need. Part of the planning therefore is to define which base stations will be masters, which slaves will be tied to which master, and consequently what Ethernet cabling will be needed.

The power supply arrangement for each base station also needs to be planned: each station can be powered through either USB or PoE.

Finally, a local coordinate system needs to be defined. In practice, the origin and the orientation of the coordinate system need to be selected. Since Z axis is always up (in reference to gravitation) and the coordinate system is orthogonal and right-handed, it is sufficient to define the orientation of either the X or Y axis. In a typical setup the origin is at a corner of a building or room, and both X and Y axes are oriented along some walls.

Installing Base Stations

By default, base stations are configured as slaves, so each device selected to be a master should first be configured with UWB Express to be a master. Masters are to be connected to LAN and by default their IP addresses will be set using DHCP. If a static IP address is desired, it can be configured with UWB Express.

Base stations should then be installed in the planned locations, their cabling (USB and/or Ethernet) installed and connected, and the red power LED of each station checked to verify power supply. Ethernet connection LEDs on each master should be checked for the "link up" condition. Base stations can be installed in any orientation, making installing them easy compared to systems based on angle measurements, such as angle-of-arrival (AoA) systems.

Finally, the X, Y and Z coordinates of each base station should be measured in relation to the chosen origin and orientation of the local coordinate system. This can be done, e.g., by using a laser distance measure.

No RF fingerprinting is required during installation or when the radio environment changes, as the positioning method used by Exafore Horizon is not based on fingerprinting.

Installing EXL Server Software

EXL is the Exafore Horizon positioning system server software running on a Linux PC. Most of the system operations and output data feed can be accessed by communicating with the EXL server using the EXACT API protocol, but some system maintenance and configuration operations require logging in to the server with a remote terminal.

There is one EXL server in each system installation. The EXL server communicates with all master base stations in the system and provides a single point of connection to a user cloud or other server(s) using the EXACT API. The system operation does not depend on access to the Internet or any computational service beyond the EXL server, and a self-contained installation on a single site with no external network connections is therefore feasible.

EXL is delivered as a single .deb file and can be installed in the normal fashion by using a Linux installation package utility.

Configuring UWB Express

Once the EXL server details, such as server address, have been provided, UWB Express connects to EXL over the network and controls it through its API. For visualizing the actual building floorplan of the coverage area, a bitmap image of the floorplan needs to be configured into UWB Express. Adding the floorplan image can be omitted if desired; UWB Express will then visualize tag positions etc. against a white background. The configuring entails specifying the orientation, scaling and origin for the image. If the positioning area has multiple floors, a separate floorplan image can be added for each floor.

Configuring the System

Each base station and tag has a unique ID printed on it, and can be added to the system with UWB Express using the ID. Base station coordinates measured during installation need to be included, as well as master base station IP addresses. Additional information, such as human-readable descriptions on base stations and tags, can also be added. Finally, system-level configuration elements such as mapping between local and global coordinate systems can be defined. Such configuration elements are optional and can be omitted if desired.

Once everything has been configured, a restart command should be issued to EXL using UWB Express to reset the state of the system. UWB Express will automatically reconnect to EXL after the restart.

After this, the system is ready for the final step of deployment – testing operation.

Verifying System Operation

The first step of system verification is to check the network connection between the EXL server and each master base station using a ping command issued through an SSH connection to the server.

A tag with a charged battery can then be used to verify that each base station can provide range measurements. The tag should be moved within the system coverage area so that it is within communication range to each base station at least at some point. UWB Express can be used to check which base stations can provide measurements at any given time, and it can also visualize the measurement result as a circle around each base station in the floorplan.

Once it has been established that all base stations are operational and can provide range measurements, the positioning performance should be verified by moving a tag around coverage area and monitoring positioning results for accuracy and availability. Once that has been successfully done, the system is ready for production use.

Summary

Exafore Horizon can be deployed in a straightforward manner using the tools and documentation provided in the delivery package, as outlined above. It can be laid out and set up flexibly to cover complex environments where indoor positioning is needed, and the installation can be augmented later with more base stations and tags when desired.