

Configuring ThingMagic UHF RFID Readers to Support Fast Moving Tags

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Introduction

The industry-standard Gen2 protocol used in ThingMagic® modules and fixed-position readers was designed to inventory large quantities of stationary tags, but options provided in the protocol also make it ideal for applications where a small population of fast moving tags must be read rapidly. These applications are supported by ThingMagic's *Fast Search™* mode which automatically optimizes many of the settings required for reading fast moving tags, and provides additional user-accessible settings to increase performance further if necessary. These settings are so effective that not only can tags be read once at very high speeds, but often can be read multiple times, allowing for advanced application-specific analysis to be done at the same time.

ThingMagic *Fast Search* Mode

The first optimization that ThingMagic's *Fast Search* mode provides is support for the maximum allowed data rate between the reader and the tag. This doubles the read rate from the Gen2 protocol default that is designed to provide reasonable performance in a wide variety of applications, including "dense reader" installations.

The second optimization that *Fast Search* provides is the ability to overcome the inherent "fairness" of the Gen2 protocol, which causes strong tags (those returning a strong response to a read event) to step aside for many inventory rounds to allow weaker tags to respond. This behavior is ideal when the reader is faced with a great number of stationary tags, but is not ideal when tags are only in the read-zone for a brief amount of time. When tags are moving, there are no "weak" tags, only tags that have not passed through the area of the read-zone where the signal is strongest, so it is best if tags respond whenever they can. If one tag responds more times than another, this is OK as long as the number of responses for all tags stays high.

The third optimization that *Fast Search* provides is the ability to shorten the inventory rounds to the minimum time required for a small population of tags. Tags respond sequentially in time "slots" controlled by the reader. Readers, by default, are conservative about the number of slots they offer – creating more slots to achieve a more complete inventory at the expense of shorter inventory cycles. As previously noted, the "anti-politeness" settings will encourage tags to respond to multiple successive

inventory rounds, so it is feasible to configure the reader to offer the fewest possible number of slots per inventory round, resulting in fewer unused slots and therefore a higher read rate overall.

The fourth optimization involves how the reader utilizes RF signaling options, as opposed to the protocol settings previously discussed. Between inventory rounds, a reader must decide when to change RF channels to provide the best performance. Normally, a reader's goal is to read many stationary tags accurately. In this case, the reader will change channels as often as possible to find frequencies at which tags in weak read-zones tags can respond. In applications where tags are moving, the movement of tags eliminates any weakness in the read-zone, so there is no benefit to changing channel frequencies often. The down-time that naturally occurs when channels are changed to read stationary tags becomes a disadvantage with no offsetting advantage when reading moving tags. With *Fast Search*, ThingMagic readers automatically detect when the tag response rate is high and will delay hopping channels until absolutely required by government regulations for wireless services, resulting in the least amount of down-time permissible.

A fifth, and final, optimization can potentially allow fewer readers to be installed at each site. ThingMagic multi-port readers can support up to 4 antennas at one time. Once again, the Gen2 default protocol settings for readers tend to work against the goals of this application: Readers will normally stay with one antenna until it is certain that there are no additional tags to be read, and then look for tags on other antennas. If this antenna-choice algorithm is maintained while fast moving tags are responding as often as possible, the reader would never move off the first antenna because the rate of tag responses would never drop off. ThingMagic readers provide a setting that overrides the automated antenna selection algorithm and switches antennas as often as required, regardless of tag responses. This allows the reader to keep returning to each antenna frequently enough to guarantee that tags can be read as they pass through the read-zone of all antennas.

ThingMagic RFID Reader Settings

To this point, the optimized settings have been described in general terms. Specifically, the ThingMagic reader settings to achieve the best results are as follows. (Note: *Fast Search* is supported on ThingMagic M6 and Astra®-EX fixed-position readers, and M6e and M6e-Micro embedded reader modules).

- “*Fast Search*” mode enabled
- Tari=6.25 usec.
- BLF=640 kbps
- Target=“AB”
- Have the reader control program (WebUI or Universal Reader Assistant) optimize the “Q” setting for the anticipated number of tags in the field. If this number is expected to be widely variable, the automated setting can be used with very slightly diminished results.
- “RF-on” time is set to the number of active antennas times the maximum time the reader can afford to stay on an antenna without missing any tags.
- “RF-off” time is set to “0”
- Antenna switching algorithm set to “Equal weighting”

Fast Search for Tolling, Vehicle Management, and Race Timing

ThingMagic's embedded UHF RFID modules enabled with *Fast Search* support applications such as tolling, vehicle management and race timing where fast moving tags need to be distinguished from each other with a high degree of accuracy. Operational up to 200 kilometers per hour, *Fast Search* supports both Gen2 and ISO 18000-6B tags.

Results

The cumulative results of all these optimizations are significant. Using *Fast Search* mode and the recommended user-initiated settings, a reader that under normal circumstances could only achieve a read rate of around 200 tags per second can achieve read rates of 600 to 750 tags per second.

The graph below shows the results of reading fast moving tags with a ThingMagic M6e reader with all the above mentioned moving-tag optimizations enabled, for 1 to 20 tags in the field.

