Very short overview of RFID

Radio Frequency Identification (RFID) technology is a wireless technology that allows for automated data collection and a unique identification of objects. RFID systems are composed of RFID tags attached to the objects, readers that can read the tags from a distance, and application software. Every RFID enabled object has its own unique identification number (ID). Tags can be classified into three main groups based on power supply namely, passive, semi-passive and active. Passive tags operate without battery and are powered by the readers when they are in the proximity of the readers. Passive RFID tags use backscattering to reflect back the reader radio waves to the reader, usually at the same carrier frequency. The reflected signal is modulated to transmit data.

Semi-passive (battery assisted) tags use battery for their internal operations but they use backscattering for communication with the reader. The energy needed to power up the chip is obtained from the battery but backscattered mechanism is still used for communication between the reader and tags. The antenna of passive tags is optimized for collecting energy and not for achieving the maximum signal level. On the other hand, battery-assisted tags are designed to reflect maximum signal achieving in this way longer reading range. Therefore, this technology has a great potential in mining industry too for example tracking of miners, equipment and mobile assets. Active tags use battery power for both communication and internal operations. RFID readers are used to excite passive and semi-passive tags and read data encoded on tags. Figure 1 illustrates the functions of passive, semi-passive and active RFID tags. The frequency of RFID ranges from low frequency (LF) to microwave. The frequency ranges, characteristics and typical applications of RFID systems are provided in Table 1.

Table 1: Frequency band, characteristics and typical applications of RFID systems

Frequency band	Characteristics	Typical applications
125 kHz -134 kHz (Low frequency)	Penetration through materials, can be read in proximity of metals and liquids, low data transmission rates and low reading ranges,	**Manufacturing support, large vehicle and container identification, access control, animal identification, explosive detection**

	inexpensive	
13.56 MHz (High frequency)	Penetration through materials except metal, higher data rate, reading of large number of tags simultaneously, potentially inexpensive	**Parcel tracking and services, airline baggage management and reconciliation, library systems and rental services, smart cards, access control, explosive detection**
900 MHz (Ultra-high frequency)	Higher reading range, smaller antenna, Line of sight required for higher range communication	**Supply chain management applications**
2.45 GHz or 5.8 GHz (Microwave)	High data rates (100 Kbits/s), high reading range, absorbed by water and water based solutions and reflected by metal and quasi conductive surfaces, line of sight required	**Factory automation, access control, road tolling, supply chain and military logistics, mining industry applications**

Assemblages of tags, attached to objects and readers can be used to form Real-Time Locating Systems (RTLS), which enable the locating of required objects within a space in Real Time. RFID-enabled RTLS are gradually appearing in mining despite the various environmental challenges as discussed below, e.g. shielding, which can have disproportionate effects on a RTLS. The design of RTLS is the subject of fierce rivalry and patenting activity among competing firms.

References

1. Finkenzeller, K., RFID handbook, 2nd Ed., *Wiley*, 2004.
2. Bolic, M., Symplot-Ryl, D. and Stojmenovic, I., RFID Systems: Research Trends and Challenges, *Wiley*, 2010.

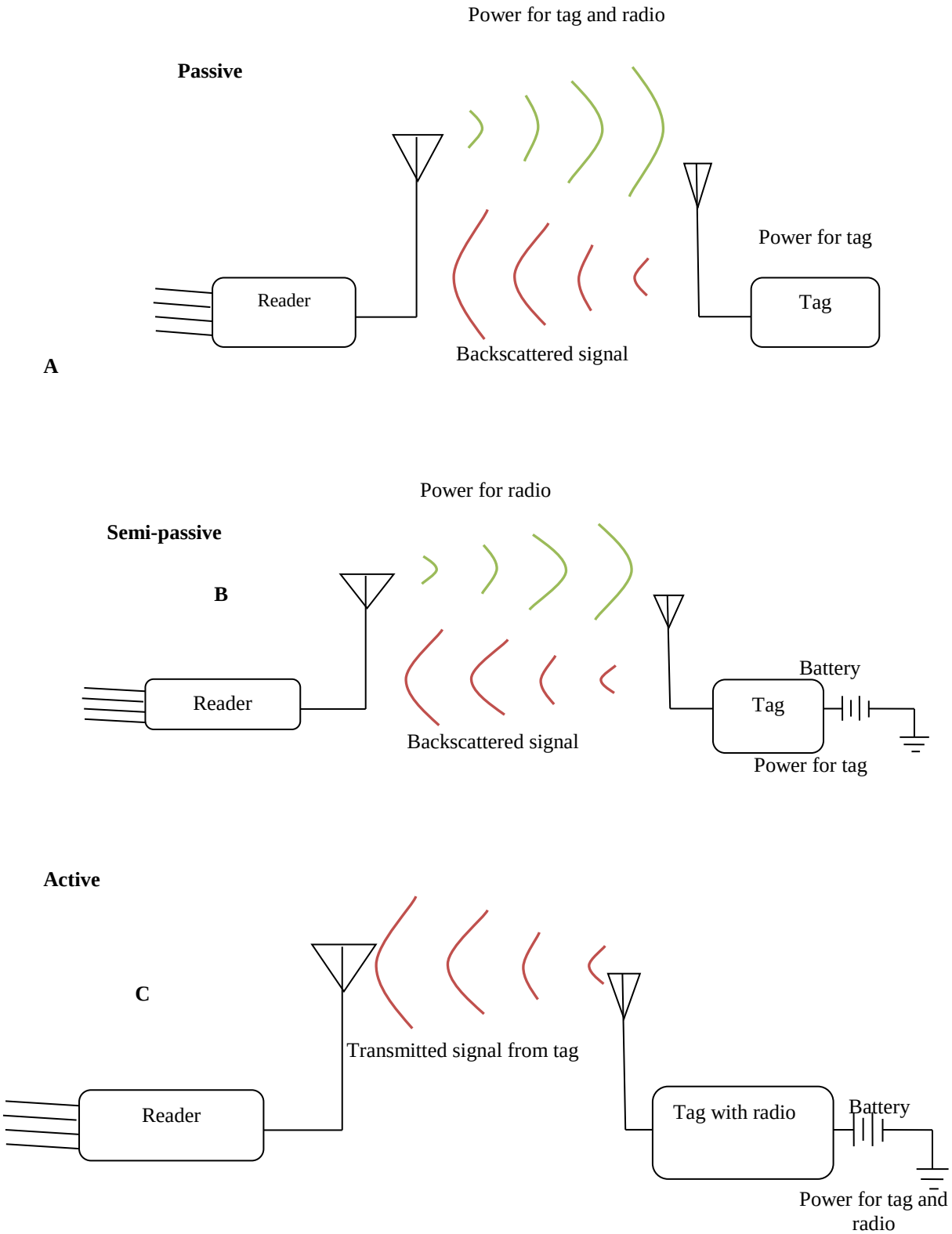

Figure 1: Function of (A) passive, (B) semi-passive and (C) active RFID tags.