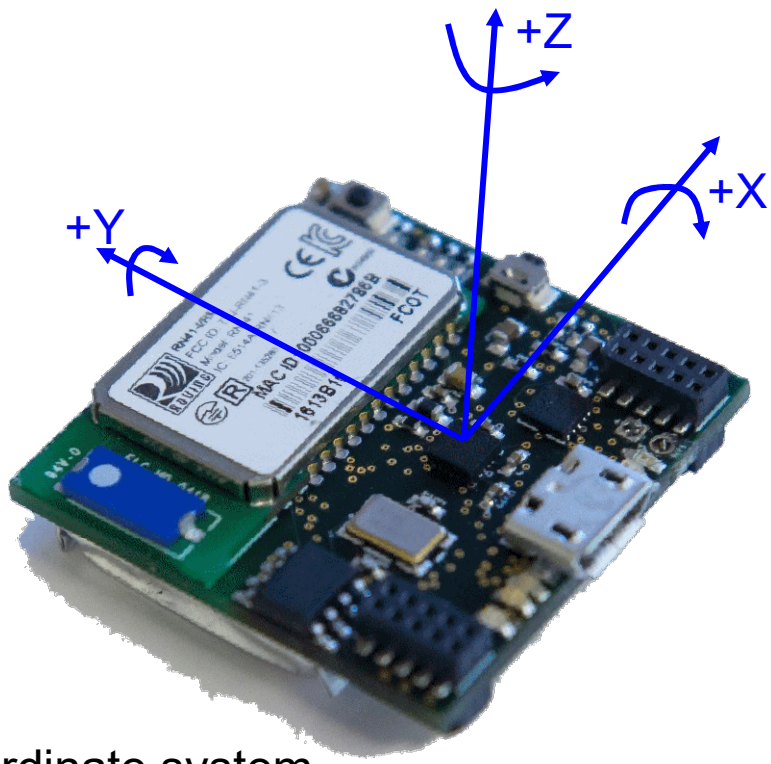
Sensor-fixed coordinate system (S)

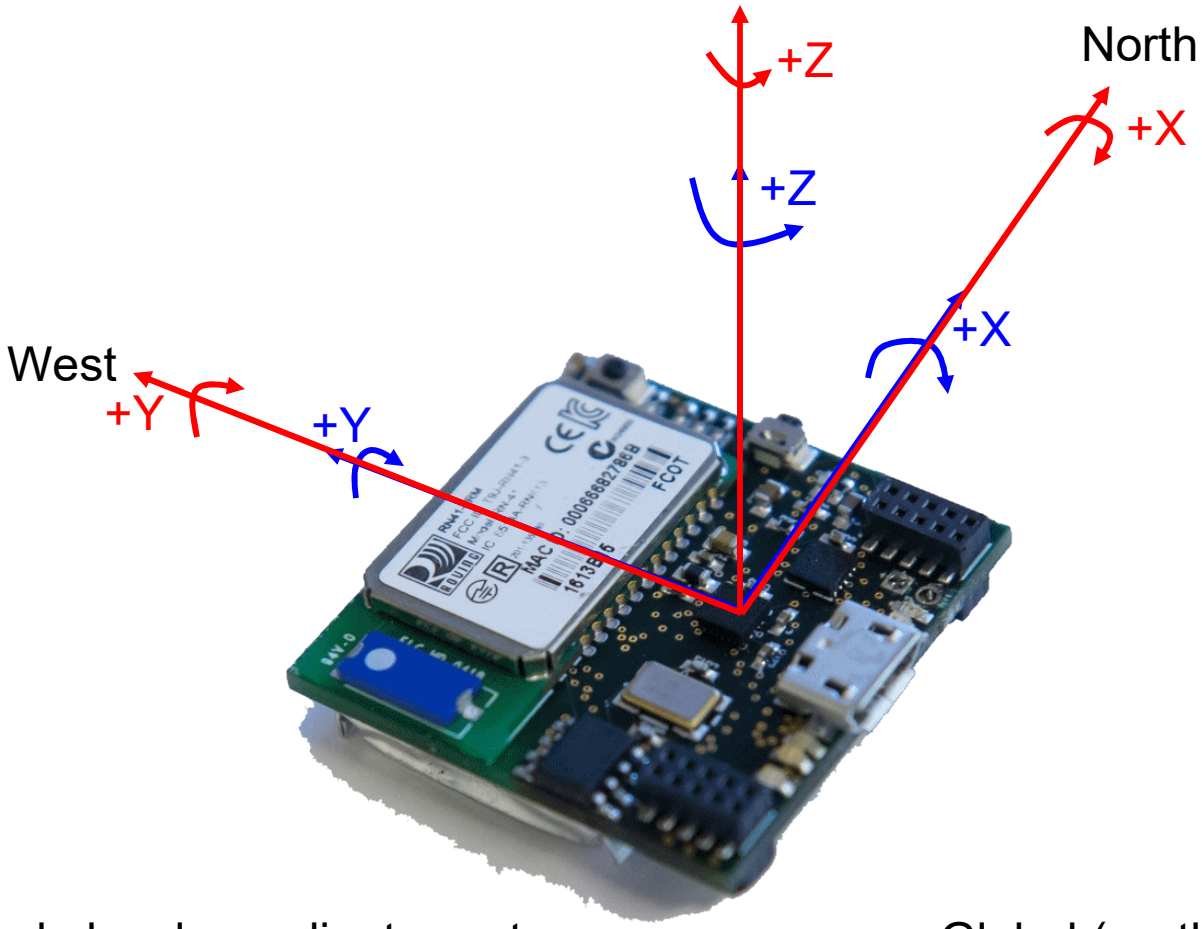
- Output of node's accelerometer, gyroscope verified to follow this convention
- Sensor coordinate system is right hand



Node local coordinate system

Earth-fixed coordinate system (G)

- Global coordinate system is right hand
- Node represented in the "zero" position (yaw=0, pitch=0, roll=0)

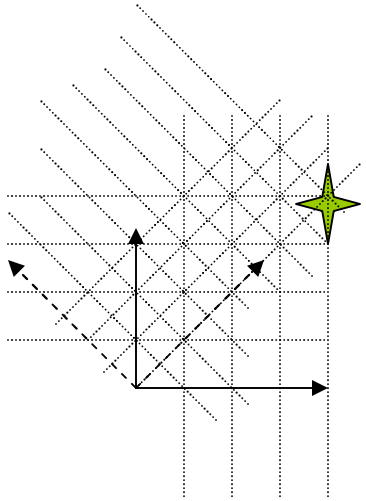


Node local coordinate system

Global (earth) coordinate system

Representation of rotations

- BlueSense reports the orientation of the sensor-fixed coordinate system (S) with respect to the earth-fixed coordinate system (G)
- The orientation is represented by a quaternion $q_{S \leftarrow G}$
- The quaternion $q_{S \leftarrow G}$ can be used to rotate a vector represented in earth-coordinates G into sensor-coordinates S

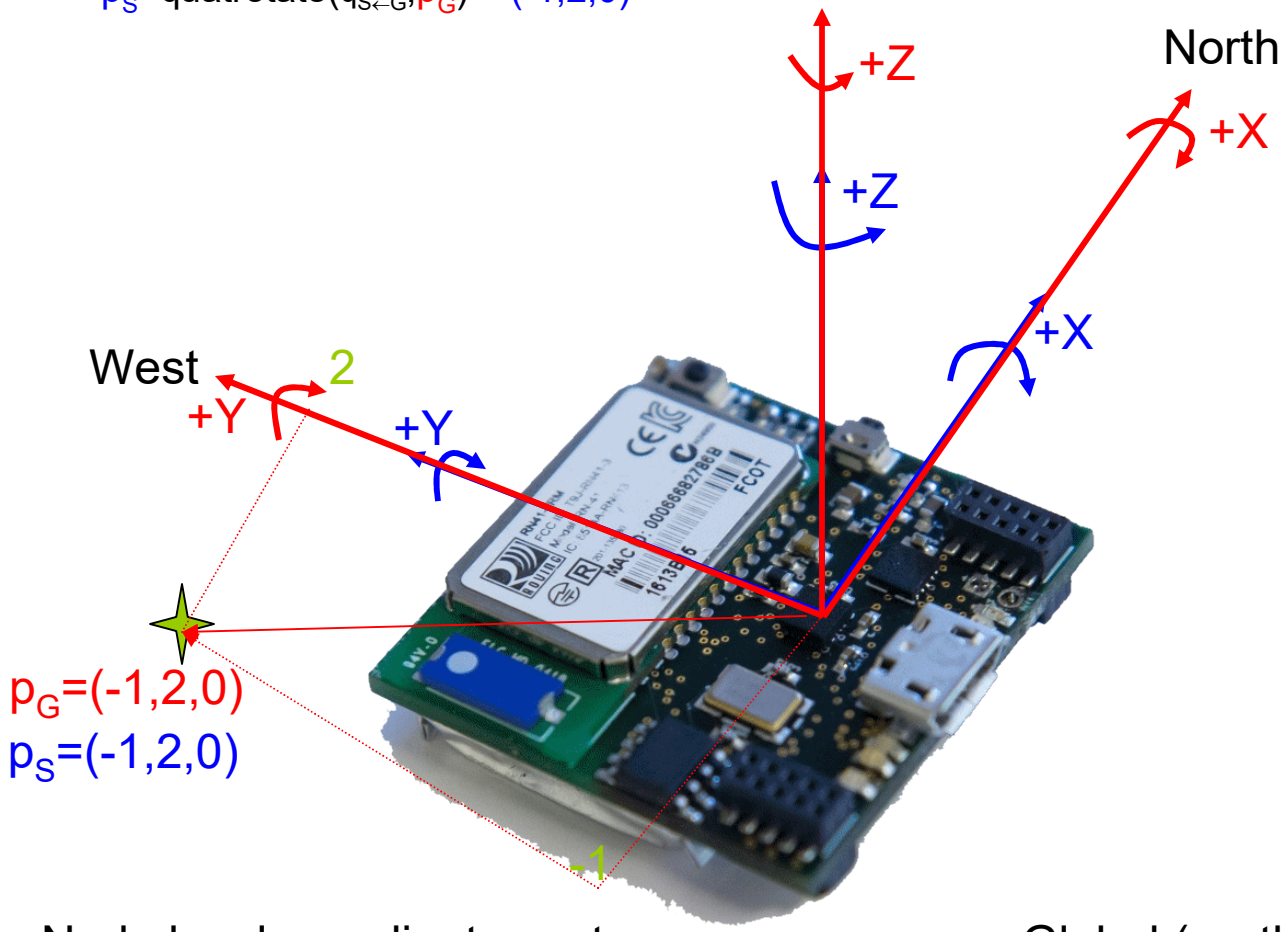


Initial sensor coordinate system
Star local coordinates ~(4,4,0)

New sensor coordinate system
Star local coordinates ~(8,0,0)

Earth-fixed (G) to sensor-fixed (S) mapping

- Application: finding local coordinates of a target provided by its absolute coordinates
- Example: star at coordinate p_G=(-1,2,0) in the earth-fixed (G) coordinate system
  - As the node is in the zero position, the star coordinate is also (-1,2,0) in the sensor-fixed coordinate system.
  - $q_{S \leftarrow G}$ = (1,0,0,0)
  - p_S=quatrotate($q_{S \leftarrow G}$,p_G) = (-1,2,0)

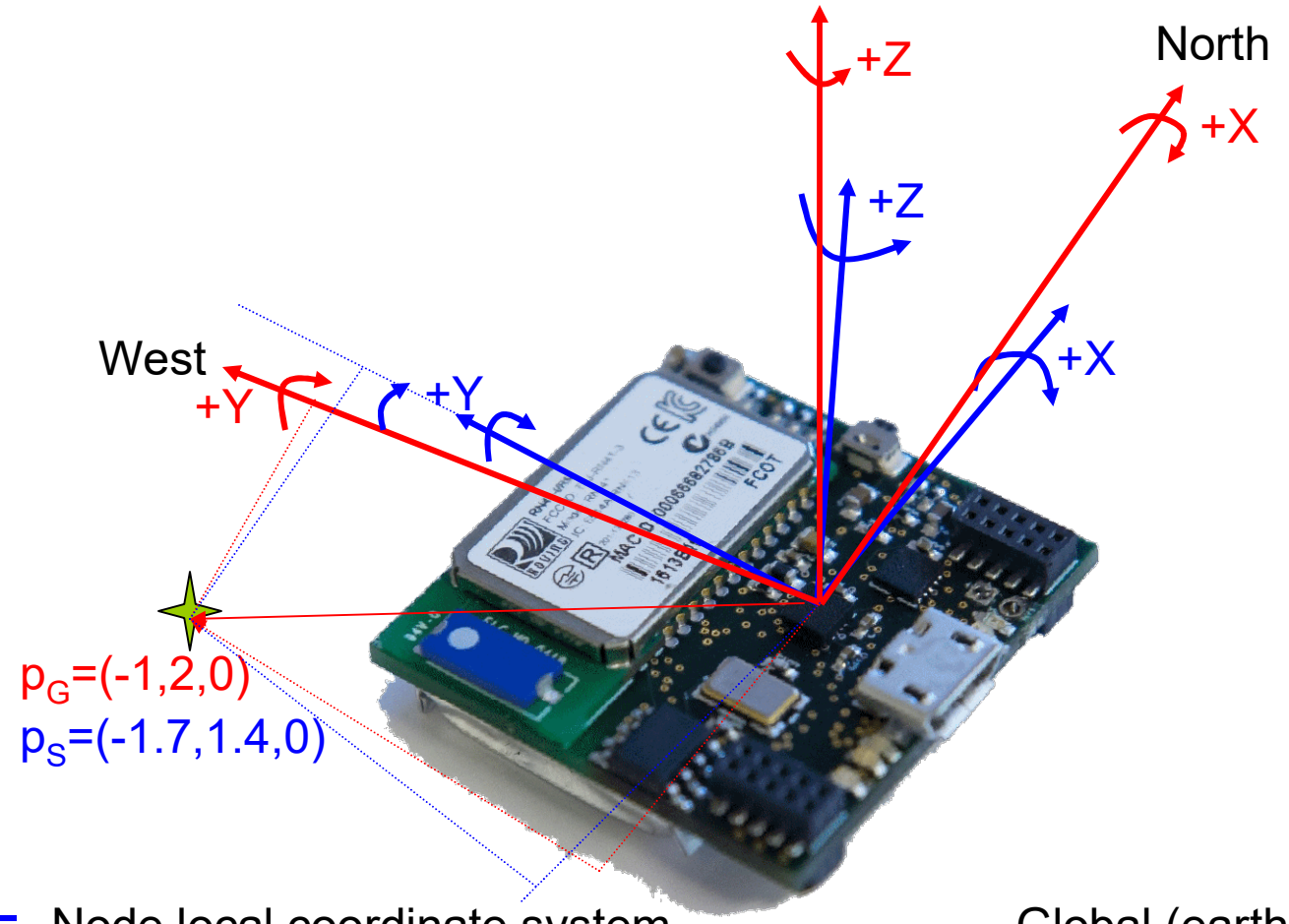


Node local coordinate system

Global (earth) coordinate system

Earth-fixed (G) to sensor-fixed (S) mapping

- The sensor rotates by ~-20° along the Z axis
  - $q_{S \leftarrow G}$ = (+.98, 0, 0, -.2)
  - p_S=quatrotate($q_{S \leftarrow G}$,p_G) = (-1.7, 1.4, 0)

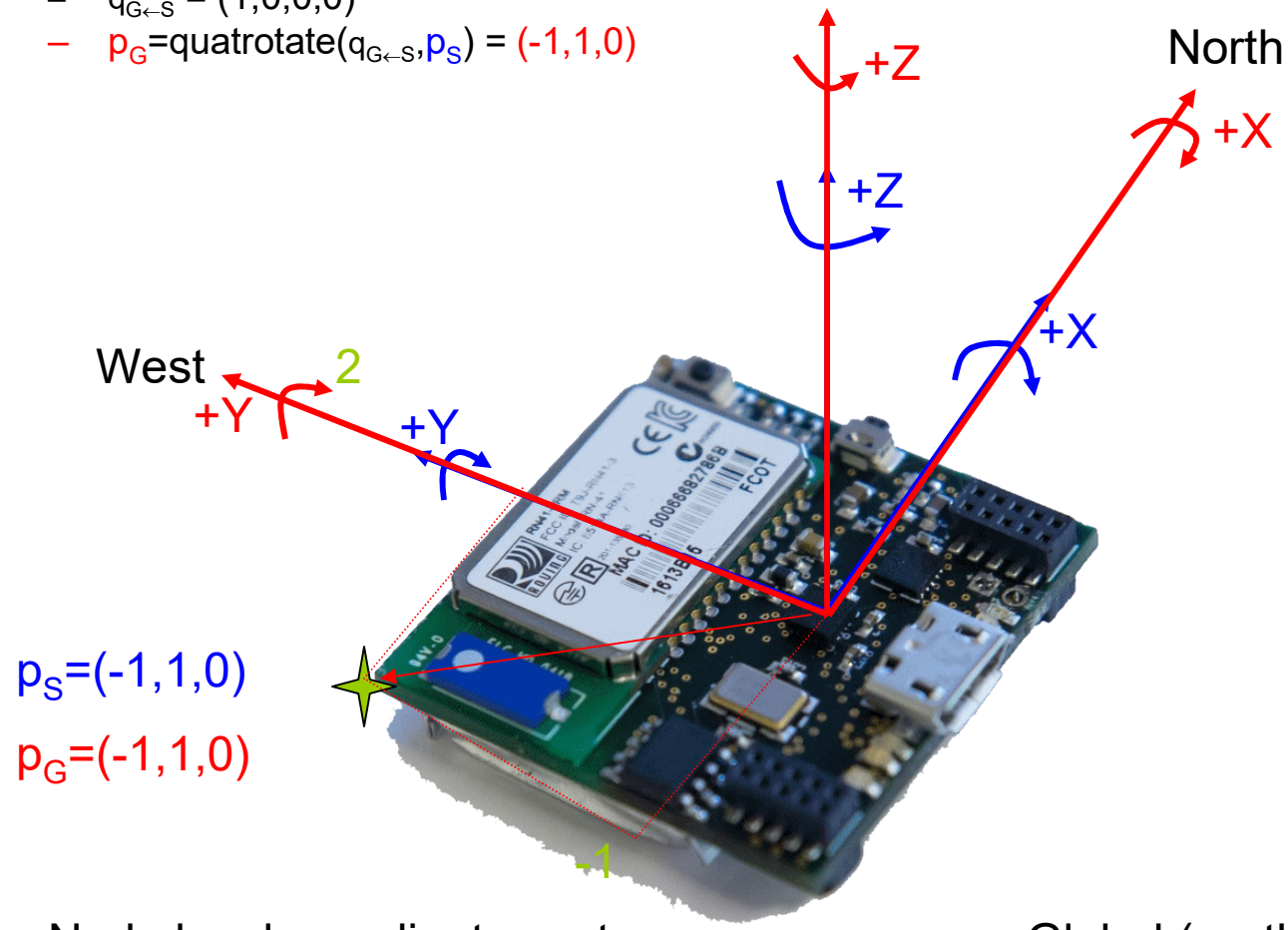


Node local coordinate system

Global (earth) coordinate system

Sensor-fixed (S) to earth-fixed (G) mapping

- Application: find earth coordinates of a target located in sensor coordinates; rendering
- Example: rendering of the edge of the node at coordinate p_S=(-1,1,0) in the sensor-fixed (S) coordinate system
  - As the node is in the zero position, the star coordinate is also (-1,1,0) in the earth-fixed coordinate system.
  - $q_{G\leftarrow S}$ = (1,0,0,0)
  - p_G=quatrotate($q_{G\leftarrow S}$,p_S) = (-1,1,0)

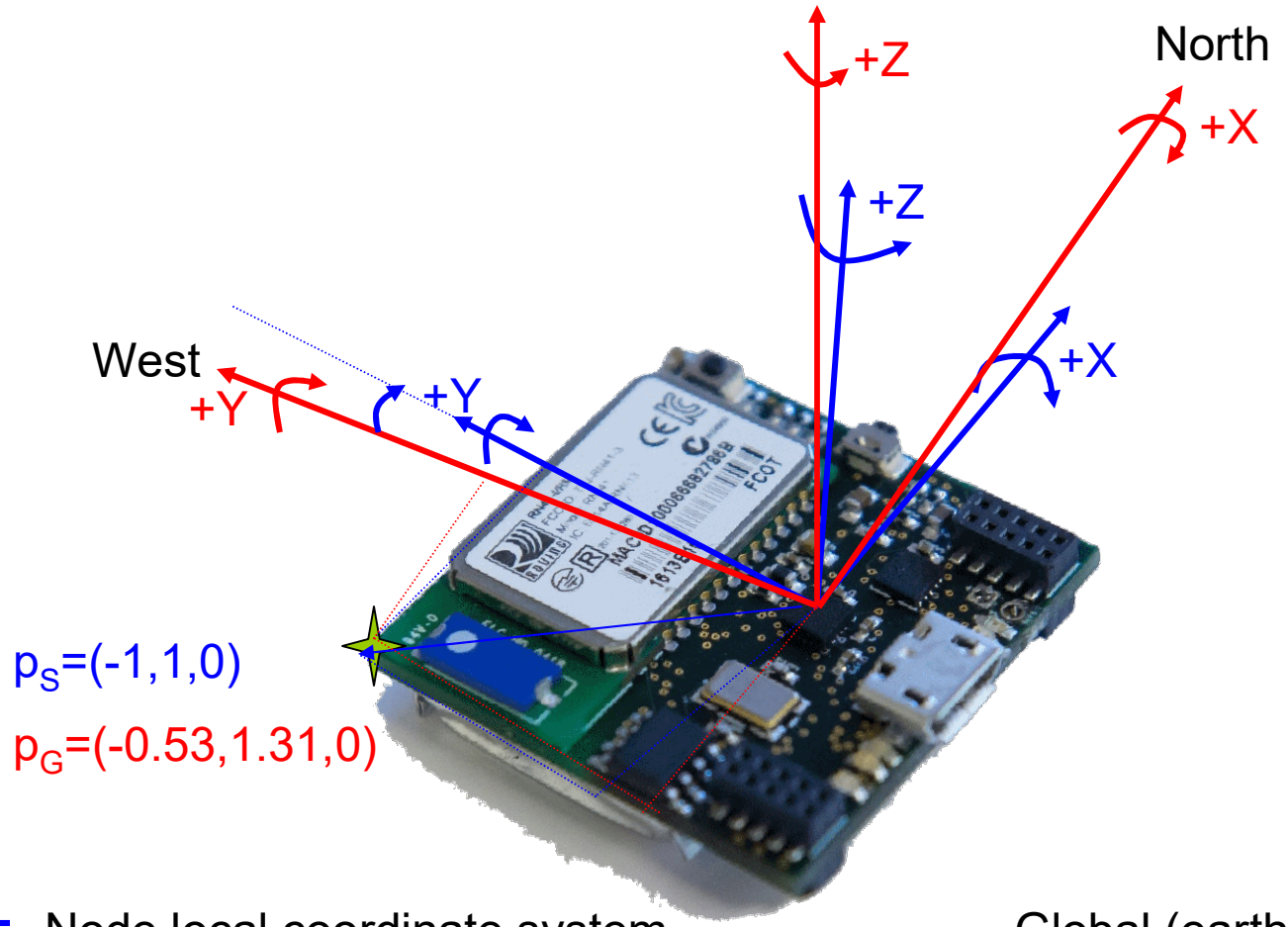


Node local coordinate system

Global (earth) coordinate system

Sensor-fixed (S) to earth-fixed (G) mapping

- The sensor rotates by ~-20° along the Z axis
  - $q_{S \leftarrow G}$ = (+.98, 0, 0, -.2) — Provided by the sensor
  - $q_{G \leftarrow S} = q_{S \leftarrow G}'$=(0.98, 0, 0, +.2) — Complex conjugate
  - p_G=quatrotate($q_{G \leftarrow S}$,p_S) = (-0.53, 1.31, 0)



Node local coordinate system

Global (earth) coordinate system