Background and Objective

- Noise sources from railway vehicles
  - Aerodynamic noise from railway vehicles
  - Friction noise between wheels and rails
  - Contact noise between pantograph and catenary

Characteristics of the metro noise
- Many curved tracks through downtown areas
- Frequent high-level friction noise induced by curved tracks
- Causes of dissatisfaction from many passengers
- Vehicle maintenance based on railway technical specification
- Measuring the noise by inspectors using a portable sound level meter manually

The need for automated measurement system using wireless communications (IoT technology)

Experimental Setup

- Real-time remote monitoring on interior noise and temperature of a railway vehicle
  - Testbed: the whole sections of a commercial Metro Line #1 in Daejeon, Korea
  - SDR module: data acquisition from sensors (analog sensor 3CH, temperature 1CH)
  - LTE module: data transmission to data server (Max. speed of 115.2kbps)
  - Sensors: sound level meter (2EA), thermocouple (K-type, 1EA)

Calculation of equivalent noise level and average temperature in each section

\[
L_{eq} = 10 \log \left( \frac{1}{n} \sum_{i=1}^{n} 10^{\frac{L_i}{10}} \right)
\]

\( L_i \): noise level at i data [dB(A)]
\( n \): no. of data during a period of time

Equivalent sound level: the average noise level during a period of time

\[
L_{eq} = 10 \log \left( \frac{1}{n} \sum_{i=1}^{n} 10^{\frac{L_i}{10}} \right)
\]

\( L_i \): noise level at i data [dB(A)]

Discussion and Conclusion

- It is verified that the analyzed result in an individual section logically corresponds to the geographical shape of the metro line.
- Noise levels of 65~76dBA in linear sections, 75~80dBA in curved sections
- Average temperatures of 21.9℃ and 23.8℃ in upward and downward train, respectively
- It is confirmed that analyzed results for equivalent sound levels and temperature changes can be accessed using both exclusive web-site and mobile application in a remote area.

It is expected that the system can be utilized as an automated monitoring system for the internal environments in railway vehicles by substituting conventional methodology when it is applied to a commercial metro line in the future.