

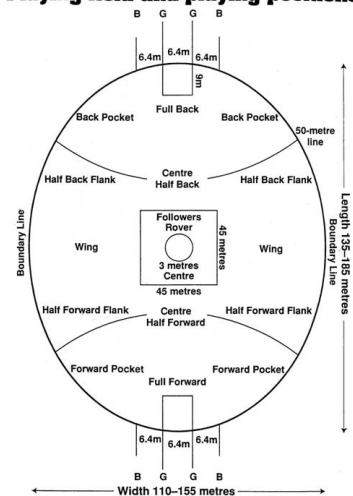
**UWB** (ultra wideband), **LPS** (local positioning system)  
radio **tracking of the ball** at sub 10 cm accuracy, in 3D

### installation examples



Stadium system: 12 UWB horn antenna  
 Covered field size for stadium: Sydney 200×160m  
 Covered field size for stadium: Melbourne Perth 190×150m

**Playing field and playing positions**

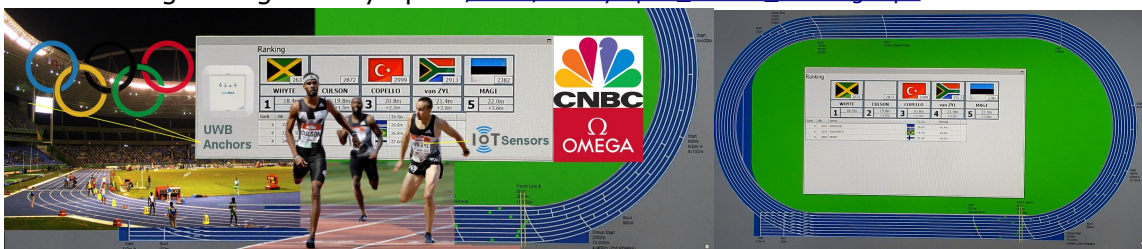


# 1 Background on tracked sportsballs



The UWB tracking sensor is placed at the centre of the ball. The centre is the best position. Placing the UWB radio on the valve causes a significant reduction in range because the radio is then too close to the ground (depending on the ball orientation). Placement of the sensor at the centre ensures the radio transmitter is never too close to the ground.

PURE-openrtds has experience in systems inside a stadium used for real-time broadcast and officiating. See for example the video on real-time tracking accuracy of athletes delivered to Omega for officiating during the Olympics [/video/RIOolympics\\_athlete\\_tracking.mp4](#)



The maximum distance to be covered for stadium use is within the specification of the field and stadium system (WA01, horn Antenna anchor types).

## Tracking accuracy

The real-time tracking accuracy of the sports balls is sub 10cm 1cpk on a 'standard' sports field. Typically below 5cm (idle).

## Production and sales

The tracking system electronics is produced in the Netherlands on a SMT line at AIRTLS bv. Inhouse designed and developed tools produce the patented ball inner structure in factories in india. Sales, workshops and tech demonstrations by Pure LLC, located at Aspire Sport arena, Doha Qatar.

## Installation

anchors are the fixed reference points use to measure distance

Mobile anchors can be placed ad-hoc on the ground and a special algorithm determines the geometry (placement of the anchors as X Y coordinates)

Tags are the object to track and forward the sensor data.

A mobile system is practical for ad-hoc deployment on a training field.

## 2 System

### 2.1

Sport Balls have a centre mounted tag inside + 1 magnetic charge cable.

Tags and Sport Balls have 1 or more internal batteries, a calibrated UWB tracking transceiver, Bluetooth transceiver and IMU (gyro, acc, magneto).









Optional sensors are: pressure sensor, Mox and CO2.

### 2.2 Tracking system

Type		Range [m]
AT-01	Display tag	
FA-02	Mobile Field anchor	up to 100
WA-01	Standard anchor IP67	up to 300
PA-01	PV-Solar powered anchor	up to 300
HA-01	Horn-Anchor	up to 800

Application of tracking system for 3 different environments:

	Anchors	50..150Hz	Tracking 25..50Hz	0.001..1Hz
Stadium	12 Horn antenna	balls	players + referee	assets
Standard sport field	12 PA01 or WA01	balls	players + referee	assets
Mobile system	6 FA02 Mobile anchors	balls	players + referee	assets

Stadium system	Standard field system	Mobile system
	Some light poles are used to mount anchors 	Carry system in backpack. Automatic field deployment 
Installation time: 2 days typically 6 mandays of work	Solar powered anchors reduce cable installation cost	System fits in backpack. Anchors are battery powered
12 Horn antenna	12 WA01 or PA01 (Solar)	6 FA02 Mobile anchors
	 	 

## 2.3 Software system

Features:

- Record tracking and sensor data (example recordings can be downloaded)
- Replay of the trajectory in 3D visualised from any POV (point of view)
- Analyse and 'score' specific exercises and actions.

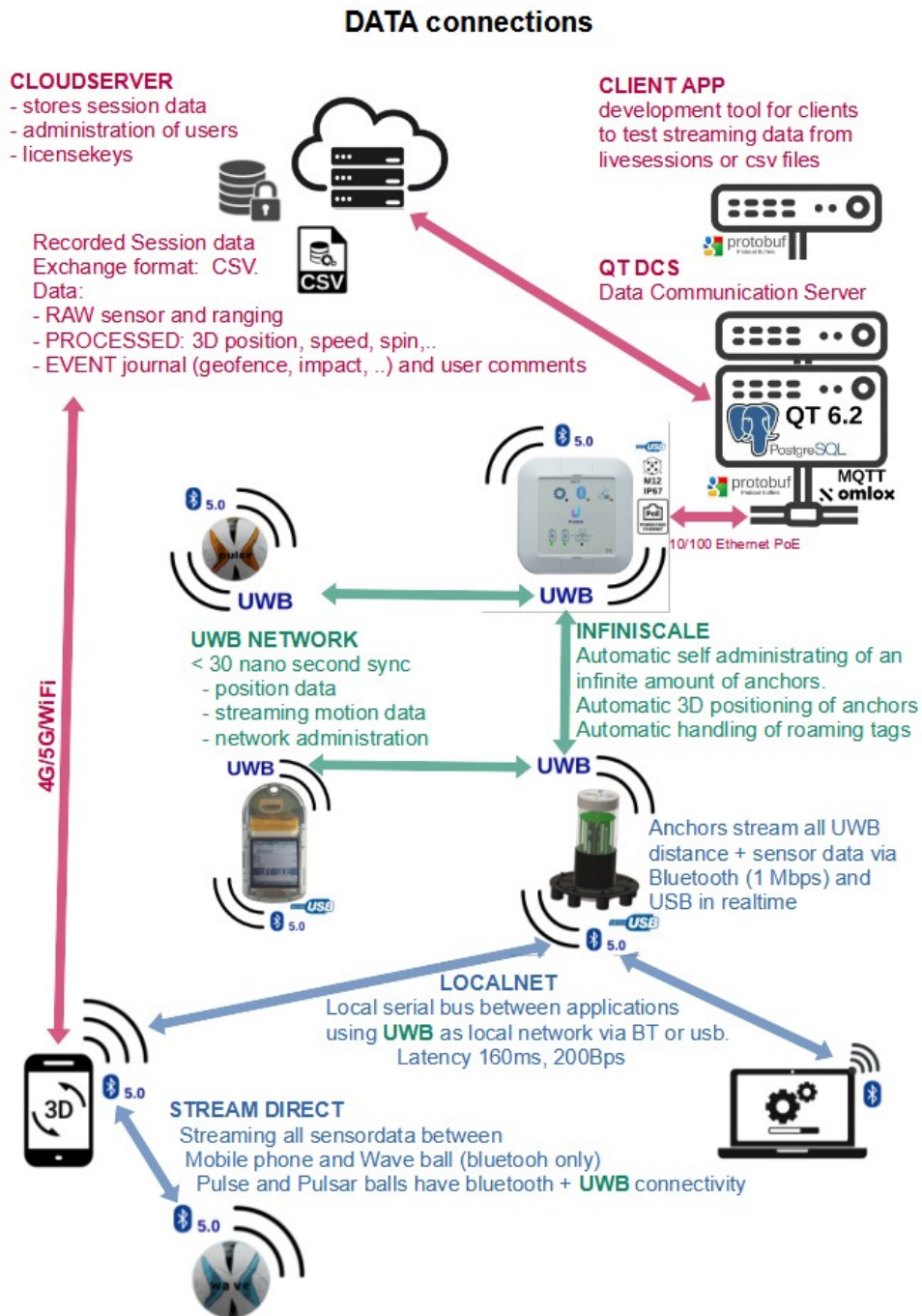
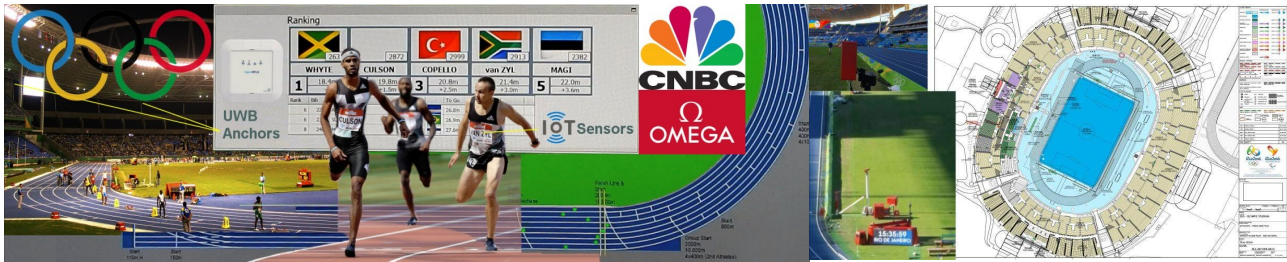


Fig1: Data connection overview

## APPENDIX: References

### RIO Olympics



Stadium	Joao Havelange Olympic Stadium ('Engenhao')
Covered Field Size	200 x 150m
UWB	12 UWB Horn antenna's at stadium ring 1 and ring 2, 2 at ground level (red box)
Tag	behind athletes identifier chest signage
Broadcast	Live televised NBC: worldwide

Video: <https://pure.coach/video/rio.mp4>

### Player tracking varsity games

Max distance anchor to tag and ball 140m



Stadium	Twickenham stadium ('the Home of England Rugby')
Covered Field Size	150 x 100m
UWB	12 UWB Horn antenna at stadium ring (800m range) + 4 WA01 at 'ground' level
Tag	At the back of the athlete
Broadcast	Live televised by Sky
2018	Added ball tracking

### Player tracking Clermont-Ferrand Rugby sevens for sponsor Omega

Max distance anchor to tag and ball 135m



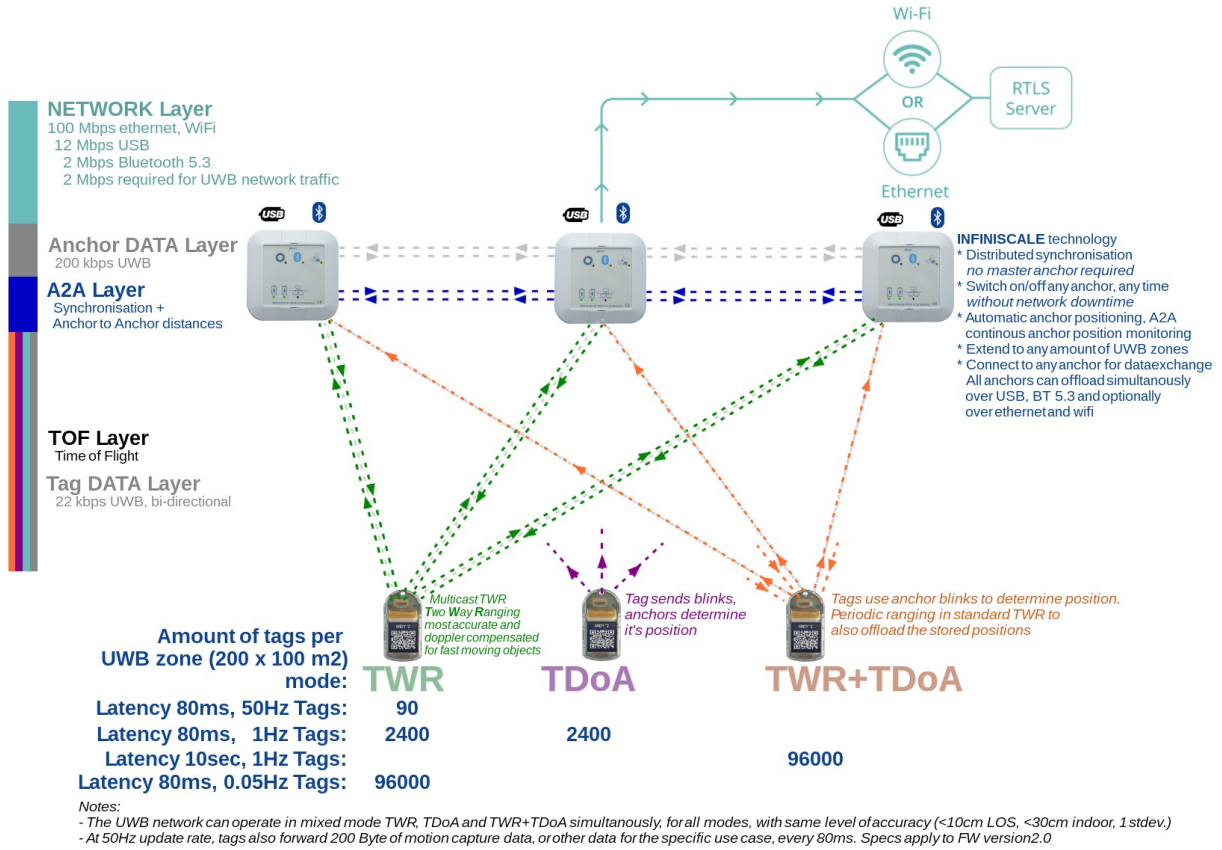
Stadium	Clermont-Ferrand
Covered Field Size	140 x 100m
UWB	4 UWB Horn antenna at 4 corners + 6 WA01 on light poles, 1 at 'ground' level (10/100 offload)

### 2023 EU rugby league tracked UWB ball for Rhino



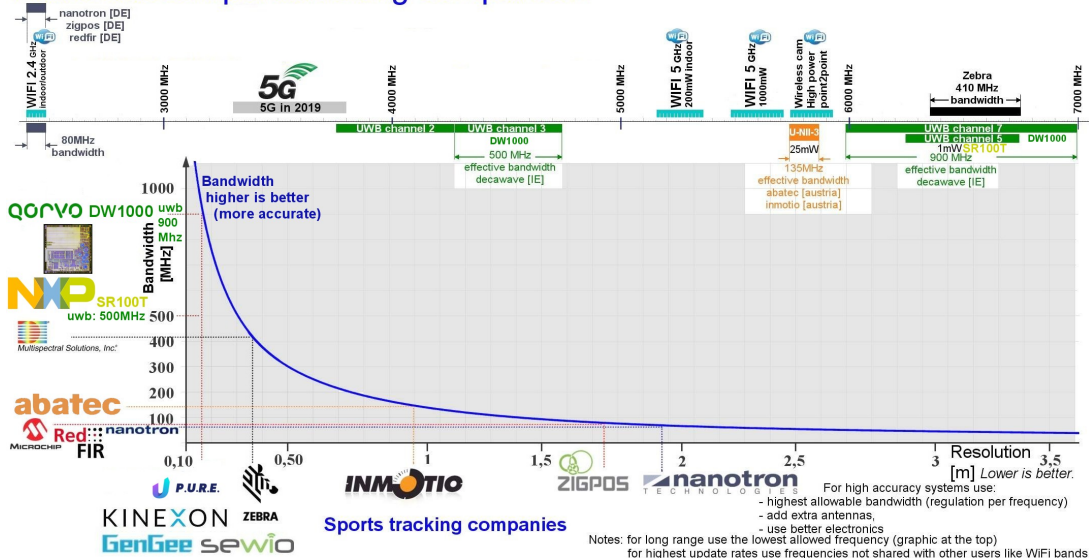
# APPENDIX: SYSTEM CAPACITY

The capacity, range and accuracy of the LPS (local positioning system) firmware version 2.0 Per UWB channel 4600, 3D locates can be processed on 28 anchors. A typical stadium requires 10 to 16 anchors. Fast moving objects like Australian footballs require a fast update rate of 50 positions per second or higher. Typically 150 to 200Hz. As an example with 4600 locates/sec, 30 balls can be tracked with a 150 Hz update rate in 3D.

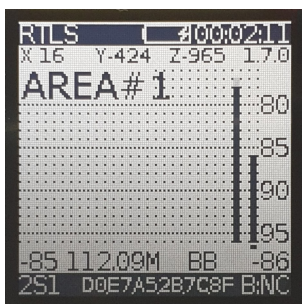


The DW1000 UWB transceiver from Qorvo is used. DW1000 chipset provide high accuracy and high data bandwidth (6.8Mbps) outside crowded wifi bands. Most tracking oem use DW1000 in basic configuration or in advanced applications with additional RF electronics to increase range en sensitivity to boost performance. For an overview see: [hightecinsport.com](http://hightecinsport.com)

## Radio based sporttracking comparison



## APPENDIX: TAG



Display used as a UWB network analyser.

MIP: memory in pixel  
Power consumption 25uW  
Direct Sunlight



To allocate tag to an athlete scan the QR code.

**Name** of the person (9 char)  
Unique **mac-address**

**ANDY '2** (UTF-8 charset)  
**D0:E7:A5:2B:7C:8F**



Referee receives message on display 'OFF-SIDE' Haptic vibration motor (optional) is activated to alert the referee

**APPENDIX:**

ANCHOR WA01

**SPECIFICATION**

nRF52840  
 UWB channel 2,3 and 5  
 Bluetooth 5.3 +8dBm

Standard range: up to 300m

**Connectivity:**

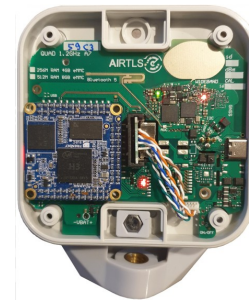
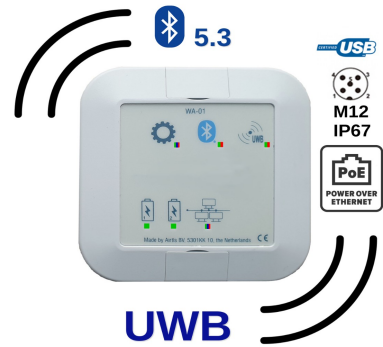
M12 connector, IP67 rated  
 4.5..28VDC power input  
 USB 12MBps

**Optional features.**

PoE 2.5 Watt. 2kV isolated, power supply. A & B compliant  
 Ethernet (requires linux SOM to be installed)

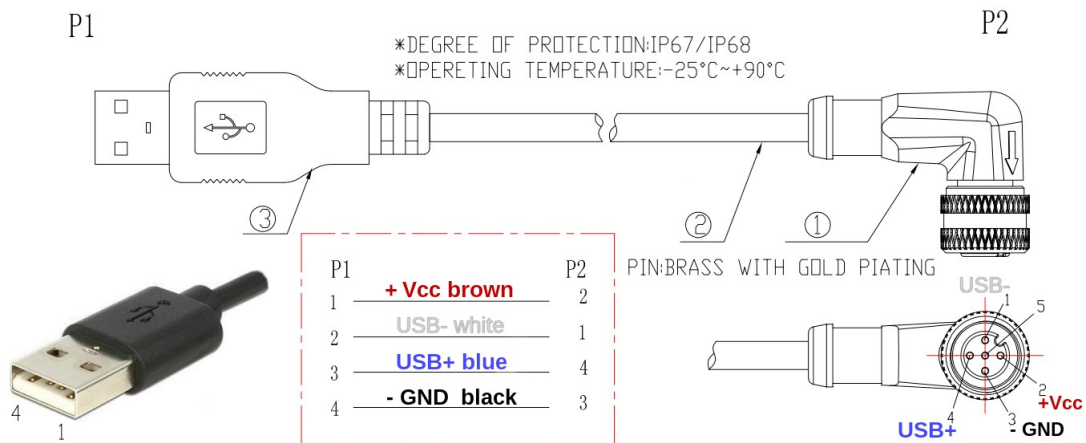
**Optional items:**

3/8" UNC bracket  
 Quad-core 1.2GHz H7 linux board, 10/100 ethernet



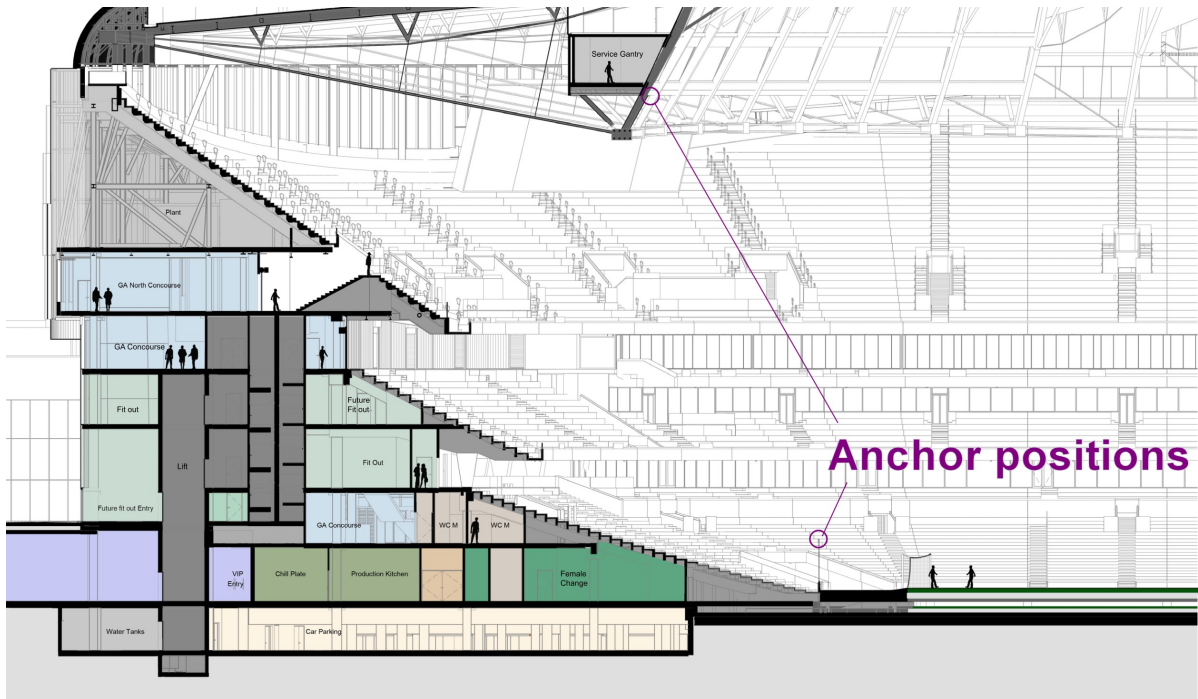
**M12 Cable:**

USB<>M12 length 1.8m  
 M12<>M12 length 4, 8, 12, 20m  
 M12 splitter to M12-male, M12-female





## APPENDIX: Stadium system



## CONTACT DETAILS



**AIRTLs Sport**  
Koxkampseweg 10  
5301 KK  
Zaltbommel, The Netherlands  
info@airtls.com, 06 28349948