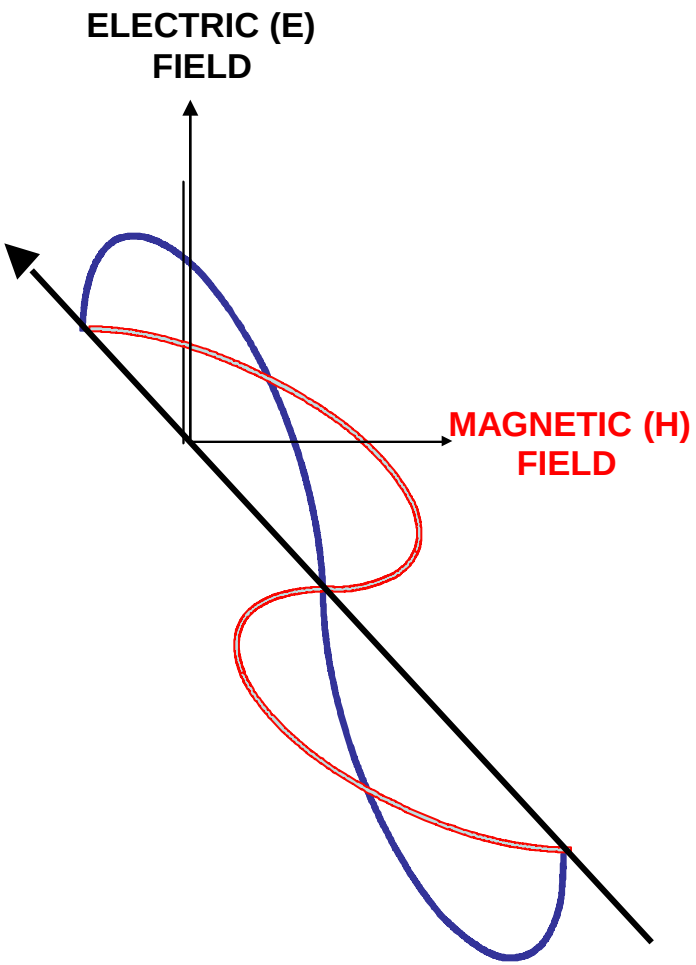
Technology Selection RFID

LF/HF/UHF

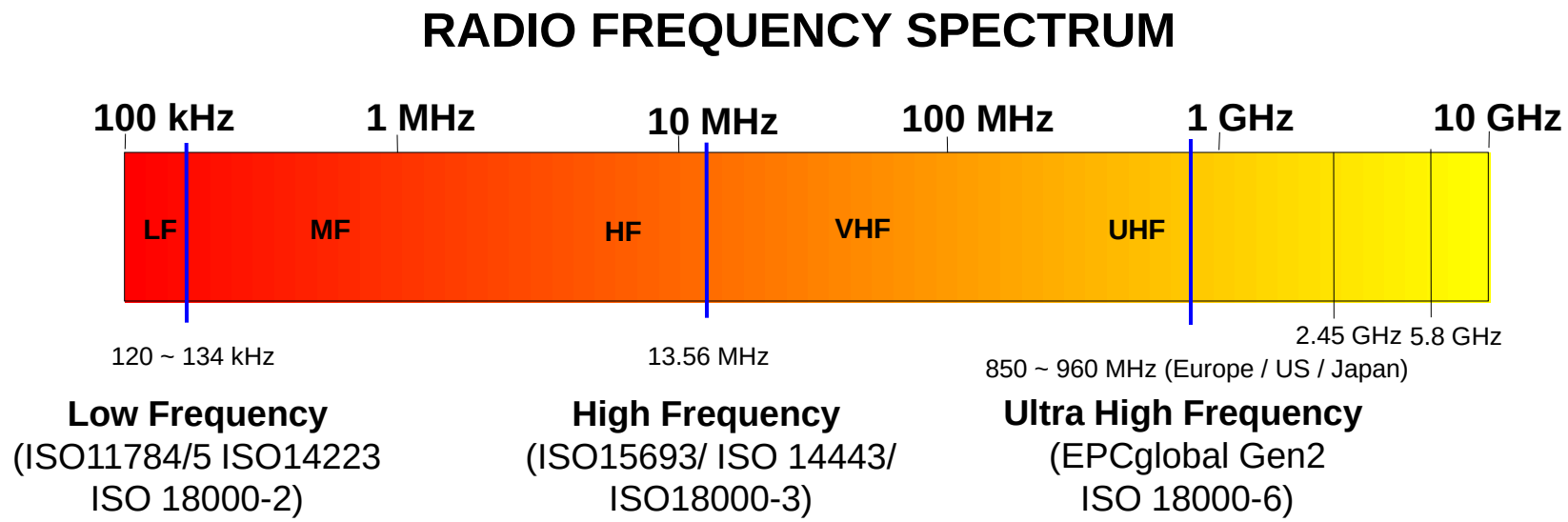
Quick Physics Lesson (Reminder)



- **Radio signals are electromagnetic waves, having a magnetic component (H-Field) and an electric component (E-Field)**
- **LF & HF systems use the Magnetic field only to transfer power and information by induction and coil antennas**
  - Strength of this field falls off quickly
  - Liquids have less of an effect on H-Field
- **UHF systems use the Electromagnetic field to transfer power and information by capacitive coupling with dipole antennas**
  - Strength of this field doesn't fall off as quickly which provides for a potentially longer read distances
  - Liquids absorb this field and reduce performance
  - Metals either shield signals or detune the tags
    - Special metal mount tags are typically required

Frequency of Operation

RFID tags exhibit different characteristics at different frequencies:



Low Frequency < 135 kHz

ADVANTAGES	DISADVANTAGES
Relative freedom from regulatory limitations	Does not penetrate or transmit around metals e.g. iron, steel
Best performance because of the high max. regulatory field strength level (1.3m, button tag)	Slow read speeds: Can only read ~ 20 tags per second (4k Bit/second)
Freedom to design different tag antenna form factors (compared to HF and UHF) gives best performance with small tag designs	Relatively large reader antennae
Penetrates materials well e.g. water, tissue, wood, body	
Excellent non-line-of-sight communications	Inlay construction
Very well defined read zone	- Is thicker than 13.56MHz and 900MHz - Inlay may be more expensive i.e. application dependent
No limitation using ferrite antenna for improved performance	- Requires wire antenna, typically > 100 turns
Simple and low cost readers and antennae	

High Frequency 13.56 MHz

ADVANTAGES	DISADVANTAGES
Simpler antenna design and lower manufacturing cost for paper label inlay (typical design: IC glued to etched antenna on plastic foil)	Does not penetrate or transmit around metals
Higher data rates: Can read up to 50 tags/second	Medium read range (50cm, button tag)
Good non-line-of-sight communication	For same read range compared to LF, bigger tag size is required
Controlled read zone	Constraints in designing different antenna form factors for readers and tags (low performance for small sized antennae)
Thinner tag construction i.e. foil antenna	Limitations on use of ferrite antennae e.g. higher cost
Penetrates wood/tissue	For animal applications, a more rigid construction is needed compared to usual plastic foil inlays to withstand the very tough environmental condition. This will increase the cost of the final Tag.

Ultra High Frequency 868 - 956 MHz

ADVANTAGES	DISADVANTAGES
	Does not penetrate or transmit around metals The performance is badly affected by tissue, water absorption = Not suitable for implants and Bolus
High data rate: Can read up to 1500 tags per second (dependent on regional regulations)	
Thinner tag construction i.e. foil antenna	Sensitive to nearly any material around Reflexions may disturb the application
Lower manufacture cost for inlay only (secondary packaging of inlay most likely required for livestock tag)	Different performance worldwide due to local regulations
Large read range with line-of-sight communication (up to 8 meters)	Complex readers and antennas and set up required for gate applications
	For animal applications, a more rigid construction is needed compared to usual plastic foil inlays to withstand the very tough environmental condition. This will increase the cost of the final Tag
Penetrates wood	For same performance compared to LF, larger tag size is required (<1m, button tag)

Frequency Selection

Parameter	Capability of Frequency Options		
	< 135 kHz	**13.56 MHz**	**2.45 GHz/UHF**
Cost ***Transponder*** ***Chip*** ***Antenna*** ***Reader***	*medium/low* *medium* *medium* *low*	*low* *lowest* *lowest* *medium*	*medium/low* *lowest* *lowest* *high*
Range ***Passive***	*high*	*medium*	*medium /high*
Form Factor flexibility	*high*	*low*	*medium*
Data Rate ***Down-Link (Reader to Transp.)*** ***UP-Link (Transp. to reader)***	*low* *low*	*medium* *medium*	*high* *high*
Cost of Reader /Antennas	*low*	*medium*	*high*
Complexity (set up)	*low*	*medium*	*high*
Environment / Noise **(EMI / *Broadband* Discrete *- in Band)***	*Medium*	*Low*	*Medium*
Environment, ***- Tissue/Human Body*** ***- Metal***	*NO absorption controllable*	*Lim. absorption controllable*	*Strong absorption reflection*