

11.3 Gbps Wireless Throughput Reached at Train-to-Ground Connectivity Testing in 2020

PPC-10G-Rail 70/80 GHz wireless radios were successfully tested for train-to-ground connectivity at real railway conditions on high-speed railway line. The max aggregated throughput at two wireless channels from the head and back of the specialized communications testing carriage reached 11300 Mbps.

ELVA-1 team reported on the successful test of PPC-10G-Rail train-to-ground communication system on the real railway line conditions.

In the experiments, the test track section of 6.3 km was included three passes at a distance of 2,300, 1,300, and 2,700 m between base stations. The base stations were equipped with compact 30 cm diameter antennas and were located on contact wire supports at a height of about 5 m from the railhead.

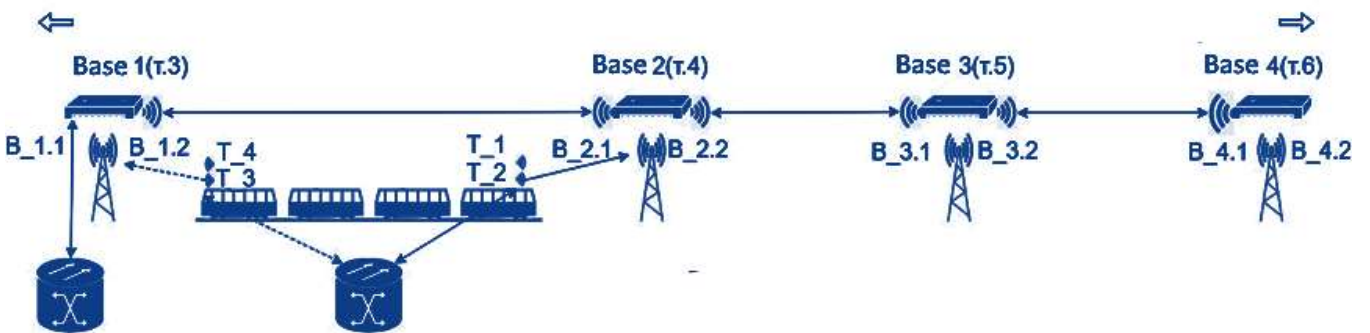


Diagram (above) and map of the testing



ELVA-1 train-to-ground communication system is designed to solve the problem of providing high-speed trains with a broadband Internet connection on straight sections of the railway.

For minimizing the cost of the project, PPC-10G-Rail base stations could be deployed at 2 km distance from each other or even longer. Such distance is probably the longest in the industry consider various publicly available reports.

The other factor for lowering project cost is PPC-10G-rail base stations ability for installation at existed contact wire supports (masts) along the tracks with minimum efforts and using cheap mounting sets.

Photos of the PPC-10G radios on the train and on masts along the tracks

The results of the train-to-ground communication tests held in the year 2020 on the railway line were preceded by tests in the year 2019. At those initial tests, it was shown a possibility for 10 Gbps connection to a moving train from the contact wire supports at real railway conditions using 70/80 GHz E-band equipment. The distances between base stations at those tests were 370, 500 and 600 m.

At the tests in 2020, PPC-10G-Rail base stations were equipped with compact 30 cm antennas and mounted near the level of the contact power wires at a height of about 5 m from the railhead.

For testing the connection on the move, the railway operator has provided a communication laboratory carriage with the locomotive. On the roof of the laboratory carriage, in both forward and in the opposite direction, PPC-10G-Rail radios with small horn antennas were installed.

A series of passes were carried out along the test section of the railway in both directions and with a change of the track (passes at the first and second main tracks).



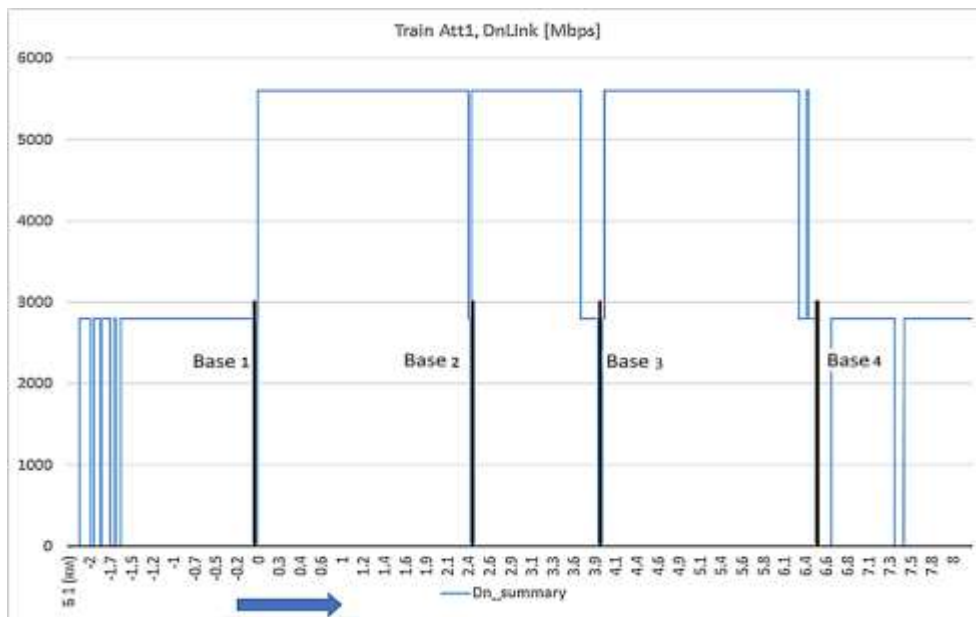
Photo of the PPC-10G-Rail radios on the roof of the lab carriage

The following test results were confirmed at the report signed by the group of railway operator's officials:

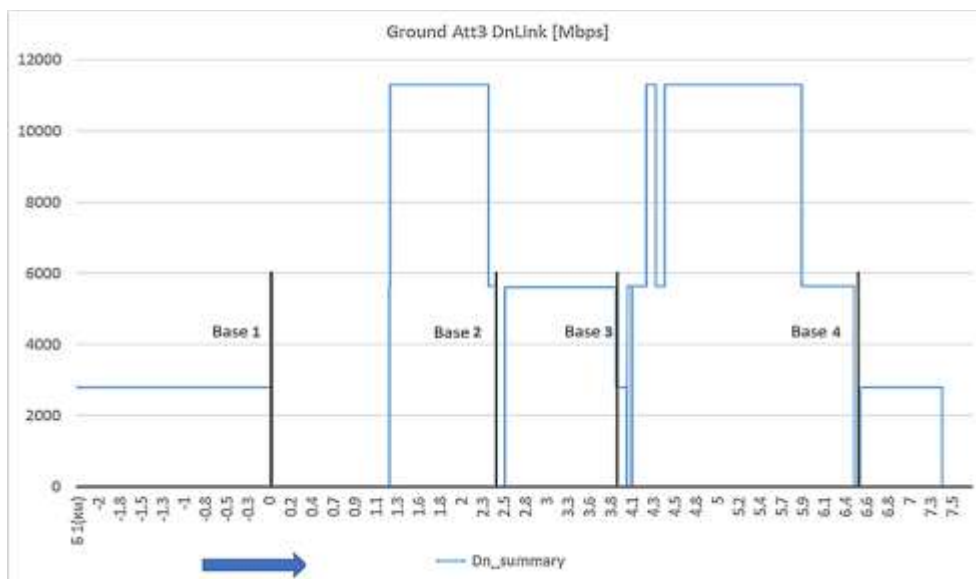
- A stable data exchange rate from any base station was protocoled at 5650 Mbps, while the total data transfer rate was 11300 Mbps (taking into account communication in both directions as 2x 5650 Mbps).
- The minimum data transfer rate for all tests was no worse than 2800 Mbps per channel (the total bandwidth to train was no worse than 5650 Mbps consider connection into both directions).

- The maximum distance between base station to provide any train-to-ground connection was 4 km, with confirmed recommended distance between base stations about 2 km.
- The network architecture works stably on straight sections of the track in conditions of line of sight between base stations and train radios. An essential condition for the stability of the connection is the straight-line profile of the track without curves, significant differences in heights (descents and ascents), which is generally typical for the structure of high-speed railways.

Diagrams of communication channels throughput and radio signal level (RSL) between base stations and train radios were attached to the test report and are as following ones.

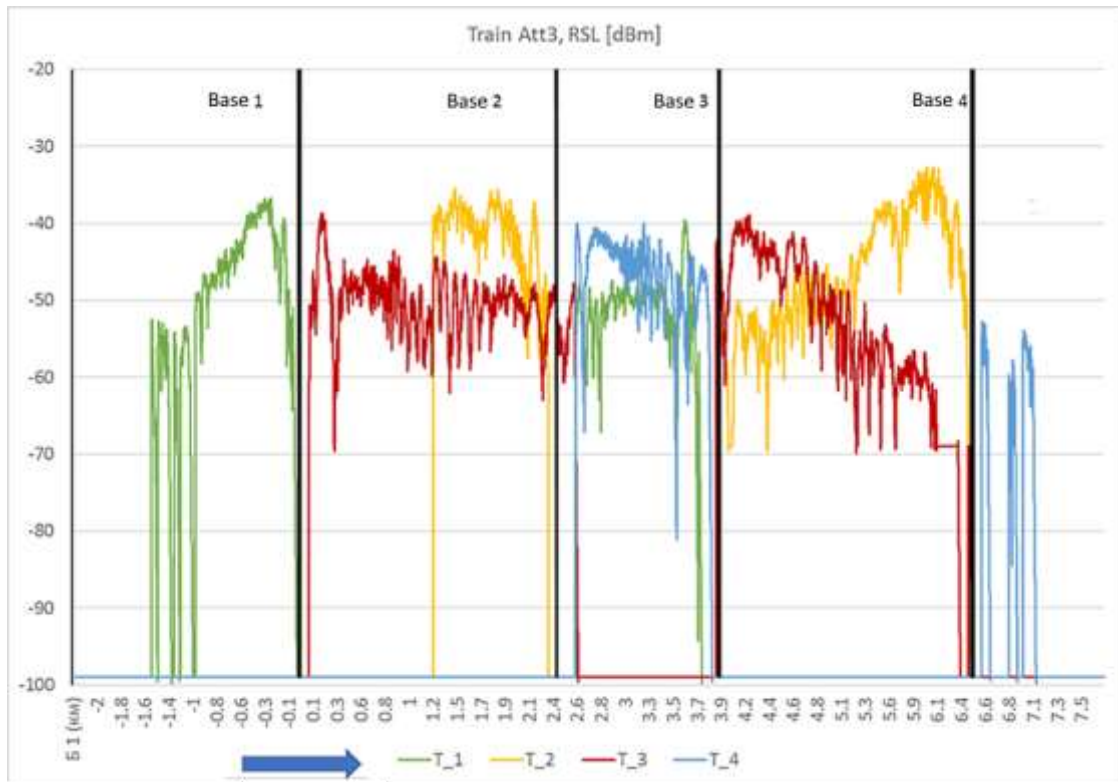


Aggregated throughput from Front and rear train PPC-10G-E (2.8 Gbps)



Aggregated throughput from front and rear train PPC-10G-E (5.65 Gbps)

(No connection slot between base stations #1 and #2 was due to a short power failure in the carriage lab)



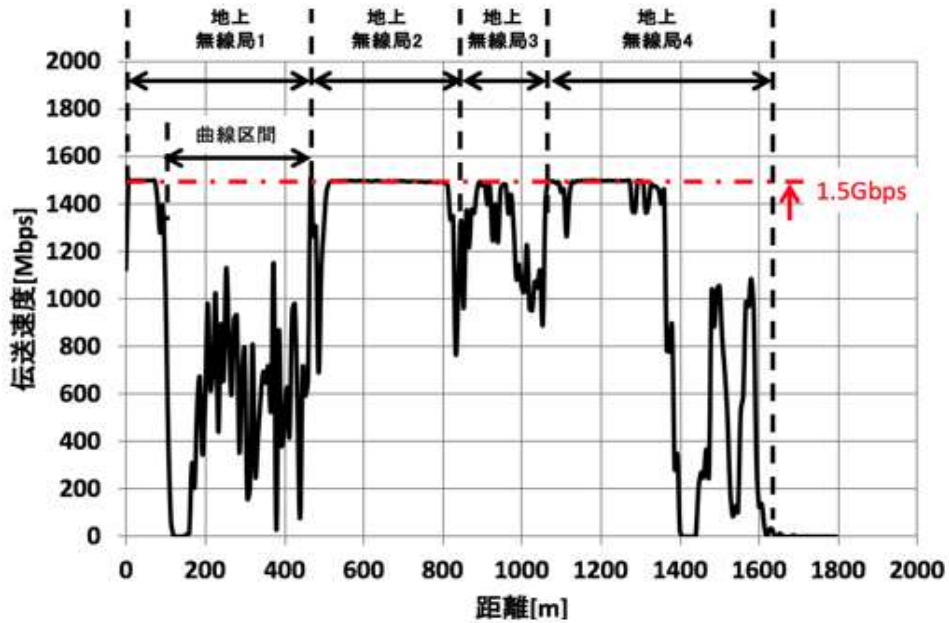
RSL in dBm for front and rear train PPC-10G-E (5.6Gbps)



The photo of the test track, also from the binoculars

ELVA-1's results of the testing at the railway line are far superior to recent global train-to-ground trials and pilot projects which are publicly available on the Internet to compare.

Result of Japan team with up to 1500 Mbps connectivity and 200 m to 500 m distance between base stations:



<http://www.hitachi-kokusai.co.jp/news/2019/news190129.html>

For more information of ELVA-1 PPC-10G-Rail E-band solution for train-to-ground connectivity please contact us at e-mail: sales@elva-1.com

