Series 500 Deployment Guide

Chris Higgins

RM010_Deployment_1.0
Revision 1.0
25 April 2013

Omnisense Ltd.
3rd Floor, St Andrew's House
59 St Andrew's Street
Cambridge
Cambridgeshire
CB2 3BZ
http://www.omnisense.co.uk/
Tel: +44 (0)1223 651390

Table of Contents

Revision History

Version	Date	Author	Notes
0.1	3/04/13	CH	Draft for review
0.2	17/04/13	AT	Internal review
1.0	25/04/13	CH	First Release

1 Introduction

Omnisense's series 500 is easy to deploy but there is some thinking to be done and a few tasks to undertake in order to make the deployment truly effective in your environment. This document guides you through the basic mathematical understanding, the system configuration process and some case studies of other deployments.

2 The coordinate system

The Omnisense system can compute positions with no configuration. The positions of the devices will make sense *relatively* but the coordinate space they are computed in will be arbitrary: rotated and translated when compared with the real world in ways that are not easy to picture.

To make the computed positions relate to the environment we must *fix* the positions of some devices. "Fixing the position" implies that the device is put in that position and does not move *and* that we inform the system of its location.

To define a coordinate system for a three dimensional space, we must fix the positions of at least four devices. You can picture this as one for each of the three axes and one for the origin. In practice we fix as many devices as are needed for coverage of the area.

How do you decide how to orient the coordinate system within your environment? There will be many possible ways of doing so and none will necessarily be best or even better than another. A good general answer to the question though is choose an orientation that will minimise your effort in determining fixed positions.

For example, indoors, where fixed devices may attach to walls, placing the origin also on a wall or better in a corner in many cases eases the measurement of fixed device locations. Outdoors, placing the origin in the middle of a space may make sense, but looking for a suitable marker such as line of lampposts or another wall may help.

Once you have chosen an origin you must orient the coordinate system correctly from it. Use a *right-handed coordinate system:*
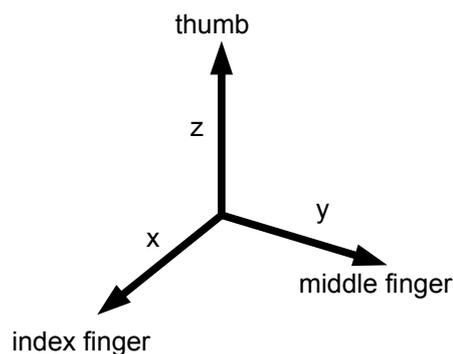
The index finger points along the x-axis. Your middle finger is bent in towards the palm of your hand and forms the y-axis. Your thumb points away from them and gives the z direction.

This says how to place the x, y and z axes relative to each other; you still get to decide where to fix it in space and how to orient it.

3 Fixing the locations of devices

Once you have decided where to put the fixed devices, and also decided the extent of the zones in your environment you can configure the system with this information using the system's web pages. Browse to the PC's IP address on port 8000 and click on "Config" to bring up the configuration page.

To browse to port 8000, on a computer whose IP address is 192.168.0.1 type "http://192.168.0.1:8000" into the address bar of your browser.

3.1 Device Configuration

You can give a device a name and a fixed position and say whether to report its position. The name and position are optional. Clicking on a row opens up a form to configure a device, as shown below.

Devices

Id	Name	X	Y	Z	Report position
ce0000c9					yes
ce0000b3					yes
ce000087					yes
ce000062	gateway				yes
ce0000b4					yes
ce0000bf					yes
ce0000a7					yes
ce0000b6					yes
ce0000a5					yes
ce0000a9					yes
ce00009c					yes
ce00008a					yes
ce00009a					yes

ce000062

Name	gateway	Same (x,y,z) as	[▼]
X		Swap (x,y,z) with	[▼]
Y			
Z		Report position	☑

save cancel

Zone Configuration

Zones

Zone	Id	Bottom left			Top right		
Dining Room	2	0.000	0.000	0.000	5.000	5.000	2.500
Garden	3	5.000	0.000	0.000	10.000	5.000	10.000
Bedroom	1	0.000	0.000	2.500	5.000	5.000	5.000

Click on a row to configure a zone.

Click to add a new zone: add zone

Name	Garden	Id	3

Bottom Left

		Top right	
X	10.000	X	15.000
Y	5.000	Y	15.000
Z	0.000	Z	10.000

submit   cancel   delete Garden   add as new region

Zones are configured as a union of *regions*. Regions are simply boxes defined by a bottom-left point and a top-right point on the X-Y plane. The figure above shows a new region of the Garden zone being added.

Clicking on a row of the table allows a zone to be updated or a new region added to the same zone. To create a new zone use the "add zone" button.

3.2 Background images

You can upload an image and then select it to be used as the background in some of the diagnostic tool windows.

Image

You can set an image to use as the background in some of the graphical display windows.

Current image: **None**

Select an image to use ▼ use

Upload an image Choose File No file chosen   upload

"Choose File" selects a file on your local machine, and the upload button transfers it to the Omnisense PC. Once you have uploaded and image select it and click "use" to make it the current image.

To make the image appear on the position display you also need to define a zone called "map". The image is displayed within this zone.

3.3 Position Reporting

Position Reporting

Id	Name	Report position
ce0000c9		☑
ce0000b3		☑
ce000087		☑
ce000062	gateway	☑
ce0000b4		☑
ce0000bf		☑
ce0000a7		☑
ce0000b6		☑
ce0000a5		☑
ce0000a9		☑
ce00009c		☑
ce00008a		☑
ce00009a		☑

save changes

Choose any devices that have their computed position reported.

You can turn position reporting on or off using the devices table but the position reporting table allows it to be done for several devices together, which may a bit faster. This affects how the graphics output will plot the devices (solid colour for locatable sensors) as described in the RM011 (Player Tools Reference Manual).

3.4 Configuring a Server IP Address

The Omnisense software listens for client connections (on port 1234) but it can also be configured to connect to a server.

Server IP address

The IP address of a server to connect and send location output to:

Server IP address [   ] Server port [   ] change server address

If the server IP address and port are set the location engine will poll it for a connection. If the connection is dropped, the location engine will try to reconnect.

4 Restart the System after Making Config Changes

Changes to config do *not* take effect until the system is restarted.

5 Deployment Hints

The Omnisense Cluster Geolocation System is unique in the ease with which it can be started to provide locations straight out of the box, however it is a radio system which by its nature is affected by the environment in which it is deployed.

This section contains a checklist of some basic information intended to help optimise the performance of your relative positioning system.

5.1 Radio propagation

Picture a device attached to a thick wall. Now try to visualise what happens to the radio signals broadcast by the device.

Backwards through the thick wall the signal is heavily blocked, and may disappear entirely.

Forwards the signal propagates in all directions, reaching out to all parts, going around some obstacles, being blocked by others, rebounding off others, until eventually losing all energy.

This is the coverage area of the device, the area in which it may potentially participate in radio signal measurement.

Not all walls completely block signals of course. The amount of energy that is lost depends on the construction of the walls. Interior walls of a building are usually easily passed through whereas the more solidly constructed exterior walls cause more of a problem.

For some materials the signal penetrates but starts to lose energy. For other materials, the signal is reflected. Metal structures are common sources of reflection. Try to avoid placing devices on or close to metal structures.

5.2 Geometry

Good geometry plays a key role in how well the positioning system performs. By "geometry" we mean the dispersal of the fixed devices relative to a mobile device we are positioning. If the mobile device is surrounded by fixed devices we stand a better chance of getting good positions than if all of the fixed devices are to one side of the mobile.

For example, some number of fixed devices will be placed on the outer boundary of the covered area. If mobile devices go outside of this area and move away, the positions will get steadily poorer.

Inside the boundary area we aim to evenly distriute the fixed devices so as to achieve the best possible geometry no matter where inside the boundary a mobile device wanders.

Remember that Omnisense's system is a full 3-D positioning system so geometry includes the third dimension. To get the best possible radio coverage from a fixed device it is often best to place it high above the desired area, especially outdoors. Even so, try to put fixed devices at a variety of heights.

It is often not possible to place devices at ground level as their transmissions and reception would be interrupted.

Geometry and coverage (see next section) can sometimes conflict. If in doubt prefer to optimise your coverage.

5.3 Coverage

Try to devise an even spread of the fixed devices throughout your deployment area. Typically this

will entail a number of them spanning the outer boundary of the area covered, and others spread within the area.

Some deployments, such as buildings, may only have boundary devices as there are no reasonable interior candidate locations or they are simply not needed. Other buildings have internal corridors and stairwells where coverage may be needed.

On a large area deployment if boundary devices cannot cannot reach back across the area to the coordinator node then another device must be placed in between. This will be either because of attenuation through walls or other obstructions or because there is large (100 metres plus) distance between perimeter devices.

This will typically happen quite naturally as you deploy devices around your covered area. But if no data is being received from a device it may be that it cannot communicate with the rest of the system.

5.4 Line of Sight

One should attempt to deploy with good sight lines between fixed devices. For example along a long flat wall with a protruding beam it is better to offset slightly onto an adjacent wall so that devices get as direct as possible a view of their neighbours.

This rule of thumb should be applied even through a wall or a floor. For example in the illustration below if 2 identical networks were deployed in parallel in a building (red devices and green devices) it can be seen that there are more blocked paths among the red devices than the green ones, resulting in the expectation of better performance from the green network. This network will exhibit more direct rather than bounced (indirect) signal paths.
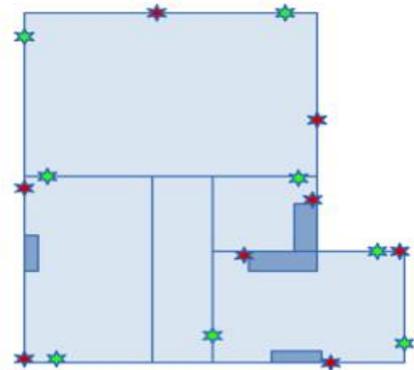
5.5 Movement

Data from the accelerometer within the mobile devices is used as part of the location engine solution, and so it can sometimes be helpful to move devices (give them a jolt) if other devices around them have been moved and they appear to have lingered. This may be helpful after, for example, a change of fixed device positions during a demonstration of the product.

5.6 Configuration

Don't forget to restart after making a configuration change. Give mobile devices a minute or two to settle after a restart.

Define a landscape rather than portrait orientation, as this will make the best use of screen space when viewing position plots.

If you have zones that contain other zones (e.g. a whole building, which contains a number of floors and then rooms), then the sequence in which the zones are defined is significant. Outer zones should be defined first (with lower "id" numbers) and inner zones last. Otherwise the zone output will only contain the outer zones.