

RFID - Technologies

Overview and Selection Guide

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Agenda

What is RFID?

RFID technology elements

LF, HF, UHF

Frequency Selection Guide

Main parameters to consider

Properties of frequencies in special environments

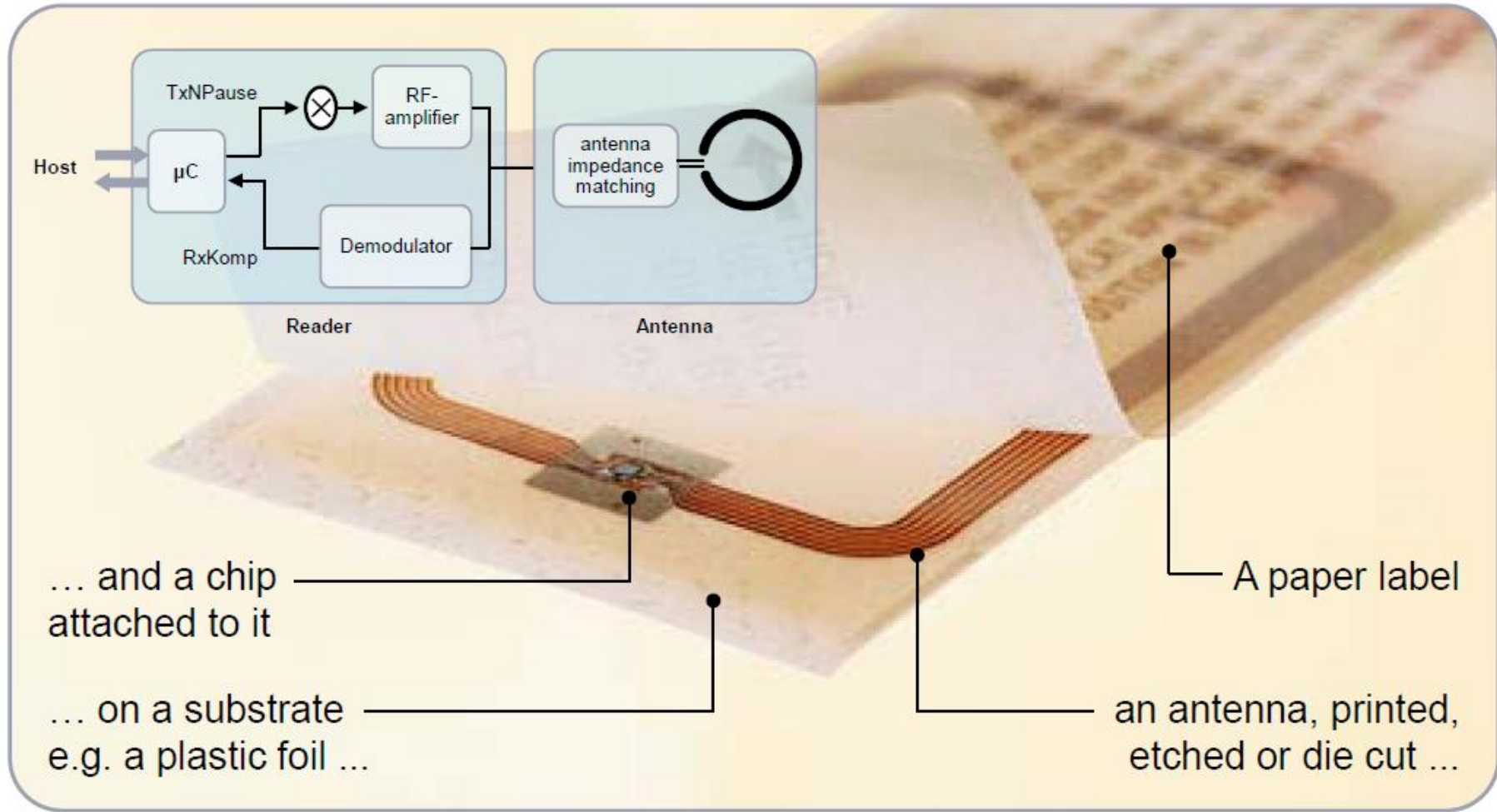
Main standards

Special focus on UHF

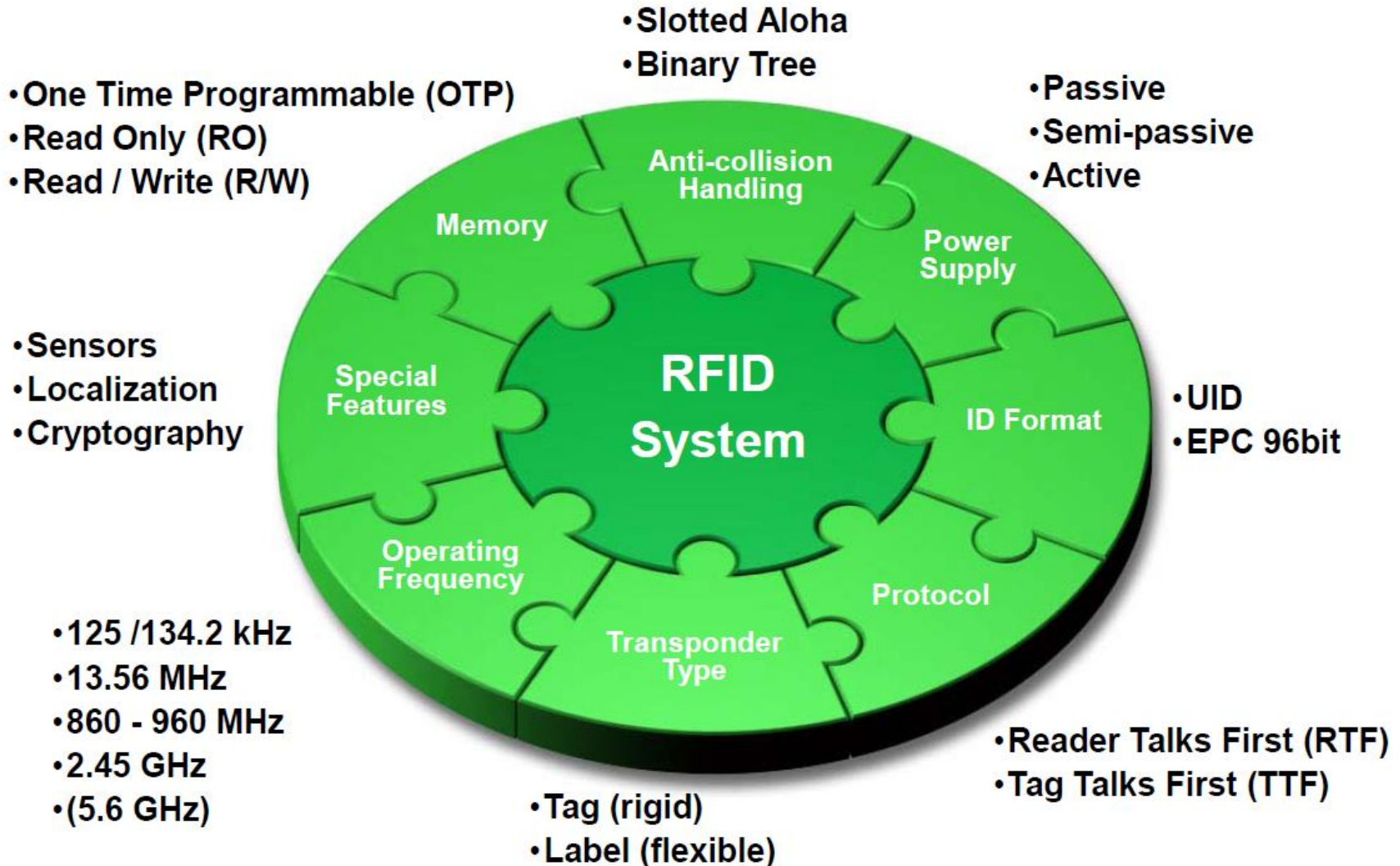


Special thanks to NXP for providing some of this material

RFID Overview



RFID Technology Elements



Active vs. Passive Tags

■ Active Tags

- Are battery or external power operated (like a cell phone)
- Have high operating range and can include complex sensors
- Are more expensive than passive tags
- Need maintenance (e.g. battery exchange)

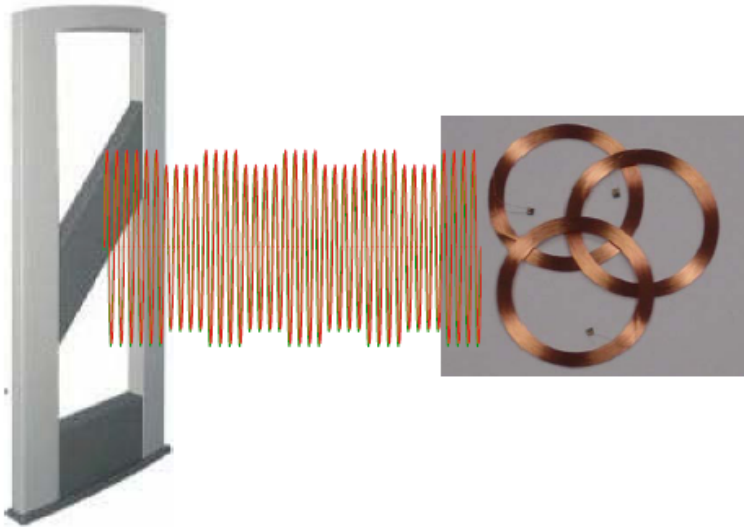


■ Passive Tags

- Get their power from the reader RF field (reader field ~1000 times as strong as the tag's answer)
- Do not need maintenance
- Are cheaper and more robust than active tags
- All tags offered by HID are passive



LF Technology (Low Frequency)



➤ Standards:

- ISO 11784/85 Animal ID, TTF
- ISO 14223 RTF & TTF
- ISO 18000-2 Item Management

➤ National Regulations:

- Worldwide harmonized

➤ Physical concept:

- Inductive coupling

➤ Operating frequency:

- 125/134.2 kHz

➤ Antenna:

- Coil

➤ Operating distance:

- Up to 1m

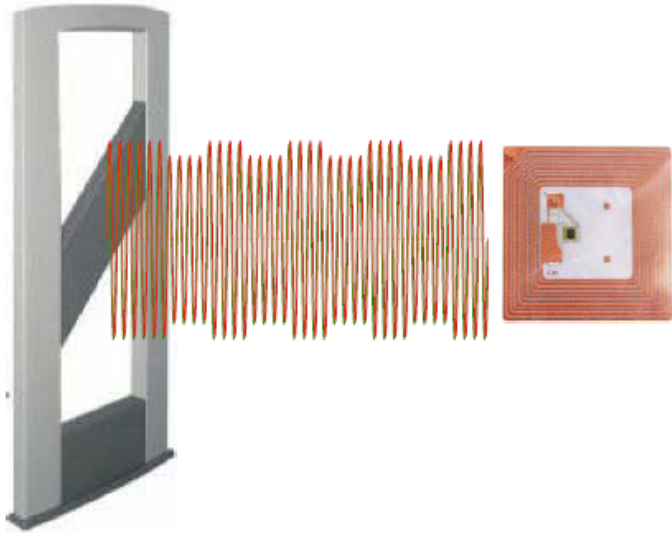
➤ Environmental influences:

- Weak influence on operating distance
- Works in metal environment

➤ Application:

- Animal identification
- Industrial environment
- Access Control

HF Technology (High Frequency)



➤ Standards:

- ISO 14443 Proximity Card
- ISO 15693 Vicinity Card
- ISO 18000-3 Item Management
- HF EPC Gen2

➤ National Regulations:

- Worldwide harmonized

➤ Physical concept:

- Inductive coupling

➤ Operating frequency:

- 13.56 MHz

➤ Antenna:

- Coil

➤ Operating distance:

- Vicinity: up to 1.5m
- Proximity: up to 10cm

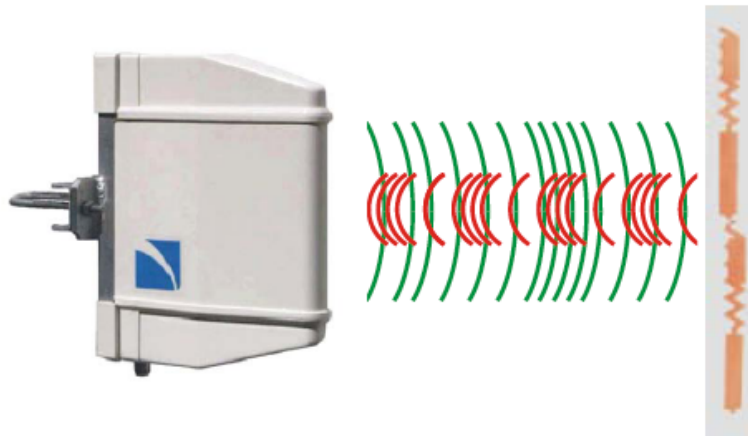
➤ Environmental influences:

- Weak influence on operating distance
- Works in metal environment

➤ Application:

- Libraries
- Public transport
- Product identification
- Access control, ...

UHF Technology (Ultra High Frequency)



➤ Standards

- EPC Class I Gen2
- ISO 18000-6 Item Management

➤ National Regulations:

- No worldwide harmonized



➤ Physical concept:

- EM – wave propagation

➤ Operating frequency:

- 860 – 960 MHz

➤ Antenna:

- Dipole and/or loop

➤ Operating distance:

- Far field: up to 15m
- Near field: up to 50cm

➤ Environmental influences:

- Influence on operating distance by reflection and absorption

➤ Application:

- Pallets and container ID
- Fashion
- Retail
- Electronics

General Comments

- This presentation focuses on passive tags for all forms of logistics applications only
- Comparisons are done to best differentiate between technologies and not by absolute values
- Please look for updated standardizations and regulations as they change regularly

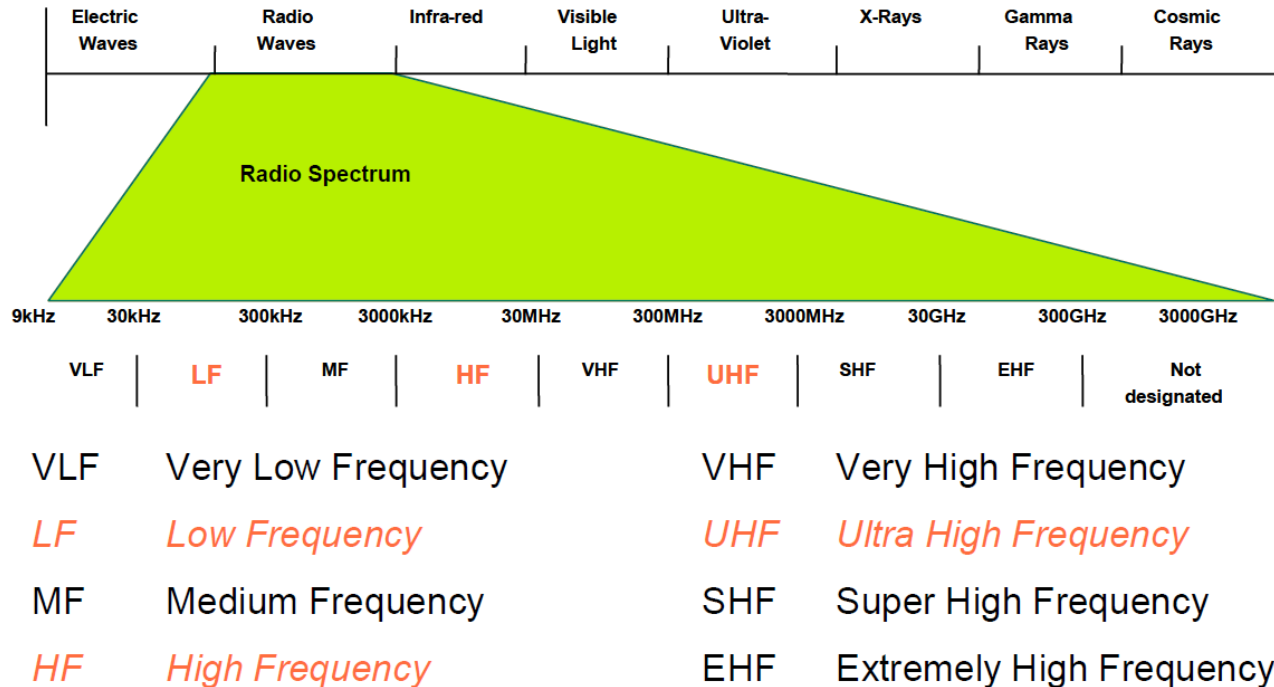


Main Criteria for Frequency Selection

- There is no single frequency able to fulfill all requirements of any high volume application
- Standards and regulations need to be considered for any application aside functional parameters
- System parameters such as
 - Read range required
 - Costs of tags/labels and readers
 - Existing Know How
 - Integration possibilities at given location
 - Environmental conditions like metal, humidity, tag orientation, number of tags concurrently in the reader field etc.
 - Memory capacity and read/write speed - need to be fulfilled



Electromagnetic Spectrum



- As the frequency increases:
 - The amount of data transfer per second increases
 - Radio waves behave more like light
 - Ability to penetrate materials diminishes

Effects of Materials on RF

Material Composition	Effect on RF Signal
Corrugated Cardboard	Absorption from moisture
Conductive Liquids	Absorption
Glass	Attenuation
Groups of Cans	Multiple propagation effects; reflection
Humans/Animals	Absorption; detuning; reflection
Metals	Reflection
Plastics	Detuning (dielectric effect)

Main Characteristics of RFID Tags

	LF (125/134.2 kHz)	HF (13.56 MHz)	UHF (860-960 MHz)	Active Tags (2.45 GHz)
Data Transfer Rate	↘	→	↗	↗
Memory Capacity	↘	↗	→	↗
Operating Range	→	→	↗	↗
Anti-Collision Speed	n/a or ↘	→	↗	↗
Maintenance-free Operation	↗	↗	↗	↘
Water / Humidity	↗	→	↘	↘
Metal Environment	↗	→	↘ or ↗	↘ or ↗



Technology Standards

- ▶ LF: 125/134.2 kHz
 - ISO 11784/85 Animal ID Read-only
 - ISO 14223 Advanced Animal ID Transponder
 - ISO 18000-2 Item Management

- ▶ HF: 13.56 MHz
 - ISO 15693
 - ISO 18000-3 Item Management
 - ISO 14443

- ▶ UHF: 860 – 960 MHz
 - EPC global Class 1 Gen2 UHF Air Interface
 - ANSI MH 10.8.4 Returnable Containers
 - ISO 18000-6 Item Management

- ▶ 2.45 GHz
 - ANSI MH 10.8.4 Returnable Containers
 - ISO 18000-4 Item Management

HID Offering in RFID

- HID provides top quality RFID tags, cards and inlays (prelaminates)
- HID covers products for LF, HF and UHF to suit various applications, incl. NFC
- HID products support chips from all major manufacturers like



- Swiss engineering combined with own Malaysian, fully automated, ISO 9001:2008 certified production ensures affordable top quality
- Custom design services help system integrators to create innovative or specialized RFID solutions across the world
- Examples:

LF



HF incl. 



UHF





Questions and Answers

Special Focus on UHF

Why it it is cool – or not



What people love about UHF (if well designed)

InLine Tag Ultra Curve



What it differentiates it from other UHF tags:

- Small form factor but broadband (works everywhere on all continents)
- Excellent read range compared to size: > 8m
- Affixed robustly thanks to steel ring for welding
- Patent pending 3D antenna
- Curved so that it fits on metal cylinder
- 100% water proof to IP69K, withstands the rigors of barrel disinfection



*36 tags read (tags in pallets) at once with success
(we used Impinj reader/antenna)*



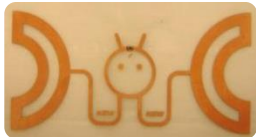
*840 tags read at once
while truck are running through!!
(we used Impinj reader)*



Environment influence on tag: *Surrounding materials*

UHF tag's maximum reading range depends on the surrounding material!! This is a disadvantage of UHF compared to HF, but can be turned to an advantage some times...
See experiment below to show how a UHF tag can be influenced by its environment:

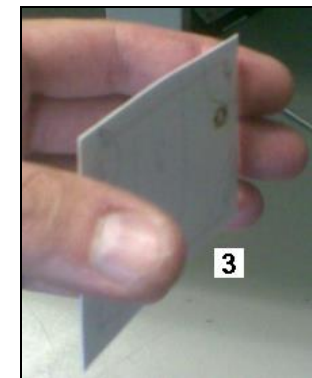
Inlay used from KSW:



**Reader from
Impinj:**

Freq: 902-928 MHz
Power: 4 WEIRP.

- | | |
|-------------------------------|---------------|
| ▪ In AIR (non laminated) | 6 m |
| ▪ After 0.8 mm PVC lamination | -10 % |
| ▪ Tag affixed on plastic | -15 % |
| ▪ Tag affixed On Glass | -10 % |
| ▪ Card in leather wallet | -50 % |
| ▪ On metal | -100 % |
| ▪ In water | -100 % |



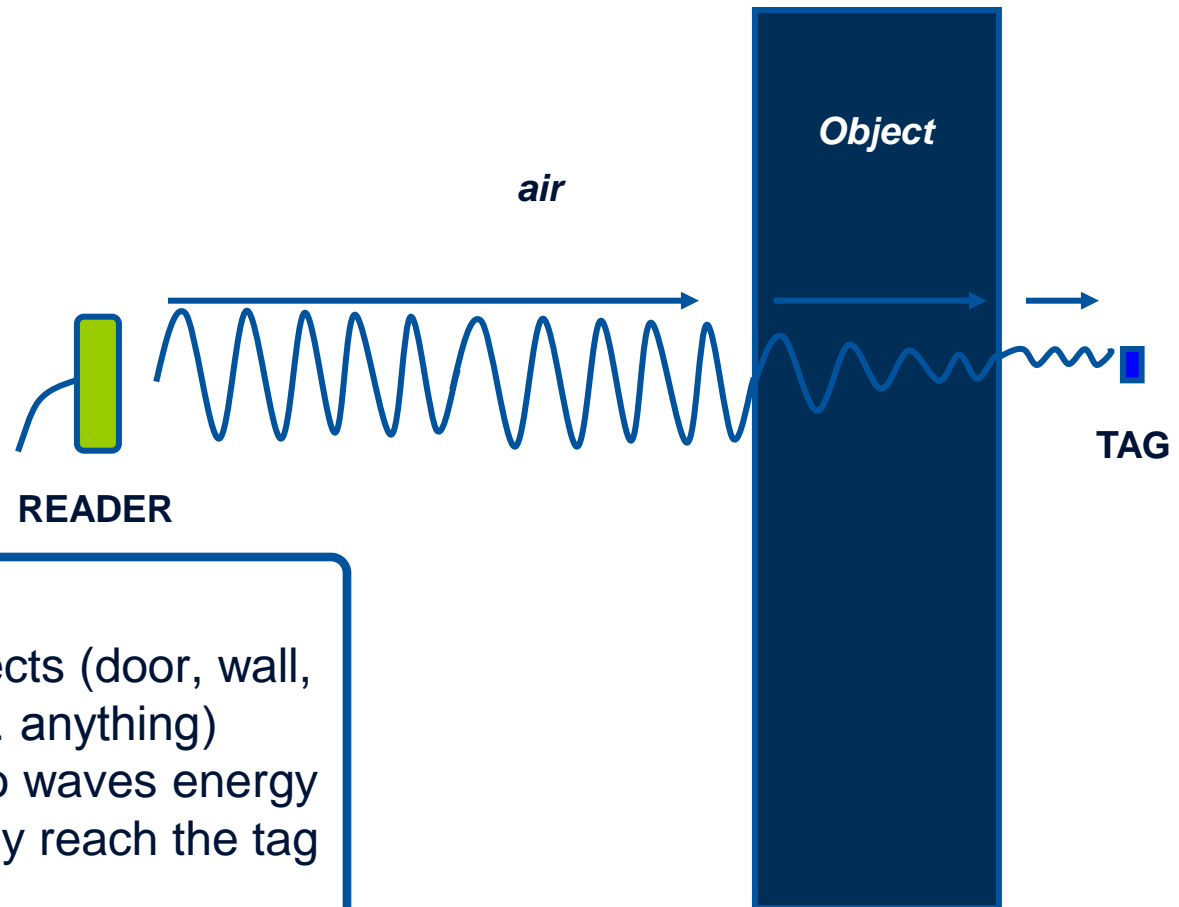
Environment influence on tag: *Energy holes*

Energy holes are unavoidably created, because the radio waves from reader are reflected from nearby objects...these reflected waves contribute in a destructive manner at the tag position



Environment influence on tag

Energy absorbing objects

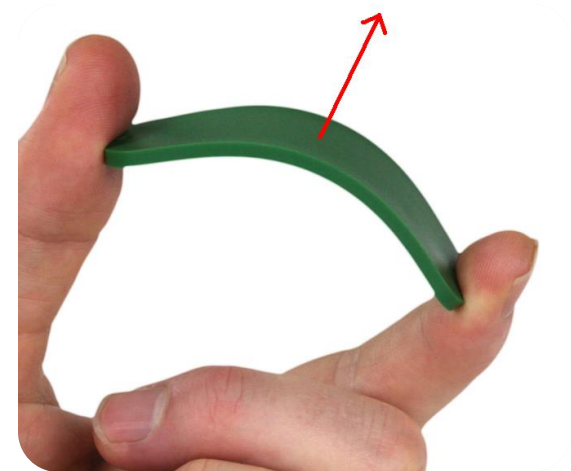


- Energy absorbing objects (door, wall, human being, water ... anything) would absorb the radio waves energy from reader before they reach the tag

SlimFlex™ Tag – Read Range vs. Bending

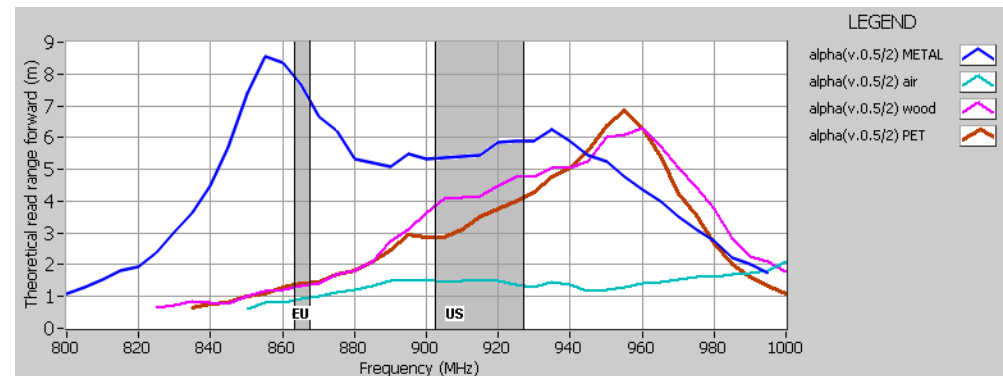
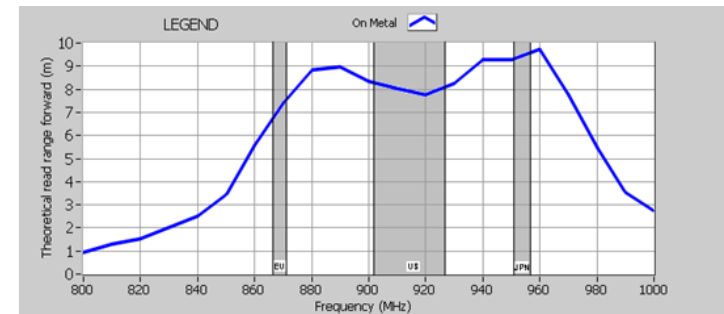
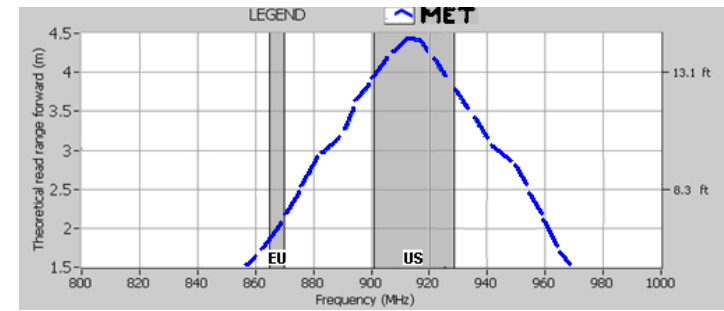
Bending Radius	Read Range		
	EU (m)	US (m)	JPN (m)
flat	9,1	8,1	8
200 mm	8,05	7	7
150 mm	7,5	6,8	6,5
100 mm	6,4	5,6	5,5
50 mm	5,6	5	5
25 mm	4,2	4	4,15
20 mm	4	4	3,9
10 mm	0	0	0

The tag beam focus is the one shown in the screenshot.
 The reader antenna main beam focus is in line with the shown tag beam focus.

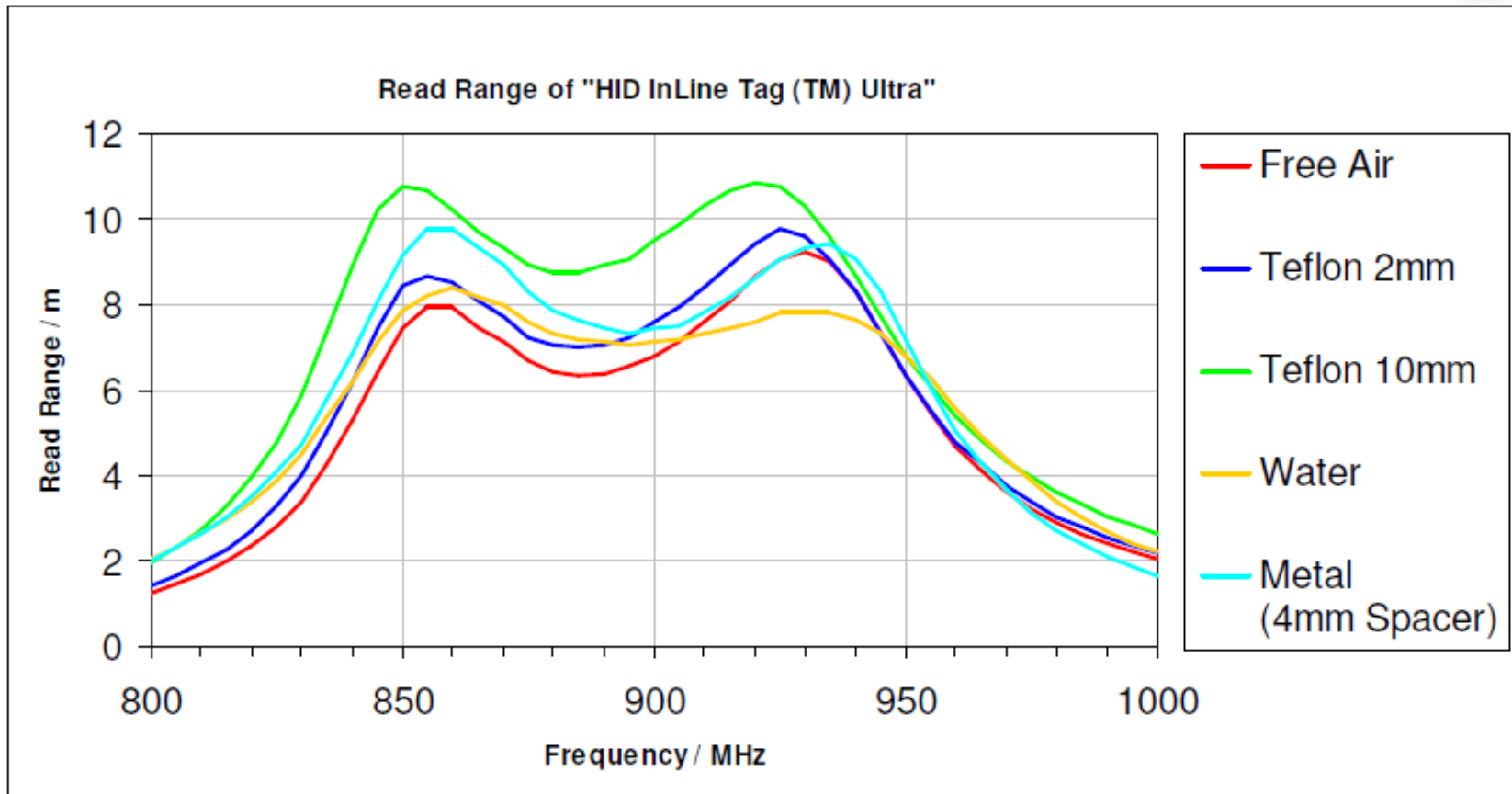


UHF Frequency Bands and Read Ranges

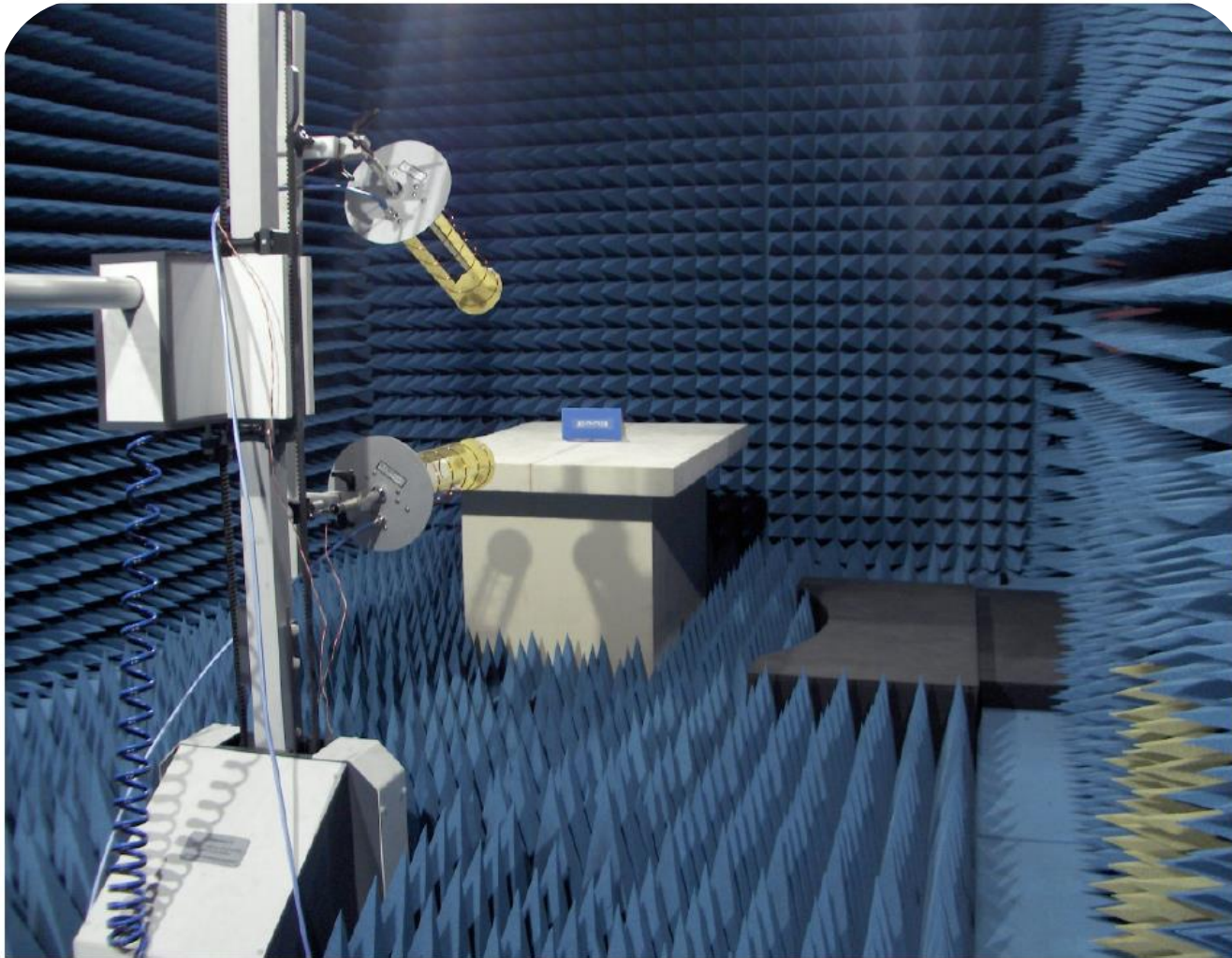
- Monoband Tag (US)
- Broadband Tag
- Broadband tag specialized for on-metal use, affected by environment



Good „all purpose“ tags show similar curves in many environments



UHF Test Setup



Mechanical test setup in the anechoic chamber at the EECC lab



Questions and Answers





