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The Instruction of Parameter Setting

Purpose of This Document

We provide the description of parameter setting for unitech products which carries ThingMagic M6e Micro RFID module. This will allow users to understand the basic definition of each parameter on M6e Micro, and set parameter for different scenarios.

Before understanding the basic definition of each parameter, you must first know how UHF RFID (Gen2) works:

Basically, the RFID reader will powers up the tag while communicating with the tag. This type of system could be regarded as if two people try to send messages from one building top to another at night, one of them only has a flashlight (RFID reader), and the other only has a mirror (RFID tag). A person with the flashlight can send the message via turning the flashlight on and off, but when he wants a one on one respond, he must keep the flashlight on so that his partner can signal back through the mirror. However, there may be other people on top of the building holding a mirror as well, which also receive the signals from the same flashlight, and ready to send the messages back. The Gen2 protocol is designed to process with such communication challenges.

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Chapter 1 – Types of The Parameters

Through parameter setting, the RFID reader can control the behavior of the tag and respond to the message according to the reader's request. These settings do not remain in effect long. After a few minutes, the Gen2 protocol expects all tags to return to their default state so that the second reader will automatically know the initial state of the tags when it encountered them.

Although there are many Gen2 settings, the parameters that can be adjusted for each RFID module are different. Judging from the parameters provided by the M6e Micro module, these parameters could be divided into 3 categories:

1. Parameters that control how the RFID reader communicates to the tags
2. Parameters that control how the tag communicates back to the RFID reader
3. Parameters that control when tags respond relative to each other to avoid communication collisions

The following will explain the above 3 categories in detail.

1.1 Reader-to-Tag Communications

Parameters that control how the RFID reader communicates to the tags

- Parameters that will be used:
  - Tari (includes link rate)

There are 2 parameters control reader-to-tag communications, Tari and link rate. Tari controls the length of a dot (or dash) and the link rate controls how quickly the dots and dashes are sent. ThingMagic module adjusts both of these Gen2 parameters together. When the users apply a smaller Tari value, the link rate will be automatically increased. That is, Tari values offered are 6.25 usec, 12.5 usec, and 25 usec, which are automatically paired with link rates of 160 kbps, 80 kbps and 40 kbps.

The smaller the Tari value, the faster and shorter the signal sent by the reader. It means that the tag will receive the reader's signal more quickly and frequently, so the tag will reply the signal to the reader faster. Therefore, if users want to increase the reading speed, they can select a smaller Tari value. However, because a smaller Tari value means that the reader’s signal is shorter, the signal will be weaker and the noise will be larger, thus the reading distance will be shorter.

1.2 Tag-to-Reader Communication

Parameters that control how the tag communicates back to the RFID reader

- Parameters that will be used:
  - BLF (Backscatter Link Frequency)
  - TagEncoding

There are 2 settings that users can use to control the tag-to-reader communication approach, BLF and TagEncoding (called M value). The BLF is the raw signaling rate. Data rates supported by ThingMagic M6e Micro are 250 kHz and 640 kHz, the higher frequency sets, the faster speed of data sending back to the reader. The M value (tag encoding) essentially controls how many times a symbol is repeated. An M of 2 means that each symbol is repeated twice. M values of 1 (FM0), 2, 4 (each symbol is repeated 4 times), and 8 (each symbol is repeated 8 times) are supported by ThingMagic. The Gen2 protocol provides this option to repeat symbols to maximize the chances that the reader can decode a very weak signal from the tag. Just as it is easier to understand someone who is whispering in a noisy room if they repeat everything they say several times, so too, the RFID reader will decode a weak signal more reliably if “M” is 2 or greater.

In conclusion, if the users pay more interests on reading speed, they can set BLF as 640 kHz and M value as FM0 to achieve the highest tag-to-reader data rate. However, although this parameter combination can speed up the reading rate, it will also face the same issue as the Tari value mentioned above, that is, the faster the speed, the greater the noise, which will shorten the reading distance.

1.3 Prevent the communication collisions

Parameters that control when tags respond relative to each other to avoid communication collisions

- Parameters that will be used:
  - Q
  - Session
  - Target

Imagine that if many tags receive the signal from the reader at the same time and send back messages to the reader, it may cause the signals to interfere with each other and the reader can hardly decode any messages. Q, Session and Target are used to control how soon and how often, a tag responds to a reader, to avoid the above situation.

Q value is the reader announces to the tag population the number of response opportunities it will give to them. Each tag picks a number randomly within this range and the reader starts announcing response slots. Each tag will respond to the reader only when their selected slot comes around. The Q value is a number from 0 to 15, and the number of slots is 2^Q power. For example, if the user wants to count 512 items (with RFID tag individually), it is recommended to set the Q value to 9 (i.e. 2 to the 9th power). Nevertheless, not every time the number of tags is 2^Q power. In that case, the ideal number of slots has been determined to be about 1.5 times the number of tags. Moreover, if the number of tags is variable and unpredictable, the user can set "Dynamic Q" so that the reader can automatically determine Q based on the results of consecutive rounds (if there are many collisions, increase "Q", if there are many unanswered response slots, decrease "Q".)

When initially setting up the Q value, the reader also sends 2 other pieces of information to all tags, “Session” and “Target”. Below is the definition of these two parameters:

1. Session: Determines when a tag will respond to a query from the reader, and how long it should delay until it re-responds.
2. Target: What status (“A” or “B”) the tag should be in to participate in the inventory round. The “A” means that the tag has not yet responded to the reader. The “B” means that it has. The "Session" setting determines how long the tag waits in the “B” status before returning to the “A” status so it can join the inventory round again.

There are 4 Session options that user can select, Session 0, Session 1, Session 2, and Session 3. The following table is the definition of these 4 Session options:

Session Type	Description
Session 0	Tags reset to the A state upon power up
Session 1	Once read, tags move to the B state and remain there for between 0.5 and 5 seconds before returning to the A state
Session 2 & 3	Tags persist in the B state for at least 2 seconds to a maximum time that is tag specific Please note, if users apply S2 & S3 to read the tags, may cause them held in state B for long period of time, users cannot read them using target A in this period.

According to the default setting of ThingMagic M6e Micro, the read rate is about 200 tags per second. Under these conditions, if there are around 100 tags to be read, we recommend using “Session 0”. If there are about 400 tags to be read, “Session 1” is recommended. And Session 2 and Session 3 for more than 400 tags. For example, if the user sets the Session as “Session 0” to read a large number of RFID tags, it may waste a lot of time reading duplicate tags, because these tags will quickly switch from “B” status to “A” status and rejoin the inventory round. As a result, the reader keeps receiving the information of these tags repeatedly, and cannot read other tags that have

not yet responded.

For “Target” setting, the tags will always power up into the 'A' state for each session. In other words, when the tag receives a signal from the reader, it will be in the state of "A" first, and after replying to the reader, it will be in the state of "B", and "Session" will control how long the tag will remain in the state of "B".

M6e Micro module provides 4 options, “A” state, “B” state, “A then B” state, and “B then A” state. When user sets “Target” as “A”, it means that the reader always looks for tags that are in the “A” state, while tags held in their “B” state by their “Session” time are ignored. “A then B” tells the reader to read all the tags in the “A” state, then read all the tags in the “B” state, and keep repeating this process. The following table summarizes the 4 target options.

Target	Description
A	Reader always looks for tags that are in the “A” state. Tags held in their “B” state by their “Session” time are ignored
B	Reader always looks for tags that are in the “B” state, and Ignores the tag which with "A" state
AB	Ask the reader to read all the tags in the “A” state, then read all the tags in the “B” state, and keep repeating this process
BA	Ask the reader to read all the tags in the “B” state, then read all the tags in the “A” state, and keep repeating this process

The above explains the Gen 2 protocol parameters provided by M6e Micro.
The next section will list a few simple scenarios for practice and discussion.

Chapter 2 – Examples of custom settings usedte

Please follow the settings below based on the tag quantity and customer expectation.

1. Tag Qty.: 1 pcs
   Customer Expectation: Require long reading distance

Parameters	Value	Note
Power (dBm)	30	The power level will directly affect the reading distance, it is recommended to adjust to the maximum value
Antenna On Time (ms)	1000	
Antenna Off Time (ms)	100	
BLF(kHz)	250	User pays more attention on reading distance, so choose a lower BLF value to reduce the noise
Tari (uSec.)	25	Let the reader send a longer and stronger signal to the tag
Session	S0	
Tag Encoding	M4	Makes the reader more likely to decode tags with weak signals (because of the long distance) “M8” is not recommended since it will take a lot of time to decode the tag. If customers want to increase the reading speed slightly, they can choose “M2”.
Target	AB	No matter the tag is in the "A" state or "B" state, the reader will request the tag response to increase the chance of reading the tag
Q Value	StaticQ 0	Just read 1 tag, so select "StaticQ 0" (2 to the 0 power)

2. Tag Qty.: Not sure

   Customer Expectation: Read all tags as soon as possible

Parameters	Value	Note
Power (dBm)	30	
Antenna On Time (ms)	1000	
Antenna Off Time (ms)	100	
BLF(kHz)	640	The higher frequency sets, the faster speed of data sending back to the reader
Tari (uSec.)	6.25	Small Tari value means that the tag will receive the reader's signal more quickly and frequently, so the tag will reply the signal to the reader faster
Session	S1	Extend the time for the readed tags to remain in the "B" state to prevent the reader from repeatedly decoding the same tags
Tag Encoding	FM0	Makes the reader more likely to decode tags with weak signals (because of the long distance)
Target	A	
Q Value	DynamicQ	Not sure the tag qty., the user can set "Dynamic Q" so that the reader can automatically determine Q value based on the results of consecutive rounds.

3. Tag Qty.: 100 pcs
   Customer Expectation: Read all tags in long read distance

Parameters	Value	Note
Power (dBm)	30	The power level will directly affect the reading distance, it is recommended to adjust to the maximum value
Antenna On Time (ms)	1000	
Antenna Off Time (ms)	100	
BLF(kHz)	250	Choose a lower BLF value to reduce the noise
Tari (uSec.)	12.5	Due to the large number of tags that need to be read, "25 usec" is not recommended to avoid spending too much time reading all tags.
Session	S1	Extend the time for the readed tags to remain in the "B" state to prevent the reader from repeatedly decoding the same tags
Tag Encoding	M2	Due to the need for a long reading distance and a large number of tags, "M2" is recommended. "M4" will cause users to spend a lot of time to read 100 tags.
Target	A	
Q Value	StaticQ 7	100 tags, select "StaticQ 7" (2 to the 7 power = 128)

Online references

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