| Metric | Explanation |
| --- | --- |
| Coverage | To increase coverage in a LoRaWAN deployment: increase the possible transmission distance between sensors and gateways, or place additional gateways. |
| Number of gateways | A LoRaWAN with only one sink will operate differently than one with multiple sinks. |
| Number of nodes | Increasing the number of nodes demands higher performance of the LoRaWAN. |
| RSSI | The RSSI measured by a node provides an indication of the coverage range of the gateway and how reliable communication will be. |
| SNR | The SNR experienced by a node also provides an indication of how reliable communication will be. |
| Distance from gateway | Distance measurements can be combined with connectivity measurements (RSSI, SNR, PER) to determine a gateway’s  effective range. |
| Payload size | Ideally network performance was evaluated for multiple payload sizes as these impacts transmission times. |
| Transmit power | Transmitting at higher power levels (dBm) can achieve greater range but regulatory restrictions apply. |
| Network reliability | Network reliability can be defined in several ways: number of packets received successfully, the number of valid received packets or examining the PER. |
| Power consumption | Power consumption values for the motes can be used to estimate the network’s lifetime. |
| Collision probability | The collision probability in LoRaWAN depends on the number of sensors transmitting to a single gateway and their transmission behavior, including message sending rate, airtime, transmission distance, and interference distance. |
| Number of floors or  walls between gateway  and node. | For indoor LoRaWANs this provides an indication  of the penetration capabilities of the network when combined with e.g. RSSI. |
| Single or multi-hop  network | LoRaWAN is by default a single hop network but multi-hop features can be added. |
| LoRaWAN class | Options are A, B or C. The class used defines how communication takes place. By default, LoRaWANs are class A. |
| Are nodes set to use  a specific channel  or can they choose | When nodes can choose less congested channels, the amount of nodes supported increases. |

**Problem statements:**

1. **Network Capacity Optimization and Collision Management:** How can LoRaWAN network efficiency be maximized by minimizing collisions while facilitating numerous sensor transmissions to a single gateway?
2. **Gateway Placement for Efficient Data Collection:** How to strategically position gateways to optimize data collection efficiency in LoRaWAN networks?
3. **Balancing Network Coverage:** How can an equilibrium between extensive network coverage and sufficient sensor density be achieved within an area, mitigating interferences and ensuring reliable communication?
4. **Tailoring LoRaWAN Networks for Rural Agricultural Environments:** How can LoRaWAN infrastructure be effectively designed and adapted to address the unique challenges of rural agricultural settings, ensuring seamless data transmission and optimal network performance to support agricultural operations?
5. **Energy Management and Sensor Autonomy:** How can LoRaWAN sensor energy consumption be optimized to prolong their lifespan while ensuring efficient data transmission?
6. **Data Security and Privacy:** How to ensure secure data transmissions within LoRaWAN networks, particularly concerning privacy, authentication, and prevention of potential cyber attacks?
7. **Scalability:** How can LoRaWAN networks be seamlessly scaled as the number of connected sensors and applications increases?
8. **Efficient Network Operation in LoRaWAN:** How can we enhance the effectiveness of LoRaWAN networks by managing data collisions effectively? This involves enabling numerous sensors to relay data to a single gateway while minimizing signal conflicts and ensuring seamless data transmission.
9. **Optimizing Network Reach and Sensor Density:** How do we achieve a balance between broad network coverage and the optimal density of sensors within a specific area, aiming to reduce signal interferences while ensuring reliable connectivity?
10. **Tailoring LoRaWAN for Varied Environments:** How can LoRaWAN networks be designed to flexibly adapt to diverse environmental settings, such as urban, rural, or industrial zones? This includes accounting for physical barriers and environmental conditions influencing data transmission quality.