



# Speedway® Reader FAQ

## UHF Gen 2 Tag Direction Detection

### Sensing Tag Direction

Impinj's Speedway® reader Octane™ 3.0 firmware includes an innovative new feature—the ability to determine a tag's direction of travel—and without expensive, special-purpose hardware. Using any conforming UHF Gen 2 tag, off-the-shelf reader antennas, and our Speedway reader, Impinj's proprietary tag directionality capability reports results in less than a second via an LLRP (low level reader protocol) response message—without having prior knowledge of particular EPC tag types, and even when multiple items are moving in opposite directions through the antenna field.<sup>1,2</sup>

#### 1. Why is tag direction data important?

Having knowledge about which direction a tag is traveling provides middleware and application software vendors with added data confidence by verifying that read tags are attached to valid, delivered items, and are not simply stray reads. For example, the reliable reporting of a tag's direction of travel can provide useful additional information at:

- restricted entry doors—direction of travel information adds security for items or documents with restricted access
- the back store to front store transition—direction of travel will help determine whether or not the item has been brought out to the store shelves, or returned to inventory
- the front door—direction of travel may be used to determine if items are entering a store as a customer return or exiting a store as an unpaid items, reducing store inventory shrinkage.

#### 2. How many tags can the algorithm detect simultaneously?

Impinj designed and optimized the tag direction algorithm for use in situations where less than fifteen tags pass through the antenna field at a time. This number will increase in future versions of the algorithm.

#### 3. How do I access the tag direction feature?

Tag direction can be added to your application software through Speedway's LLRP programming interface.

#### 4. How many antennas does it require?

The basic setup for sensing tag direction is a portal or walk way with either two or four antennas. The antennas are required to be physically separated, oppositely canted, and positioned at a minimum height from the floor.

#### 5. How many readers are needed per tag direction portal?

Only one reader on one side of the portal is necessary. If two stands are desired, two separate setups are required. Each reader, stand, and antenna setup act independently of each other and report independently.



**6. Will tag direction determination work in any location?**

Yes, although Impinj strongly recommends avoiding installation of the antenna stand in locations with reflective surfaces. Metal doors, metal filing cabinets, rebar in the wall, and other metal objects will cause reflections that may reduce the performance of the tag direction determination mechanism. Antenna stand side walls can also cause reflections. Care should be taken to install antennas in stands with either RF-absorbent or RF-transparent material.

**7. How does the algorithm handle stray or stationary tags in the proximity of the portal?**

Impinj recommends minimizing the number of stray tags in the field of view that will not be moving through the portal. The direction algorithm can distinguish between moving tags and stationary tags, but the performance may degrade when many strays are present. The limit of 15 tags in the field includes stationary tags.

**8. How does the algorithm report tag direction?**

Tag direction is reported on a per unique tag basis. Accumulation of tag information is not supported by the tag direction reporting mechanism. There are four reported parameters in the tag direction report for the end user:

- **EPC**—the EPC of the tag which direction was determined.
- **Decision Timestamp**—the time at which the direction decision was determined.
- **Tag Direction**—the outcome of the direction algorithm.
- **Decision Confidence Level**—the output of the tag direction decision confidence algorithm.

**9. What are the performance characteristics of the algorithm?**

The performance metric for tag direction is the percentage of tags inventoried with direction reported. The tag direction algorithm will not report tag direction if the confidence factor falls below a preset limit. Impinj specification limits are shown below. The false reporting threshold for all cases is less than one percent.

**Performance Metric for Tag Direction**

Number of Tags	Tags Inventoried with Direction Reported
1	99%
5	90%
15	80%
>15	Not specified

**More Information**

Contact Impinj to obtain a detailed application note about the tag direction algorithm.

<sup>1</sup> See <http://www.epcglobalinc.org/standards> for a copy of the LLRP specification

<sup>2</sup> Reporting result times are on average