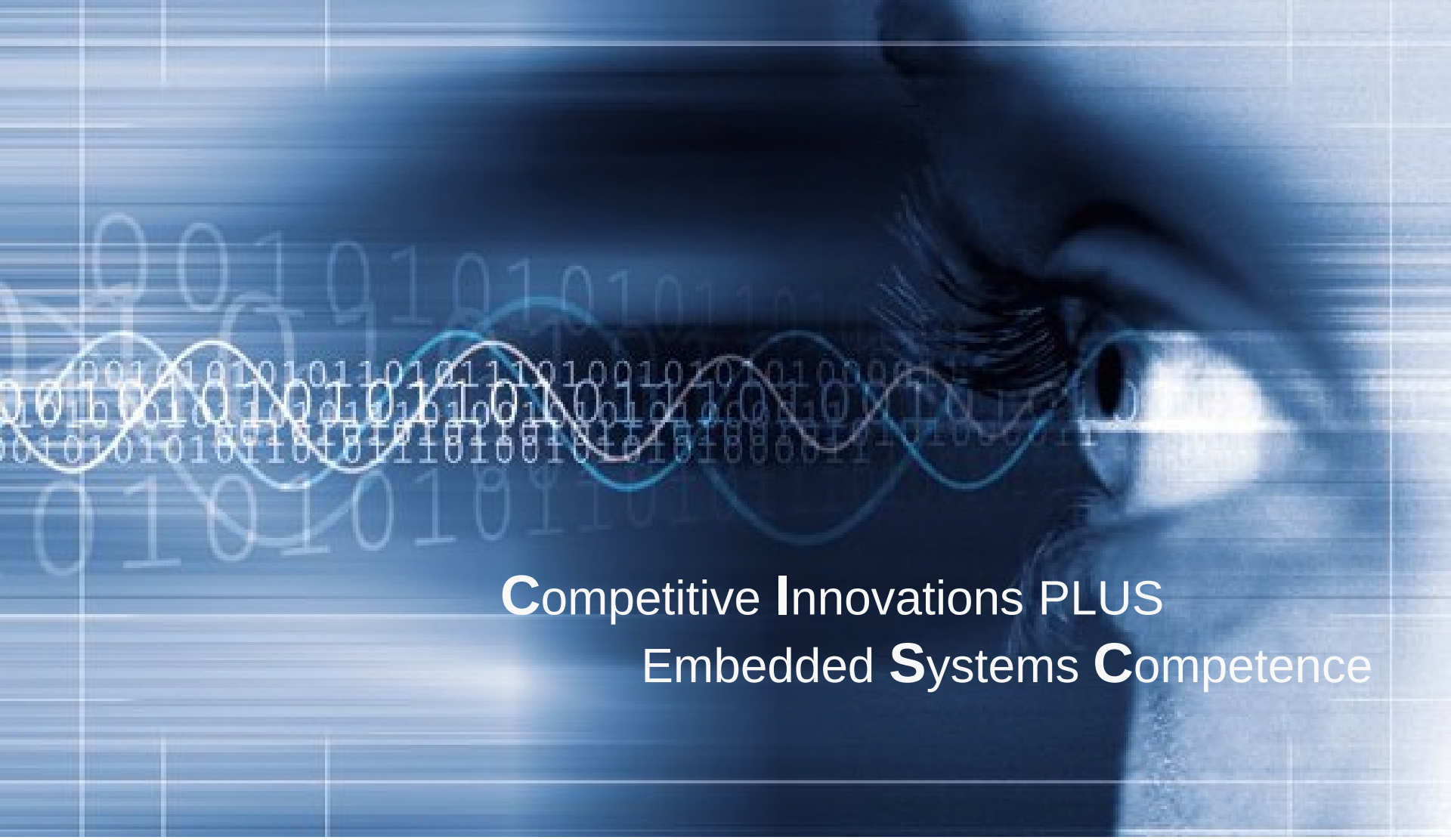

Baggage visibility using RAIN

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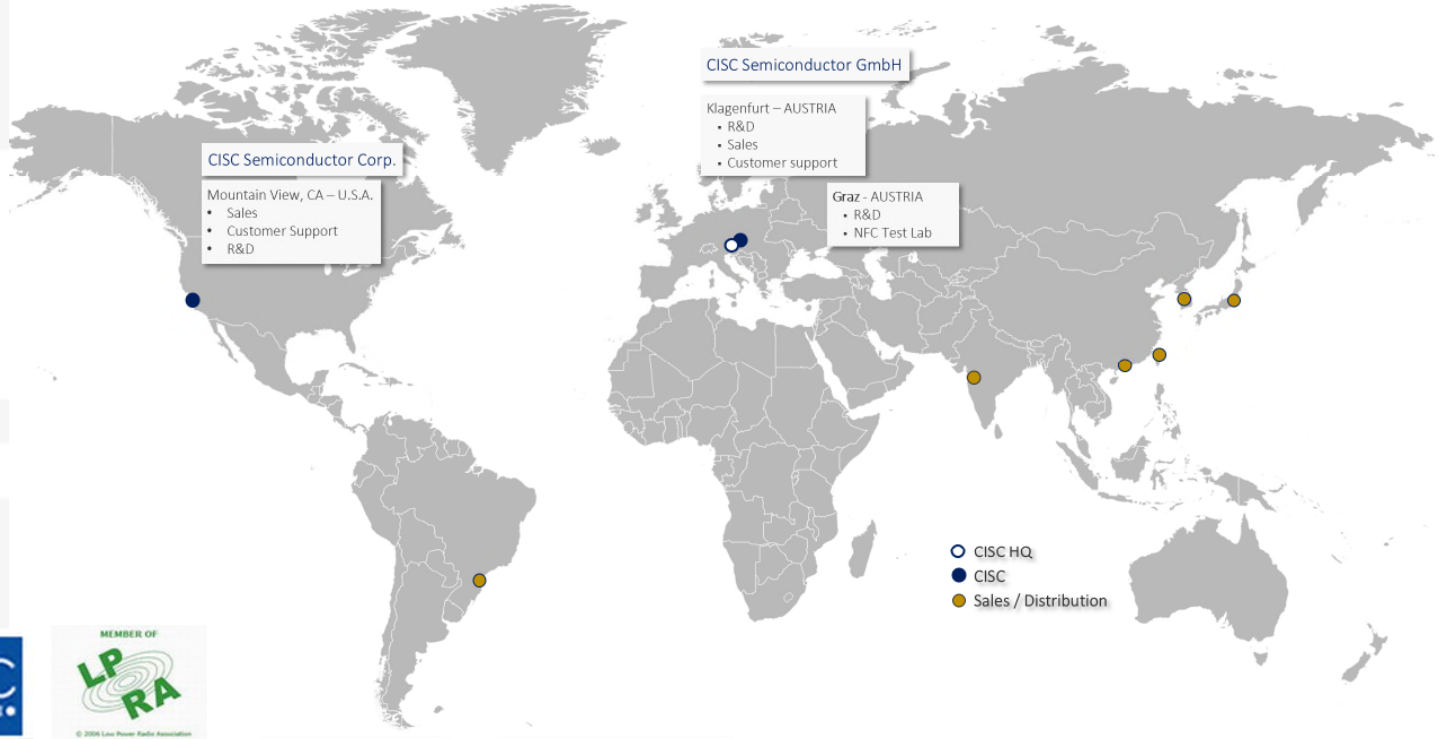
Who are we?



- ✓ Independent - CISC was founded in 1999 and is a 100% private owned company
- ✓ Experienced - CISC is managed by an international team of highest skilled experts & working with RAIN+NFC for more than 20 years
- ✓ Team of RAIN/NFC professionals with long-term, international reputation
- ✓ Measurement tool provider for RAIN and NFC conformance, performance and interoperability tests
- ✓ Standardization leader in RFID worldwide

Aviation market

The market is large and fragmented

Airlines and aerospace manufacturers have deployed RAIN technology to track

- goods within their supply chains ,
- maintenance,
- repair and operations (MRO), parts and tools,
- and other critical items on airplane (life vests, oxygen mask etc.)

IATA Resolution

- A need to offer complete visibility to journey of the baggage was required
- IATA Resolution 753 came into effect on 1 June 2018 mandates bag tracking at four key data points in the journey
- Benefits all the stakeholders by reducing the number of mishandling incidents, aid ground handling staff, improving turn around time and increasing operational efficiency

Baggage visibility

What is baggage visibility?

Completely visibility of the journey from start to the end

Check- in, transfer, loading/unloading, arrival

Main reasons for mis handled bags

- Delays in baggage transfer
  - Sita estimated that 45% of the delayed baggage was due to transfer*
- Loading/offloading errors
- Faulty bag tags
- Other security concerns

* https://www.sita.aero/resources/type/surveys-reports/baggage-report-2017

RAIN is the right choice

- Full compliance of IATA 753
- Reliable scan rates at high speed
- Reading multiple tags accurately
- Unique identification – the TID
- To scan out of line-of-sight
- To cover large read distances
- Flexible when implementing the solution
- Cost effective

Implementation

CHECK IN

Globally interoperable inlay
Right place for the inlays
Self read reader at baggage drop
Real time notification

TRANSFER

Integrated reader and antenna system to work at the sortation areas.
Ability to singulate RAIN tags read rates of the reader

ARRIVAL

Identify the bags that at baggage claim with a RAIN reader
Real time notification
Unclaimed bags enter storage area through a reader on the door

LOADING/OFFLOADING

Departure and arrival scanning of tags
Large read distances
Scan out of line-of-sight
Faster inventory round

Implementation

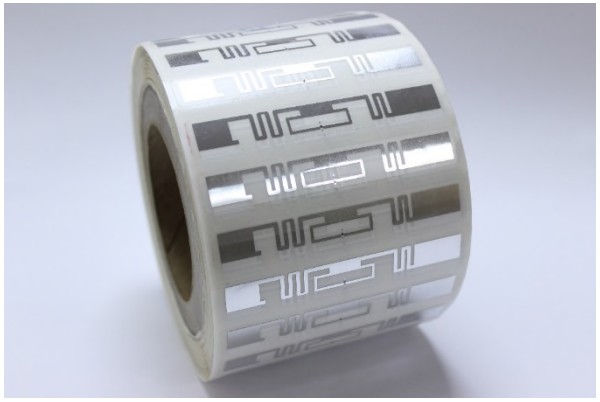
What happens when a bag is lost?

- Search for baggage holding areas
  - A network of RAIN reader request for a specific tag in the area
  - Singulation of bag tag in a pile of bags on a trolley
- Once the bag is found
  - Update the routing information
  - Print a new label

Hardware selection - Tags

What to consider while selecting your RAIN tag?

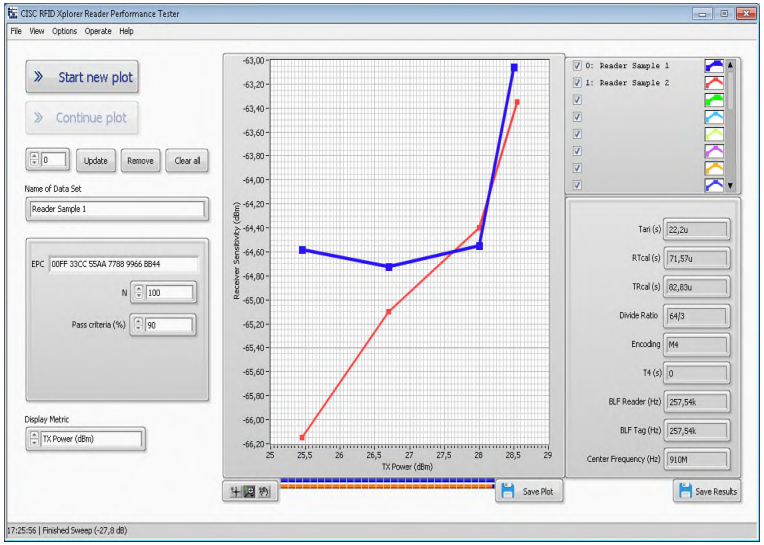
- IC, antenna design, read range, backscatter range, operating range, orientation sensitivity
- Power requirement of the reader for a tag population
- Global performance of the inlay
  - Understanding the radio regulations of the region (EN 302 208, FCC 15.247)
- Encoding of the tag
  - Encoding correctly and reading the specific tag in a limited amount of time is required
  - ISO standards for both the protocol to interact with the tag and the encoding of the data placed on the tag



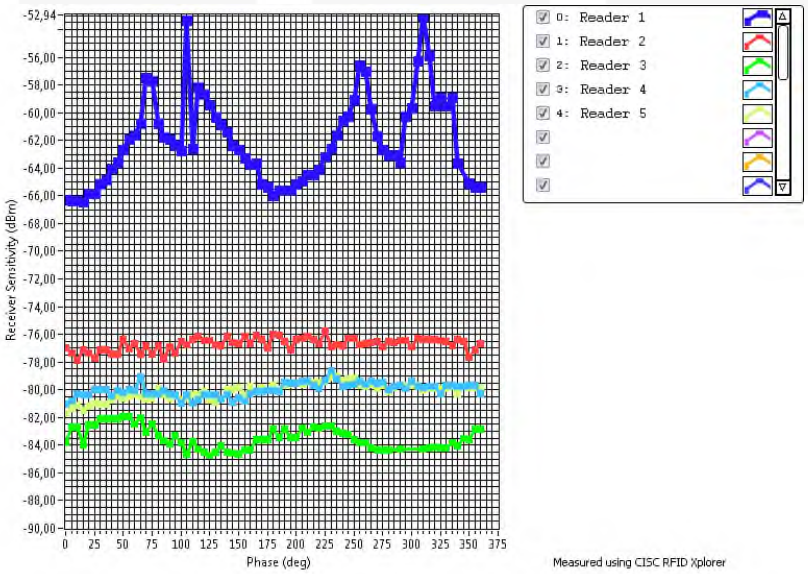
Hardware selection - Reader

What to consider while selecting your RAIN Reader?

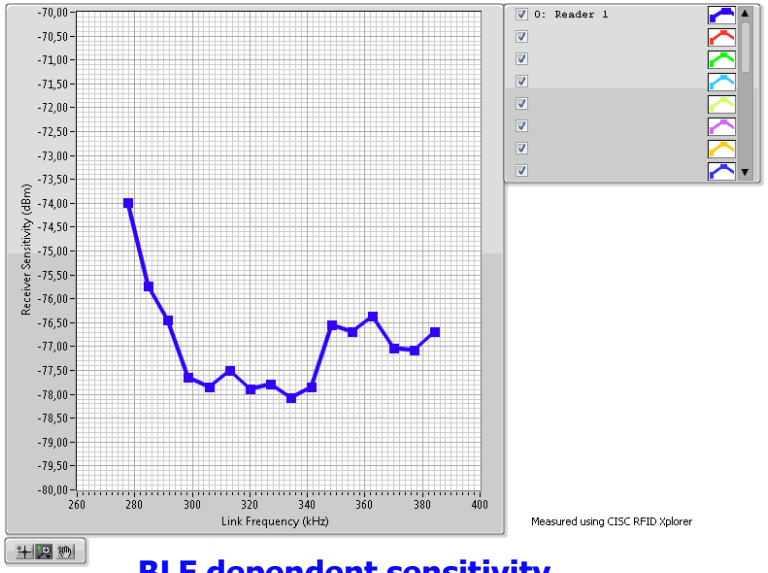
- **Power dependent sensitivity**
  - Higher the transmit power = lower the sensitivity
- **Phase dependent sensitivity**
  - Sensitivity is dependent on the phase of the received tag signal.
  - In an application, phase varies in dependency of the reader-tag distance
- **BLF dependent sensitivity**



Power dependent sensitivity



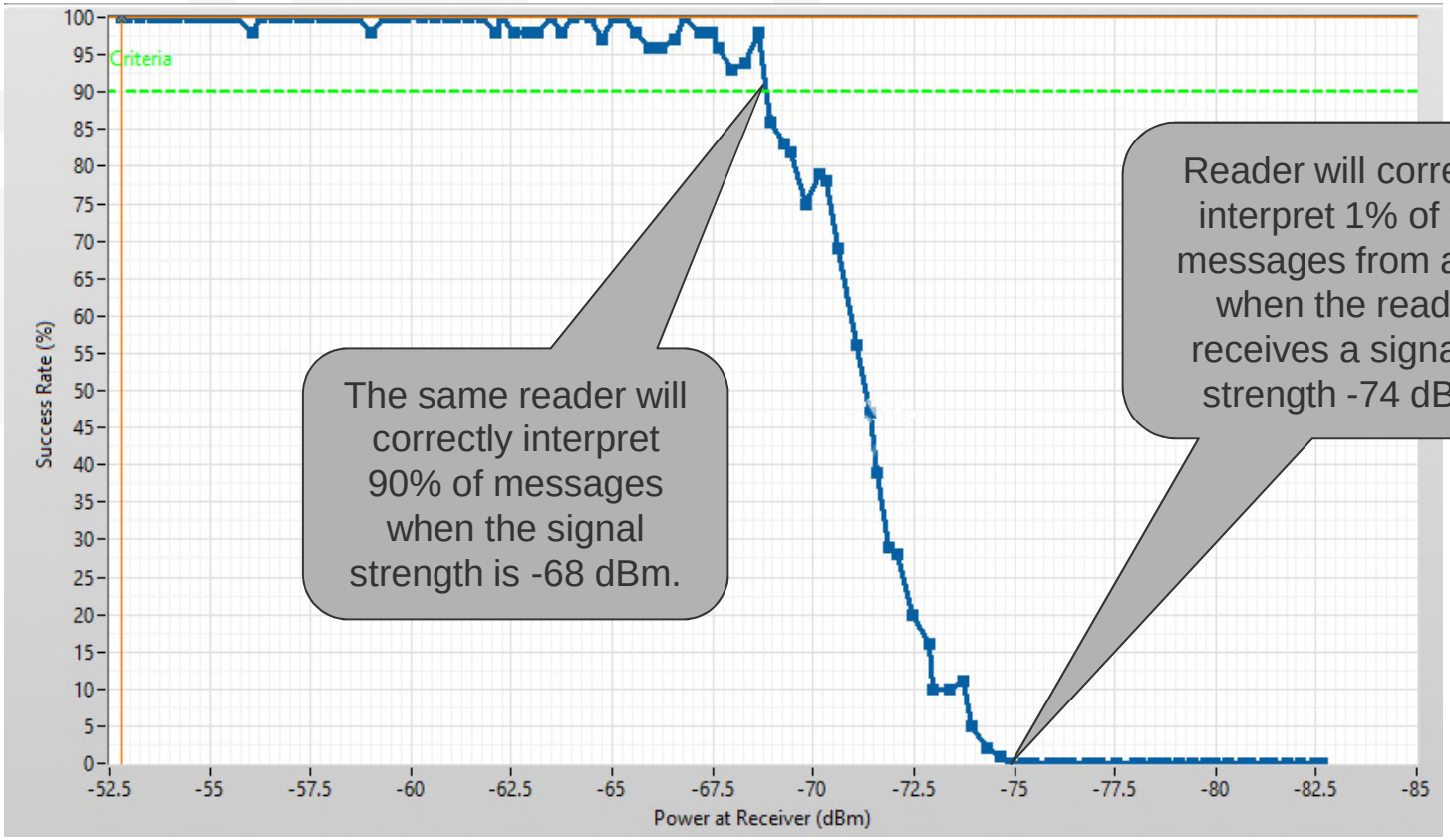
Phase dependent sensitivity



BLF dependent sensitivity

Sensitivity of the reader

- Sensitivity = Lowest level of RX signal to achieve intended read success rate.
- Key metric: Backscatter power at RX.



Read rates of the reader

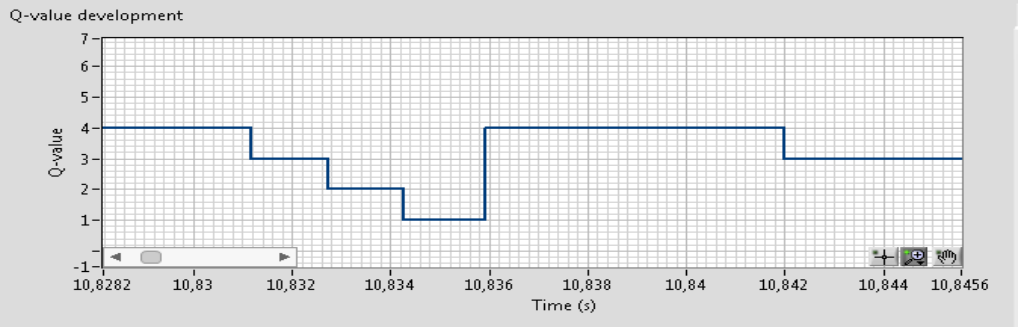
Read rates and cross rates influences the final selection of the reader

The reader rates of a RAIN reader are dependent on

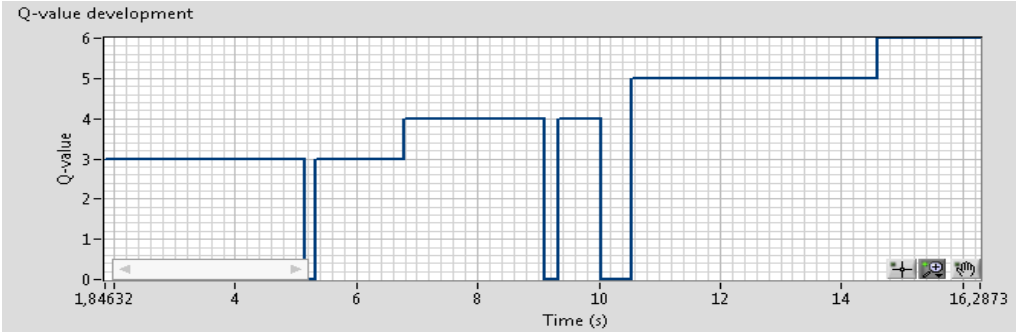
- Q-value adjustment
  - Session
  - Target inventory
- Motion of tags
  - The speed at which the tag is moving through an interrogation zone

Q-value adjustment

- Q value selection has strong influence on inventory speed
- Change in the Q value depending on the collision and empty slots detected



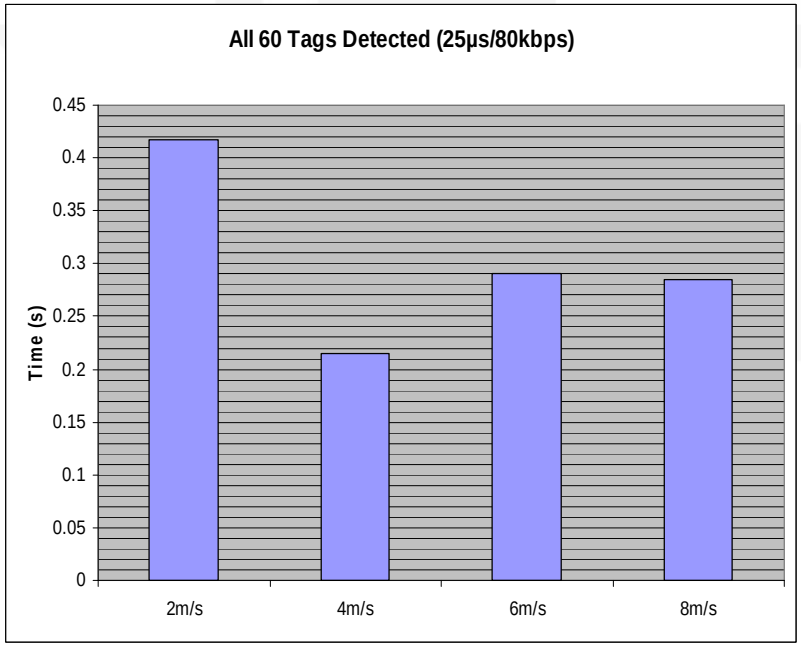
READER A



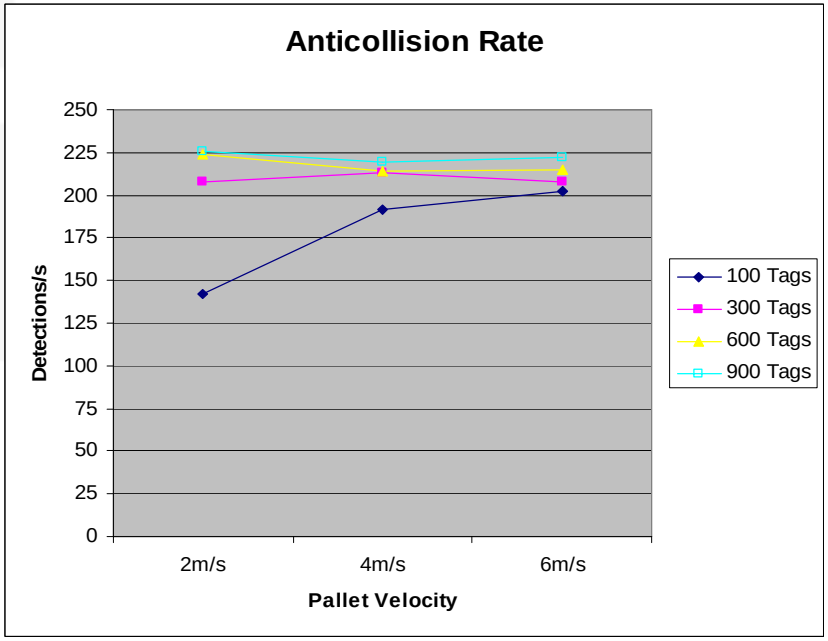
READER B

Motion of tags

- When the tags are on a conveyor belt the reader needs to reads in fast intervals with a low number of retries
- Information is collected and sent back when a new tag enters the interrogation zone
- Understanding the impact of different velocities of tags moving through interrogation zone is required



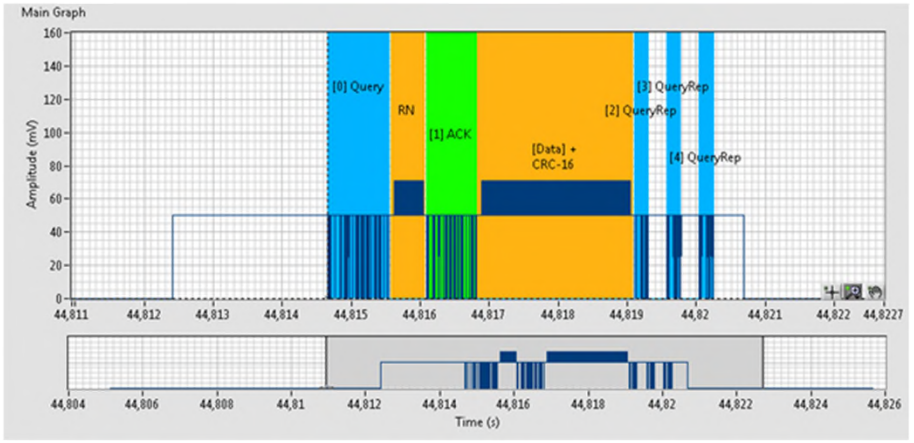
Time to detect 60 tags at different tag velocities



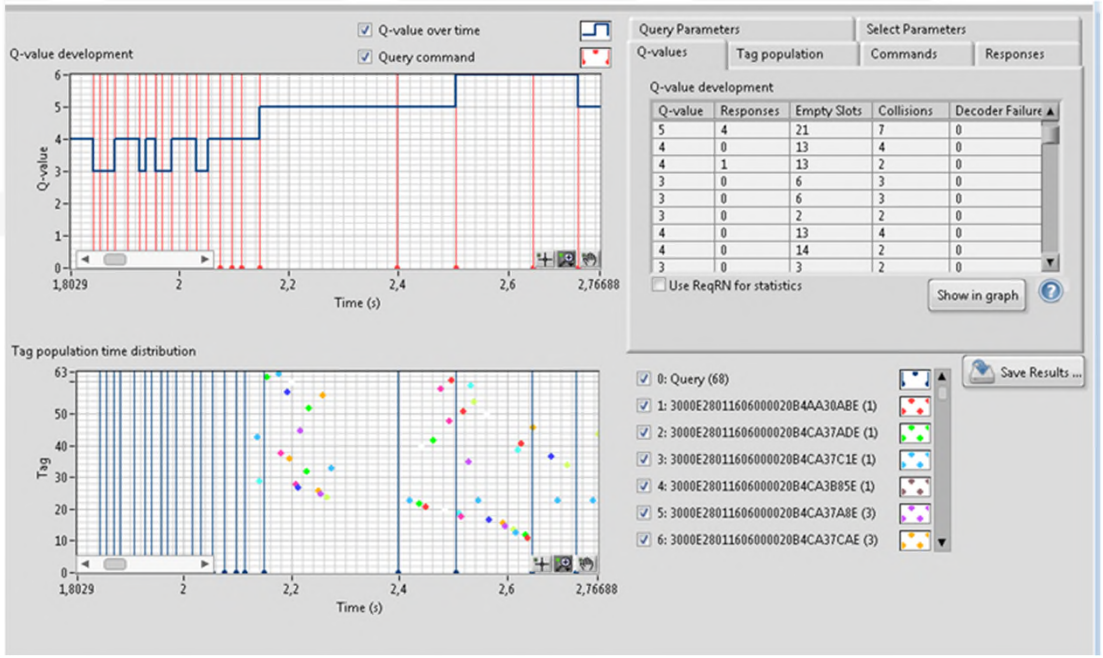
Read rate (tags / second) at different tag velocities

Debugging

- The tag is encoded incorrect
- RAIN tag did not comply to ISO specification
- RAIN tag not placed on the bag correctly
- RAIN reader reading other tags in the field
- The right setting for the reader (?)
- Slow inventory speed results in misreads



Understanding the communication between the tag and reader is the key to solving most of these scenarios



Query Parameters | Select Parameters

Q-values | Tag population | Commands | Responses

Q-value development

Q-value	Responses	Empty Slots	Collisions	Decoder Failure
3	4	4	0	0
3	0	8	0	0
3	5	1	1	1
3	4	4	1	0
3	5	4	0	0
3	2	6	0	0
3	0	8	0	0
3	3	1	0	4
3	7	1	1	0

Use ReqRN for statistics — Show in graph

Analysis of tag - reader communication

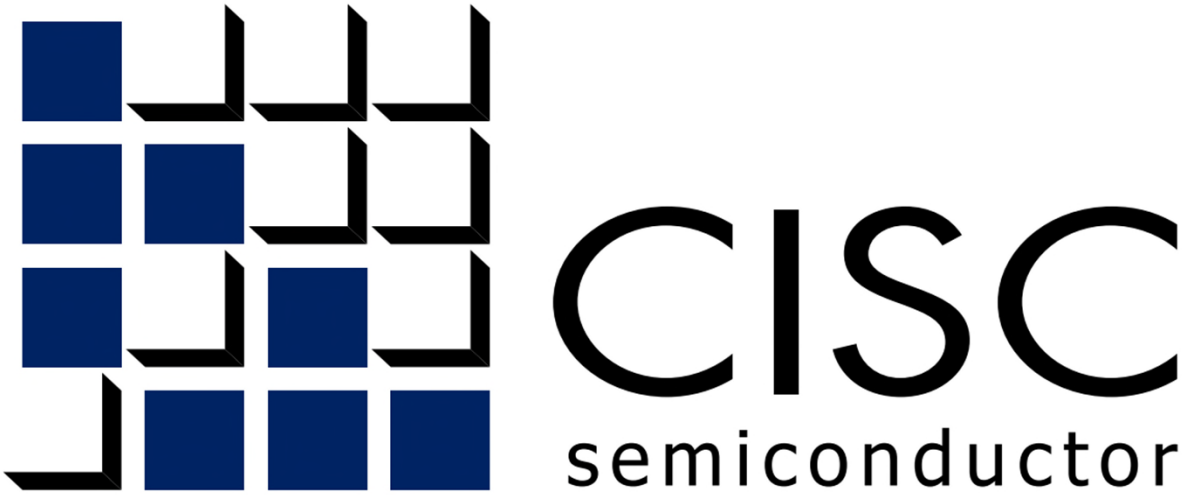
In conclusion

Adopting RAIN for baggage visibility brings many advantages

- Decrease in mishandled bags = Increase in customer loyalty
- Enhanced customer satisfaction
- Low misreads
- Increased operational efficiency (quicker loading/unloading time)
- Decrease need for manual processing

Factors to consider

- In-depth understanding of baggage handling logic
- Understand the technical aspects of the process
- Develop a selection process based on the recommended practice 1740c (radio frequency identification (rfid) specifications for interline baggage)
- Full scale implementation requires all the key stakeholders (airport, handler, airline, and the leading providers of baggage handling systems) to be on the same page



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