Propagation Issues for High-Speed Railways

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Motivation

Railway Scenarios

From Beijing to Shanghai:
- Normal – 13 hours; 40 dollars;
- Plane – 3 hours; 200 dollars;
- HSR – 4 hours; 80 dollars;

Open Issues

Emergency Reaction

In China, by 2020:
- 120,000 km – rail lines
- 16,000 km – HSR
- 8,000 km – 350 km/h

Measurement Campaign

Advantage

Using practical GSM-R base stations
Using the operating high-speed trains
Large body of measurements

Disadvantage

Difficulty for implementation
Fixed frequency and bandwidth
Fixed setup of antennas

Viaducts

Viaducts

Since 1990, over 95 disasters of railways happened all over the world, over 10,000 people got hurt or died.
In those accidents, only 6.3% are caused by the nature, others are caused by people & equipment
Over 52.6% accidents are caused by the hit between trains

Different propagation environments
Different setup of antennas

Directional Antennas

HSR-specific scenarios
Different propagation environments
Different setup of antennas

Piecewise Models

Suzuki

P_ricean \left( \frac{r}{D} \right) = 10 \log_2 \left( \frac{N}{2} \right) + 20 \log_2 \left( \frac{r}{D} \right) + 20 \log_2 \left( \frac{r}{D} \right)

Ricean

Emergency Reaction

Desert

Sea

Tunnel

Station

Viaduct

Emergency Reaction

Emergency Reaction

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