



RFID Tag Comparison Guide

Understanding Broadband Technology



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RFID TAG COMPARISON — REGIONAL OR GLOBAL?

As RFID technology continues to mature users are faced with an ever increasing array of options for unlocking new business benefits and value. Ten years ago RFID solutions were limited by short read distances and high costs. The advent of passive UHF RFID and the EPC Class 1 Gen 2 protocol shifted the paradigm for users, opening up portal based solutions and global interoperability.

Three years ago Omni-ID expanded the reach of passive UHF by enabling real world solutions for applications that require tags to work on and around metal. Today on-metal tag technology has moved on yet further with an extensive range of different tag shapes, sizes and read distances available to meet the diverse needs of many.

One of the significant milestones of this technical innovation includes the launch of the world's first truly global on metal passive UHF RFID tags. This poses the latest tag question for the user : **Regional or Global?**

BACKGROUND

The EPC Class 1 Gen 2 standard in combination with regional governing bodies, has defined a global UHF RFID band from 860-960MHz. This band clashes with a number of regional mobile phone and other pre-assigned radio bands. Therefore in practice, a subset of this band is used in each geography, the specific frequency of which is region dependant. The three most commonly used bands are:

- **866-868MHz** (EU, India)
- **902-928MHz** (US, South America and some Asian countries)
- **952-954MHz** (Japan)

Other regions of the world typically operate within the scope of these three bands.

Historically, on-metal UHF tags have been tuned to operate at only one of these frequencies, making them regional. These tags are often referred to as 'narrowband' because they have a bandwidth which is notably narrower than the full global 860-960MHz UHF RFID band. Conversely, global tags function across the entire 860-960MHz range and are therefore referred to as 'broadband' tags. Both are relative terms used extensively in RFID.

SCOPING THE PROJECT — IS MY PROJECT GLOBAL?

A simple enough question, but more often than not the answer is complex. Some will be in the fortunate position of knowing the answer at the outset; closed loop and single organization deployments are usually easy to scope and define. Difficulties arise, however, when the project scope evolves, when open supply chains exist or when source tagging is required.

Most projects start with a small scale pilot, for which a regional tag may be suitable, but this may not adequately test the full solution. Understanding the life of an asset and mapping it out can help define the full use case for RFID as well as identify the geographies involved. If the user organization is regional the choice may be simple, however in global corporations the use of regional tags can add SKU's and unnecessary complexity. In these use cases, moving to a broadband solution early in the project should be considered.

For large scale deployments where assets will be moved across geographies worldwide, source tagging may be an option. This requires the asset to be RFID tagged at the vendor/supplier location. Source tagging may be the ultimate deployment strategy for RFID in your business, as this can significantly reduce the overall implementation cost. If this is the case, then the location of the manufacturing facility should be considered especially when cross-continental compliance is required.

TAG SELECTION

Pilots and proof of concept projects provide an insight into the outstanding technical challenges associated with a deployment and help to refine the business case on a small scale. Identifying the correct tag for the pilot will ensure the success of the project and will ultimately help provide a smooth scale-up route. Selecting global or regional tags for a project may be driven first by geography requirements, but RF performance is equally important. RF performance is characterized not only by read distance, but also by read rates and the effects of detuning, which should be tested at the pilot stage of a project. Pilots are critical in validating a system's performance, which includes not only the tags but the reader equipment and the install location, as well as human factors that may affect process.

It is important to set the correct read range expectation at an early stage. Regionally tuned tags have a characteristic high peak which affords long read distance over a limited frequency range. Conversely, global tags afford less peak read range but cover the full global 860-960MHz UHF RFID spectrum. Global tags therefore support all geographies in one tag, with a relatively similar performance across all regions. Plotted on a graph the two responses look very different.

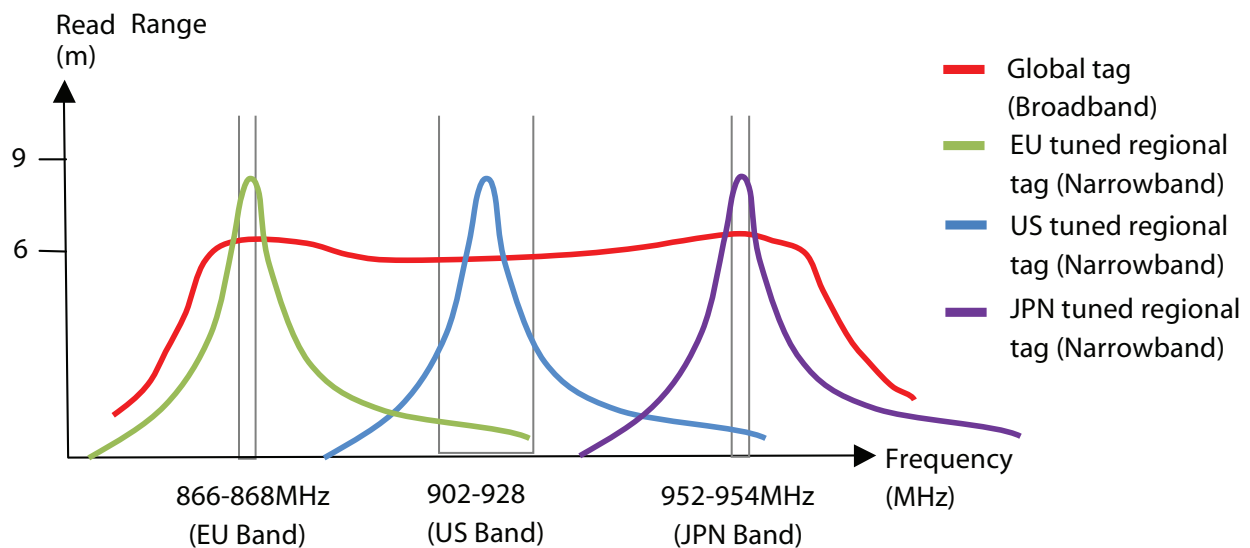


Figure 1 – Frequency plot of three regional tags and a global tag.

Looking beyond the global functionality, broadband tags offer a number of other real world benefits which at first may not be immediately apparent but should be considered.

READ RANGE TESTING

The most common test used in tag selection is a read range test. This generally involves using a fixed reader to interrogate a tag at increasing distances until it is on the threshold of functioning. Another method of read range testing involves holding a tag at a constant distance and reducing the power of the reader to the operating threshold. In simple terms this allows the tester to see how 'strong' a tag is relative to a competitive product.

As with all simple tests read range testing has a number of limitations which must be accounted for. In particular, read range testing can be misleading for applications where the tags, in real-world usage, will need to operate in wet environments or in the vicinity of metallic surfaces.

In most cases a simple read range test will report the peak performance of a tag, ignoring interfering factors. On a like for like basis this type of testing will typically favor a narrowband regional tag, with its higher peak value, over a global tag.

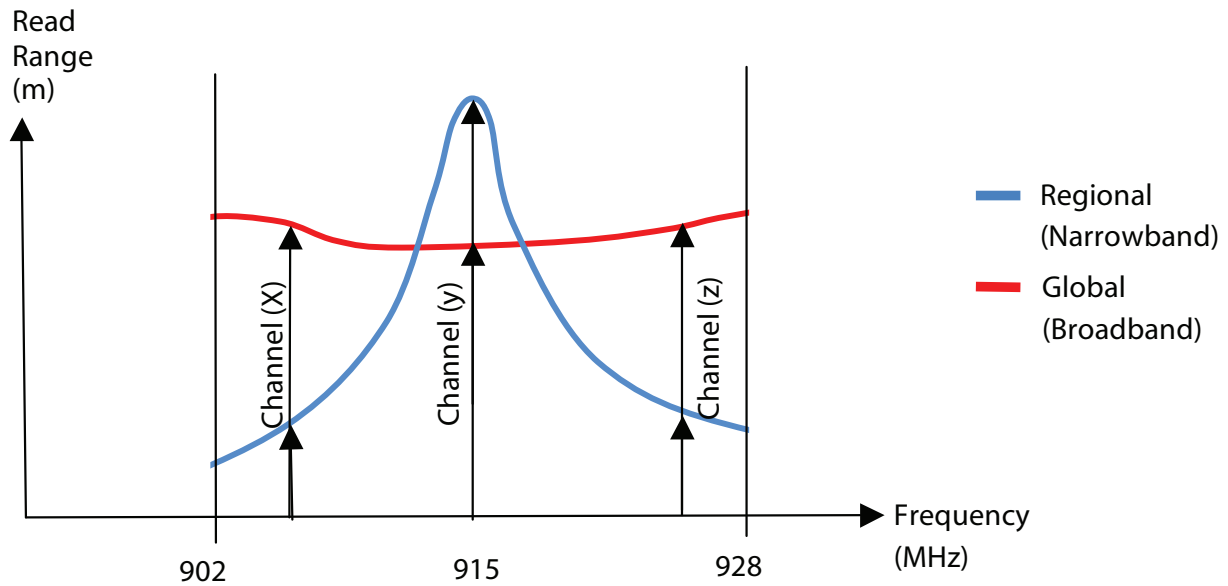
Depending on the application for the tag, the read range alone will not necessarily define how the tag will perform in your application. Two additional, important metrics to assess are read rates and detuning.

READ RATES IN PORTALS

The commonly deployed portal reader is usually configured in dock doors or choke points. In order to achieve high read rates, the tag must be capable of talking to the reader for as long as possible during transit through the portal. In most cases the actual read distance requirement, even based on a worst case scenario, is less than 50% of the maximum tag read range. Using portal readers, the time element becomes more significant than the peak range because the tag is only likely to be in the RF field for a few seconds.

Read rates are also impacted by the reader's channel hopping function. For example, within the US, the 26MHz wide allocated band is divided into 50 x 500kHz channels. The reader jumps between these 50 channels in a pseudo-random fashion spending 0.4 seconds on each channel. In a two second period the reader will randomly select five channels anywhere from 902 to 928MHz..

Figure 2 – Frequency plot, focusing on US band showing difference in regional and global tags.



Because narrowband tags have a high peak response, the read performance is highly dependent on which channels the reader selects during the two second period. If the reader selects channels near the center of the band (Y in figure 2), the read performance will be very strong. However if the reader selects the outer channels (denoted x and z), the tag may pass through the portal without being read. This variability only appears in testing conducted on a statistically relevant sample, when tens or hundreds of passes have been made.

A global tag with a flat response significantly decreases the variability associated with channel hopping. This can account for the difference between 95% and 99.5% readability under full deployment conditions.

In the EU and Japan the allocated band is only 2MHz wide, therefore read rate variability is not primarily driven by channel hopping. While channel selection might contribute in a minor way, the primary contributor to system variability is detuning caused by both environmental factors and manufacturing variability.

TAG DETUNING

Investigating sources of tag de-tuning, and testing for de-tuning effects within the system can help minimize risk during project scale up. In general, on-metal tag technology has come a long way in resolving detuning issues. However, circumstances still exist in which narrowband tags can be significantly de-tuned. These usually involve the presence of liquids or metals very close to the front face of the tag. Likely real-world scenarios include heavy rain/snow deposits on the tag or situations in which assets are stacked, such that metal is in close proximity to the front face of the tag. In these circumstances, broadband, global tags demonstrate a significant performance advantage as the effect of detuning is notably less.

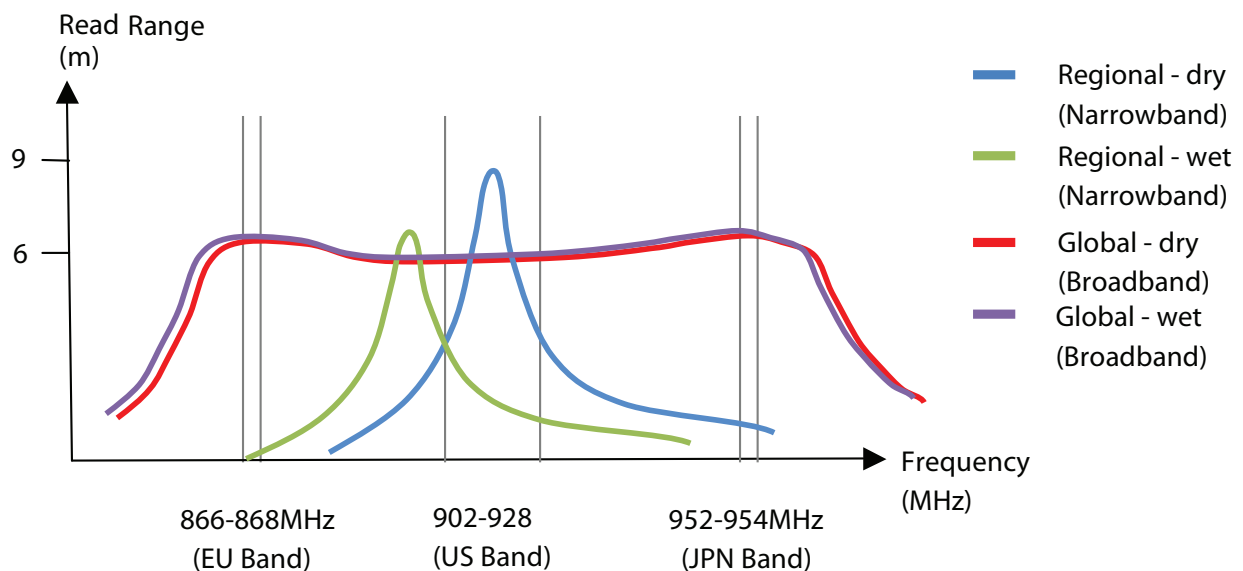


Figure 3 – Frequency plot showing the effect of detuning on regional and global tags.

A regional tag can suffer a full 75% reduction in read distance in extreme cases of detuning, however little if any change is observed with a broadband tag.

Further to the effects of detuning caused by environmental factors, tags themselves will have some inherent variability from the manufacturing process. While tag quality processes are better than ever, it is still common to see a population of tags with a measureable standard deviation. This variability is most noticeable in populations of regional tags where a 3 or 5 MHz frequency shift (due to manufacturing tolerances) might translate to 10-20% change in read performance, Broadband designs are inherently more stable to small variations in frequency affording users enhanced system stability.

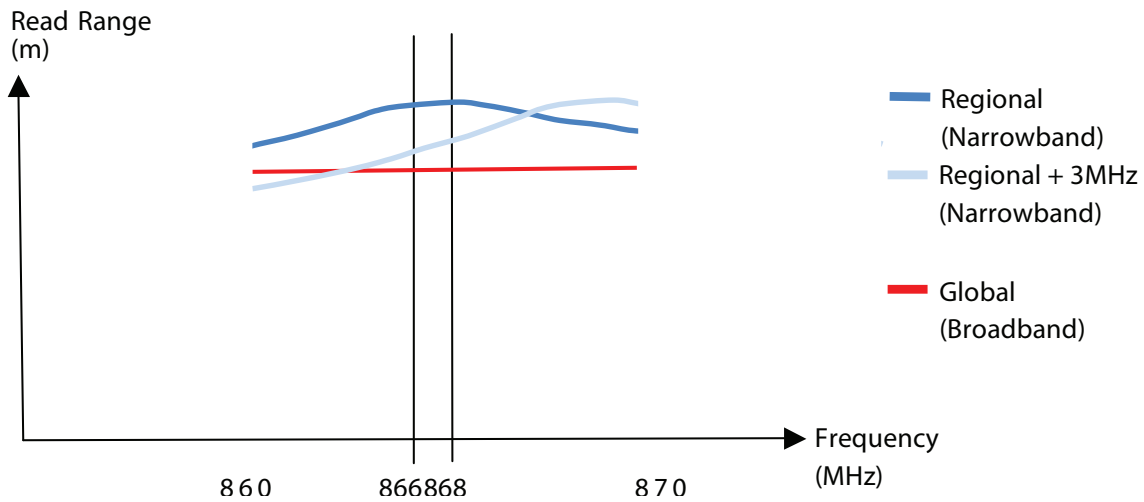


Figure 4 – Close up of EU band, showing difference in effect of 1MHz shift to regional and Global tag designs.

FINAL THOUGHTS

Recent developments in on-metal UHF passive tag technology have provided users with the option of global tags as well as the pre-existing regional tags for projects.

Selecting global or regional tags for a project is driven by geography requirements, but equally important is the RF performance requirement.

RF performance is characterized not only by read distance, but also by read rates and the effects of detuning, which should be tested at the pilot stage of a project.

Whether the project requires global or regional products, Omni-ID has an extensive range of options to meet your deployment needs. Visit us on the web at www.omni-id.com for more information or to speak to an RFID expert.

ABOUT OMNI-ID

Omni-ID is the leading supplier of passive UHF RFID tags. Omni-ID's patent-pending technology overcomes the "traditional" problems of RFID, enabling a broad range of new applications to improve accuracy and efficiency in asset tracking, supply chain management and work-in-process. Omni-ID's family of versatile RFID tags works reliably in the harshest environments including on, off, and near metal and liquids and excels in solving tracking and identification challenges with unprecedented accuracy. Omni-ID's mission is to drive the widespread adoption of RFID technology as the optimal tracking and identification solution. For more information, visit www.Omni-ID.com.

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